SPECIAL ISSUE ON AGRICULTURAL PRODUCTIVITY

PRODUCTIVITY

Vol. VI, Nos. 2 & 3, 1965

CONTENTS

		Page
	LIST OF ILLUSTRATIONS	176
	Editorial	
	Plus Productivity	177
	Part I—Special Articles	
PS Lokanathan	*Role of NPC in Agricultural Productivity*	181
AD Pandit	*Application of Productivity Concept to Indian Agriculture*	186
PL Tandon	*Hindustan Lever's Projects Yield Substantial Results*	192
Sherman E Johnson	*Steps for Output-increasing Improvements*	196
	Part II—Basic Issues	
Orion Ulbey	*Rural Cooperatives Can Play a Major Role*	209
Vernon W Ruttan	*Output & Productivity Growth in S.-E Asian Agriculture*	220
EA Saxon	*Special Concepts of Productivity*	223
DH Butani	*Application of Productivity Techniques*	236
AV Bhuleshkar	*Productivity and Technical Change : A Theoretical Analysis*	240
KS Suryanarayana	*Management under Current Farming Conditions*	248

Part III—Foreign Experience

Glen T Barton and Donald D Durost	*Contribution of Productivity to Growth in US Farm Output*	257
BI Braginskii and D Dumnov	*Labour Productivity in the USSR and the USA*	273
Roy D Laird	*Soviet Goals for 1965 and Problems of Agriculture*	277
(APO Working Paper)	*Productivity Methods in French Agriculture*	284
James H Boulware	*Food Production : Some Lessons from Japan*	289
KS Karol	*Chinese Agriculture has Big Margin for Expansion*	293
WH Senior	*Farm Management Revolution in Scotland*	295
Dupe Olatunbosun	*Incentives for Improving Nigerian Farm Productivity*	300
George Houston	*Agricultural Situation in Eastern Europe*	303
PC Bansil	*Intensification of Peasant Agriculture in Ceylon*	306

Part IV—Indian Position

AP Jain	*Planning of Agricultural Production Programmes*	317
Wilbur B Wood	*Development of Human Resource—Key to Productivity*	321
MS Randhawa	*India's Programmes for More Food Production*	326
PS Sharma	*Relative Variations in Productivity*	341
Pareshnath Chatterjee	*Indifferent Behaviour of Agricultural Productivity*	349

Part V—Provincial Papers

T Ramakrishna Rao	*Inter-District Variations in Madras State*	356
Gunvant Patel	*How Gujarat Tackles Problems of Production*	364
BN Sahu	*Peep into Productivity in Bihar*	368
M Srinivasan	*Farm Productivity Trends in Madras State*	370

Part VI—Foreign Productivity Organisations

HS Burtt	*Management & Productivity Go Hand in Hand*	375
Itzhak Wolf	*Experiences of Work in Israel*	379
UK Team Report	*Methods and Practices of Farms in USA*	384

Part VII—NPC Papers

K Pennathur	*Organising for Agricultural Productivity*	397
DH Butani	*Incentives and Motivation in Farming*	404
GK Nayar	*Productivity Efforts in Agro-Industries*	409

Part VIII—Case Studies

Bikram Singh	*A Farmer's Tips for Doubling Farm Output*	411
Israel Institute	*Harvesting of Table Grapes in Israel*	417
SV Bhat	*Standardisation & Manufacture of Cattle and Poultry Feed*	422
TA Ramsubhan, SK Goel and BM Sharma	*Farm Resource Productivity Relating to Wheat Crop*	430
DN Kherdekar	*Standardisation of Farm Implements & Equipment*	438

Part IX—Mechanised Farming

BKS Jain	*Mechanisation Can Lead to Swift Change*	449
UK Team Report	*Development of Farm Machinery in USA*	455

Part X—Significant Details

VI Chacko	*Productivity in Plantation Industry*	459
DS Sawhny	*Systems of Management for Cultivators*	463
Dru Srivastava	*Impact of Different Types of Risks*	475
Satwant Singh	*From Subsistence to Surplus Farming*	478

Illustrations

Threshing in Chola days Between pp 176-177

New Horizons in Farming I Pages 253-256

Farmer on the march to his field **253**; Ploughing in progress **253**; New variety of wheat **253**; Transplantation of paddy **254**; Harvesting with hand sickle **254**; Two South Indian women with stocks of paddy **255**; Threshing and winnowing **255**; Land under reclamation and mechanised operation **256**.

New Horizons in Farming II 313-316

Cultivated terraces in Japan **313**; Paddy seedlings covered with Vinyl sheets **313**; Motor-driven hand tiller **313**; A tractor for every job **314**; New self-propelled combine harvester **314**; Checking height of new wheat varieties in a Cambridge farm **314**; California rice field **315**; Area in semi-arid West of USA with unirrigated land **315**; New machine which saves up to 40 per cent of cost per hectare* **315**; France's Centre d'Etudes Techniques Agricoles (CETA) **316**; Fruit industry in France **316**.

New Horizons in Farming III 413-416

A view of a typical plantation area, and a woman plucking tea leaves **413**; A tea field **413**; View of a coffee plantation **413**; Vegetable cultivation—brinjals and cabbages **414**; Students being trained in the correct maintenance of vegetable plants **414**; Lush fodder for cattle **415**; Scientifically produced pea crop **415**; Milk processing section storage tanks in Kaira plant **416**; A feed-milling plant **416**.

New Horizons in Farming IV 465-472

Anti-locust operations: A villager trying out a hand-dusting machine **465**; A demonstration in elimination of locusts by throwing flames **465**; Aerial spraying **465**; An agronomist conducting a study class on use of fertiliser **466**; Soil analysis **466**; FACT's oil gasification plant **466**; Practical lessons in application of manure mixtures **467**; Research workers studying crossed plants in a farm attached to CRRI, Cuttack **467**; Students of soil chemistry at work in IARI Laboratory **467**; Soil conservation work at Kheti **468**; Kulu's terraced fields to prevent erosion **468**; Typical Gullying **468**; The Desi Plough **469**; The Mould-board plough (IARI's improved variety) **469**; Japanese type single bullock yoke **470**; Indigenous Ragi Seed Spout Drill **470**; Four-row Multi-grain Seed Drill **470**; Seed Cleaner **471**; Three-row Seed-cum-Fertiliser Drill **471**; A view of a pairing plough **471**; Two-row Japanese type Paddy Weeder **471**; Power Tiller **472**; Paddy Huller **472**.

(Also, a number of line drawings, and cartoon by our artist)

*One hectare is about 2.5 acres

This Journal

"...I do not want to miss any issue of PRODUCTIVITY..."—SM Upadhyay, Junior Staff Officer, Hindalco, Renukot, Mirzapur, UP.

THE EDITOR cannot adequately express his gratefulness for such touching letters as the one quoted above, of which he has been the fortunate recipient during the last many months that we have been struggling with this massive volume on agricultural productivity.

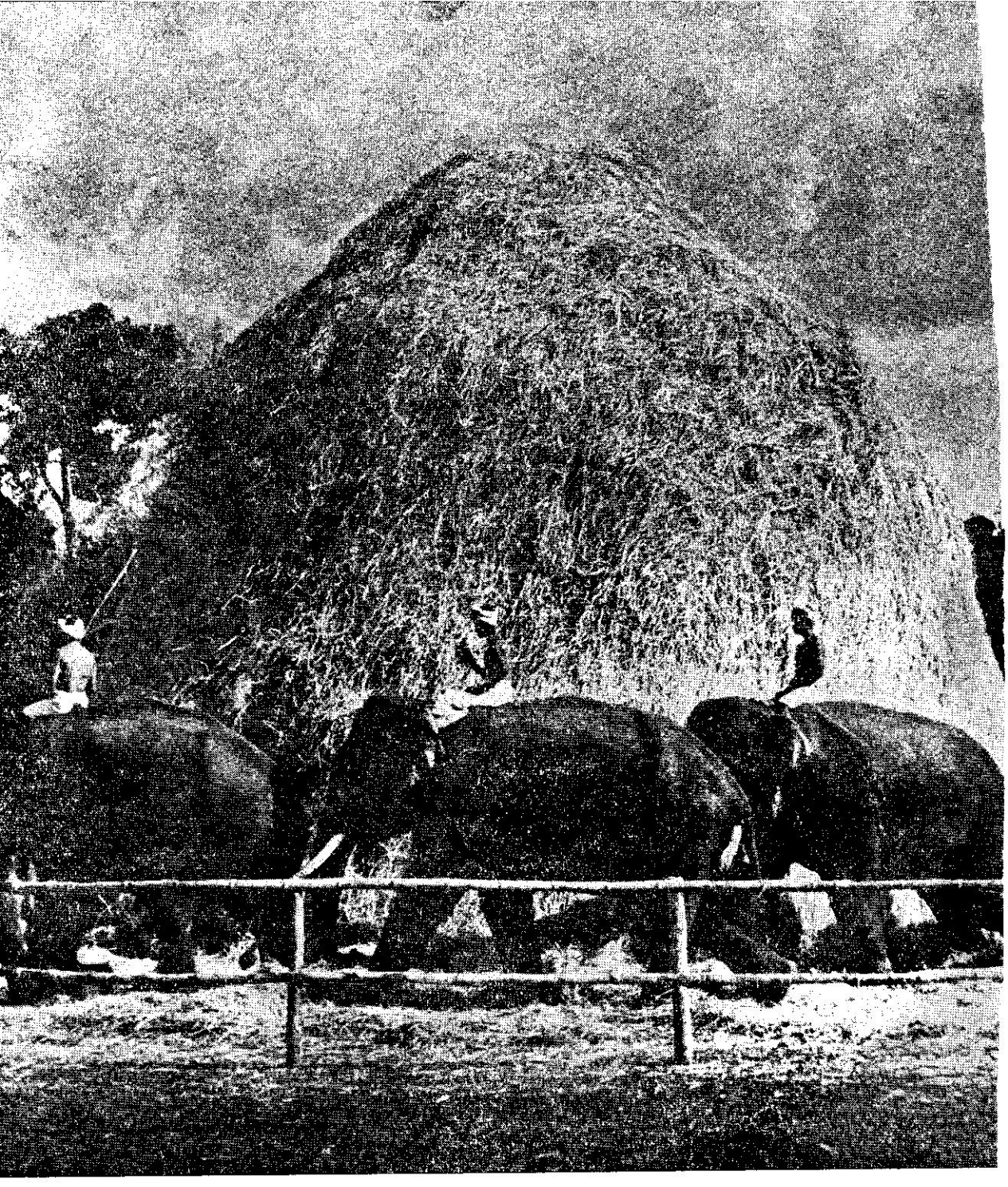
These kindly communications, however, make us feel rather apologetic for the unconscionable delay that has occurred in the publication of this journal. The fact that we had rather serious difficulties in getting good quality paper at a reasonable price, and that the blackouts supervened along with shorter hours of work, earlier shut down of electricity and lights, the shifting of the journal to a new and modern printing press —all these, however, are only excuses, not sufficient, in all conscience, for a delay of nearly three months that has occurred in publication.

The real fact is that 'Productivity' has, for all practical purposes, ceased to be a periodical. It has become a reference volume, almost regularly prescribed for university courses in business management, various training programmes, and, above all, as a work of reference for the experts and managers working in the many industrial establishments that have sprung up in the wake of our country's Industrial Revolution.

This volume makes a departure, for we are here concerned, for the first time in the history of the National Productivity Council, with the largest industry of this great country, viz., agriculture. The real cause of the delay is that we have practically gone over, as it were, the entire world to collect material: in this issue will be found articles and research pieces analysing the basic causes of high productivity in the agriculture of the United States, France, the Soviet Union, Eastern Europe, our neighbours China and Ceylon—and we have not omitted even Australia, New Zealand, and, last but not the least, Japan, the Model of Productivity in Asia. Not to forget there is an extremely significant piece on Israel which has really accomplished a miracle in agricultural productivity in the post-war period. We have not even omitted Pakistan.

All this has taken the editorial staff nearly two years. While the readers of 'Productivity' were reading other special issues, we were processing this Special Issue on Agriculture, in the confidence that we could make it the magnum opus of NPC; and a substantial starting point for our new Division on Agricultural Productivity. This may be the NPC Working Bible for some years.

We hope it will contribute in some measure to add to the knowledge of those who are concerned with the formulation of agricultural policies, their execution and implementation; we claim, in all humility, that it may as well inspire the men and women in the field, for what can be achieved elsewhere, can also equally well be achieved here.



Agriculture is on the march in India. Side by side with the introduction of new cultivation and harvesting methods, quite a number of other primitive methods continue to be in vogue. Threshing, for instance, by placing the grain stalks on the ground or floor, and walking cattle over them, is to be found in many villages. Photo shows how, centuries ago, in Chola days, threshing was done in South India by using elephants.



For Knowing All About
Productivity And For
Making Your Enterprise
More Successful

Read

PRODUCTIVITY

Please enter subscription to

Productivity

QUARTERLY JOURNAL OF NPC

योग: कर्मसु कौशलम्

☐ Payment enclosed
☐ Bill me
☐ V.P.P.

Published
March-June-September-December

☐ One Year — India — Rs. 12.00
☐ Three Years — ,, — Rs. 32.00
☐ One Year — U.S.A. — $ 5
☐ One Year — U. K. — 20 sh.
} By Surface Mail

(Make Cheque/Postal Order payable to National Productivity Council, New Delhi)

Name.....
(In block letters)
Company.....

Address.....City.....State.....
(Full in block letters)

Please enter subscription to

Productivity

QUARTERLY JOURNAL OF NPC

योग: कर्मसु कौशलम्

☐ Payment enclosed
☐ Bill me
☐ V.P.P.

Published
March-June-September-December

☐ One Year — India — Rs. 12.00
☐ Three Years — ,, — Rs. 32.00
☐ One Year — U.S.A. — $ 5
☐ One Year — U. K. — 20 sh.
} By Surface Mail

(Make Cheque/Postal Order payable to National Productivity Council, New Delhi)

Name.....
(In block letters)
Company.....

Address.....City.....State.....

Productivity

(Quarterly Journal of NPC)

National Productivity Council

156 Golf Links, New Delhi-3

Productivity

(Quarterly Journal of NPC)

National Productivity Council

156 Golf Links, New Delhi-3

Vol. VI, Nos. 2 & 3, 1965

Editor: DH Buch

PRODUCTIVITY

NATIONAL PRODUCTIVITY COUNCIL JOURNAL

PRODUCTIVITY

THE INDIAN ECONOMY, in its most critical aspect, suffers from three major handicaps, all relating to agriculture: its incapacity to feed the people; its incapacity to provide sufficient raw materials for expanding industry (not to mention cost and quality which are critical factors in any productivity analysis); and, above all, its incapacity to generate exportable surpluses to obtain essential imports necessary for accelerating the growth rate of the economy. This is despite the fact that during the last 15 years or so, the country has invested as large an amount as Rs. 30,000 million directly and indirectly into the field of agriculture.

Not that the results are altogether insubstantial. Last year, we had a record harvest of 89 million tonnes of food grains. This year, despite a capricious monsoon, the total harvest is estimated at 92 million tonnes. Nevertheless, the fact remains that even with PL-480 imports, the quantities thus obtained from Indian agriculture are insufficient to feed the growing population.

It is really a race between the hare and the hound. Every month, we add nearly a million to the population. The population explosion is not in the offing. It has taken place. The country is right in the grip of the Malthusian devil. The authorities have now become conscious of the gravity of the situation as evidenced by the large investments envisaged for the Family Planning Programme. This,

however, will avail only in the 1970s, by which time we may be able to make a dent into the now prevailing record of near three per cent compound rate of increase in population growth, against a mere one per cent simple rate of increase in agricultural productivity, for a decade and a half.

This brings us to the crux of the problem. It is not mere investment as such in agriculture that will bring us near the Fourth Plan target of 120 million tonnes of food grains. It is Investment plus Productivity. If we had depended more on productivity than on Uncle Sam's generosity through PL–480 imports, we would have by now attained the Third Plan target of 100 million tonnes.

Precisely, at the back of the mind of the people in the Productivity Movement, there is a feeling that, if in addition to the traditional inputs of irrigation water, improved seeds, fertilisers, and the like, we were also to make a little investment in productivity techniques, there might be a significant, though marginal, improvement in the output of food grains.

This is an idea which we can put forward in the final drafting of the Fourth Plan; or in the Prime Minister's Special Plan for Agriculture, which is being talked of for the first year of the Fourth Plan, beginning April 1966. As our India Productivity Year begins in January 1966, a coordinated agricultural strategy hammered out as between the Government and the NPC may well pay dividends, infinitely greater than the investment envisaged in NPC–IPY 1966.

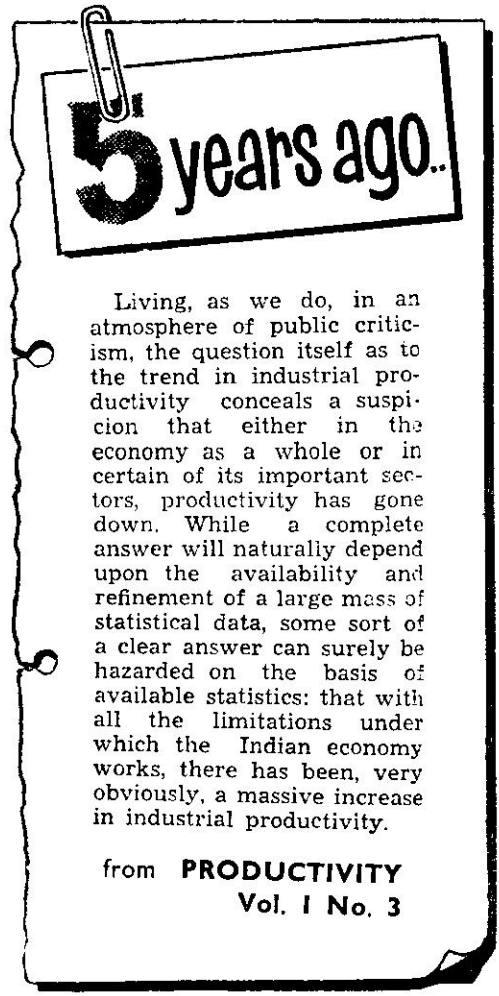
It would, however, be too presumptuous to claim that a gap of 30 million tonnes as between the Fourth Plan target of 120 million tonnes and the current annual output of about 90 million tonnes, could be bridged entirely through productivity: it amounts to a 33 per cent increase in output. Naturally, the Planning Commission would break it up—so much for major irrigation works, so much for minor irrigation works, so much for fertilisers, so much for improved seeds, etc. We may persuade them to put some modest figure also for productivity, and, what is more important, help them attain it.

The point however is, how do we make ourselves useful in the field of agriculture? It is a mistake to think that we are going to be concerned immediately and physically with the growing of crops. There are only too many people concerned with it, but their productivity is low. We would, therefore, be interested

in assisting Government organisations concerned with agriculture in respect of 'r methods of doing work, effectiveness organisation. the power to communicate with the farmers, coordination of facilities, etc. If productivity is put into all these factors, we may be able to make Government investments in agriculture more productive.

What probably we will be well advised to do is just to keep in touch with the principal policy levels at the Centre, and to indicate that we would be marginally available for feeling our way towards what we can possibly do through increased productivity for agriculture.

The possibilities are not as bleak as some critics would think. Substantial results in the field of agricultural productivity have been achieved by the Japan Productivity Centre, and by the British Productivity Council. Very substantial results have been achieved in Israel through the application of productivity techniques.



These and many other world-wide achievements in the field of agricultural productivity have been extensively reviewed in this Special Issue of the NPC Productivity Journal, for the area is critical so far as this country is concerned, and we are anxious to help. The job, however, is extremely tough, for we have to reverse the whole historical process. In developed countries, an Agricultural Revolution preceded the Industrial Revolution. Here, while an Industrial Revolution is taking place, a revolution in the techniques of agriculture is nowhere in the picture. We may be of a little help in this direction.

Acknowledgments

Photographs appearing in this volume are by courtesy of the Indian Agricultural Research Institute, the Press Information Bureau, the United States Information Services, the British Information Services, the Embassy of France, the Japan Information Centre, the Fertilisers and Chemicals Ltd., Hindustan Lever Ltd., and Larsen and Toubro Ltd.

PS LOKANATHAN

Chairman
National Productivity Council

Role of NPC in Agricultural Productivity

The most pressing problem of India is how to achieve a rapid expansion of food production. The National Productivity Council, which has been hitherto operating in the field of organised industry, has decided to enter the field of agricultural productivity. In this paper, the Council's Chairman outlines the steps proposed to be taken, and says that the productivity approach in agriculture, which should be essentially a management approach, is not only likely to pay increasing dividends, but will also provide necessary conditions to achieve the rapid growth rate envisaged in the Fourth Five-Year Plan, and to increase the level of farm incomes.

THOUGH the formal decision of the National Productivity Council to enter the field of agricultural productivity was taken early this year, it has really long been in gestation, and the thinking in the direction started years back. In fact, the suggestion came early in the life of NPC from that distinguished statesman, the late Mr Govind Ballabh Pant. Inaugurating one of our annual meetings, he expressed himself strongly that NPC could not consider its work complete unless it did something to promote the productivity of India's major industry, viz., agriculture. Despite this advice, we were reluctant to embark upon this new activity—firstly because in those days NPC had yet to prove its ground in the field of organised industry; secondly, we were not also equipped to undertake new responsibilities; and thirdly, we were aware that there were

other organisations and agencies in the field like Community Development and the Extension Services.

During the repeated crisis of the past few years, we felt, however, that we would be failing in our duty if we did not join the imperative national task of achieving a major breakthrough in the field of agriculture, particularly since we had acquired a certain measure of confidence in the application of productivity techniques. We in NPC have a feeling—grounded in the experience of the last seven years—that if we put productivity in our agricultural policies and practices, the Fourth Plan agricultural targets will have a reasonable chance of fulfilment.

The total Fourth Plan outlay on agriculture, in the public and private sectors, is likely to be Rs. 3,100 crores, and in agriculture and irrigation together Rs. 4,100 crores. However, it is not a question so much of financial magnitudes, as of the quality and quantity of inputs that go into agriculture. There is now recognition of the fact that the poor performance of agriculture is at least partly to be explained in terms of the failure of industry (including electric power) to supply the growing needs of agriculture. There is patent inadequacy (in relation to needs) of such industrial supplies as fertilisers, pesticides, and farm equipment, not to mention cement and steel which are necessary for agricultural development on the scale demanded by the country's expansion plans and rapid population growth.

Mechanisation

In fact, some of the inputs, such as small tractors, have a social significance that is not sufficiently realised. When the Russian farmer got the American-type tractor, he began to ask the authorities, whether it would be proper to expect him to operate the tractor in his strawshoes.

We have to realise that mechanisation can achieve nothing in isolation. To achieve maximum results, mechanisation must be accompanied by complementary facilities and associated with the necessary social environment.

It would be wrong to think, however, that the mere increase in our inputs would bring about a revolution in agriculture such as the one that preceded the Industrial Revolution in England, and the one that we need in this country, if the general advance on the economic front is not to be halted. What we need for this is a national awareness to utilise effectively the inputs that go into the land. The crux of the problem is how to get the most out of these inputs, how to organise farming in such a way that out of every acre we cultivate, out of every cusec of water we bring to the land, out of every ton of fertiliser and, what is most important, out of every man-hour that our hard-working cultivators put into the land, we get the maximum return. This is what we call productivity in agriculture.

So far NPC has been operating in the field of organised industry, both big and small. During these seven years of NPC's career we claim to have created a productivity consciousness in the field of industry. Practically in every part of industrial India we are daily running a number of training courses, teaching techniques like Work Study, Materials Handling, Cost and Budgetary Control, and Inventory Control. We felt, therefore, that the techniques of productivity, which for years we have applied in industry, may also be applied, with due adaptation, to agriculture.

There is a view that agriculture does not lend itself to productivity techniques as agriculture is not an industry. While

recognising the differences between agriculture and industry, there is really a great deal of commonness between the two sectors of the economy. Some of the industrial productivity techniques may not have the same significance in agriculture as in industry, but the problem of management in agriculture is basically of the same type as in industrial management, and unless agriculture is regarded as a management problem, and not merely a way of life, we are not likely to go very far. The key to agricultural productivity really lies in dealing with agriculture as a management problem. We have to deal with the same question in agriculture as in industry, like cheap and ready finance, better inputs, and supplies, better control of storage, marketing, and distribution.

If we analyse Indian agriculture and its failure to yield good results, in spite of the huge investments we have made during the last 15 years or so, we will see that basically what we have there is a management problem. As against the enormous inputs we have pumped into the agricultural economy—irrigation water, improved seeds, fertilisers, pesticides, and implements—the yields have not been correspondingly encouraging., precisely because agriculture does not have the managerial calibre for the effective utilisation of these resources. In fact, the situation has to some extent deteriorated recently, for in the past the landlord-moneylender system did provide some sort of management, even though it was for personal exploitation.

...We have not brought into agriculture the same principles of management which are essential in any business... The key to agricultural productivity really lies in dealing with agriculture as a management problem...

Training of Farmers

Of course, no one can think of reverting to the old pernicious system. But what needs to be emphasised is that our investment in agriculture by way of effective management of land, water, and other physical resources must have a proportion to the investment in those resources themselves; that is, Productivity with a Multiplier. Towards this end NPC is planning to create productivity consciousness among cultivators, extension workers, entrepreneurs, and researchers in the field of agriculture. We would like to educate the farmers in some of the useful techniques of productivity and sound management which may be of special application to agriculture.

In respect of farm production we can adopt the techniques of Work Simplification and Work Study, Methods Improvements in harvesting, transportation, handling and distribution, and in the elimination of waste at all stages. There is profitable scope for Work Study of the entire range of agricultural activities from the

preparation of land to the marketing of produce. The productivity approach has so far been neglected; this approach is not only likely to pay increasing dividends, but will also provide necessary conditions to achieve the rapid growth rate envisaged for the Fourth Plan, and to increase the level of farm incomes.

Farmers Responsive

That the farmers are responsive to the productivity approach is clear from the interesting results which the Hindustan Lever has secured through its valuable experiments. The Company presented the farmers in three blocks of 20 acres each in UP with free supplies of good quality seeds, fertilisers, and pesticides; the company's agricultural staff made sure that the optimum quantity of these resources were in fact used by the farmers, and the results have been astonishingly good. We also have the results of the progressive farmers which show that their output is three times the average output.

There is a general feeling that productivity efforts are not likely to be rewarding because in India we have to deal with millions of small farmers whose average size of farms is pitifully low, and uneconomic. From the point of view of our work, however, what is significant is not that 59 per cent of the farmers have farms of less than five acres, but rather that farms larger than 10 acres account for nearly 70 per cent of the total farm area. If we go down further and include five acres as a base, 85 per cent of the area is accounted for by farmers having five acres and more. We thus have a very substantial base in the agricultural economy in the form of medium-sized farms, and it is on these medium-sized farms that we should initially concentrate for practical demonstration of the value of the application of productivity methods.

It is no use disguising the fact that the organisation of farm productivity would be a slow process, and that the results cannot be expected overnight. We, therefore, have to work in several stages: we have so far established a skeleton Agricultural Productivity Division at Headquarters. We should allow the NPC some time to gather the necessary expertise, and to build up the core of specialised knowledge. In collaboration and cooperation with the existing organisations, we should be able to identify the areas where our work could be profitably complementary, and the other areas where NPC would have special responsibility.

Our idea is not to encroach upon the domain of any existing organisation making a useful contribution, but rather to reinforce their efforts to the extent necessary. There may be areas where we have to do some pioneering work, because these areas may not yet have been adequately covered by the existing organisations. It is possible that such areas of work may be (a) Training of small farmers, (b) Training in productivity techniques of officers engaged in Community Development Programmes, (c) Training in Farm Cost Controls, (d) Application of Work Study techniques to farming operations, and (e) Application of Method Study to storage, marketing, and also to distribution.

Revolutionary Approach

Lastly, it is also necessary to bear in mind that agriculture should not be thought of in narrow terms as consisting only of rice or wheat lands. Agriculture, in its broadest sense, includes plantation crops, poultry farming, animal husbandry, and horticulture. From the point of view of agricultural productivity, the questions relating to the transport and processing of the products of agriculture by rice and flour mills, sugar factories, oil pressing mills, and other agro-industries, may well be included in our programme in respect of agricultural productivity.

Agricultural problems are not at all new. They have been with us for years, and we have devoted considerable thought to the solution of these rather difficult problems. In a sense, there is nothing new or original even about this productivity approach. In fact, we have during the last few years concerned ourselves with problems of price incentives for agriculture, of providing more inputs in the form of improved seeds, implements, and fertilisers so that we may get the best out of the land. While all this is good and commendable, the productivity approach is, in my view, a revolutionary approach. We have so far tended to regard agriculture not in terms of the costs and profits, but in terms of mere subsistence, and as a way of life. We have thought in terms of increasing inputs without asking the further question as to how to improve the quality of the inputs, how to reduce the costs of these inputs, and how to achieve the maximum return out of a given input of resources. We have not brought into agriculture the same principles of management which are essential in any business. The productivity approach, will, therefore, be essentially a management approach. It would bring to all the farm managers, however small they may be, a sense of cost and quality, a sense of profit and return and a sense of results and achievement.

Productivity gives a new dimension to our efforts to accelerate agricultural production. Together with increased investments it is likely to bring about a breakthrough in the not too distant future. Education and training, which are at the heart of a productivity drive, will help in the mobilisation of rural skilled manpower, and will contribute rapidly to agricultural production.

It is obvious that in the agriculture sector, our hopes will be realised only if productivity becomes a mass movement, covering every aspect of the life of the rural people, numbering nearly 400 million. We, therefore, propose taking several steps, primarily through the Community Development and Extension Services, to help in creating and spreading productivity consciousness among the farming community, as we have done for industry, through appreciation courses conducted in local languages, through work study organised on medium-size farms, through publication of special productivity studies of materials handling on farms and in transit to processing industries, etc.

Pivotal Position in Fourth Plan for Farming

The age-old industry, agriculture, will occupy the pivotal position in the Fourth Five-Year Plan.

Speaking on the subject at the Silver Jubilee Celebrations of the All-India Exporters' Chamber, Mr Manubhai Shah, Commerce Minister of the Government of India, and former President of the National Productivity Council, said that the country had gone in for something adventurous—industries—with the result that not enough attention had been paid to agriculture which alone could have absorbed the "shocks" created by industrialisation.

"Without scientific and technological advances in agriculture this country cannot progress," he said, adding that efforts would be made in the Fourth Plan to prevent the estimated loss of 17 per cent in food production due to pests.

AD PANDIT

Secretary
Ministry of Defence

Application of Productivity Concept to Indian Agriculture

Drawing a comparison between traditional agriculture and commercial farming, AD Pandit says that in regard to the latter, increasing productivity is reflected in the form of lower unit costs. He argues that the application of the productivity concept involves the farm management approach, and indicates that there is a vast, uncharted field for study and research in relation to productivity in Indian agriculture. The author was formerly Special Secretary in the Ministry of Food and Agriculture.

"PRODUCTIVITY" is defined in Economics as the output per unit of input, but the word has been used in technical literature as a kind of abbreviated expression of the art of securing an increase in output from the same input or of getting the same output from a smaller input. Increase in productivity, whether in industry or agriculture, is generally the result of a more efficient use of some or of all the factors of production, viz., land, labour, and capital.

In the case of land, this means a rational layout of the factory and the residential colony in industry; rational layout of the farm, the farm buildings and residential quarters for workers in agriculture. In the case of labour, in a factory it means rationalisation of various processes of manufacture, adequate rest times for

the maintenance of efficiency throughout the working period, social security and health measures, and in-service training to improve skills; similar considerations also arise in the employment of labour in mechanised agriculture. In the case of capital, it would mean a proper layout of machinery, adequate maintenance so that the machinery could be utilised for its maximum life and not kept idle causing loss in terms of interest—this applies to both industry and agriculture—and proper storage of spare parts and other expendable stores as well as adequate arrangements for temporary storage of products and their expeditious marketing.

The productivity concept can be applied more easily to production processes which are under the control of man. As industrial processes generally do not depend on the vagaries of nature, the soil or the environment, they are amenable to greater control and, therefore, voluminous literature on productivity in the manufacturing process has grown up during the last 50 years. On the other hand, agriculture, howsoever mechanised it may be, being a biological activity, is conditioned by external factors such as soil, climate, and pests and diseases and is, therefore, not amenable to the same degree of control as is industry. However, with increasing mechanisation in America and Western Europe, the productivity concept is being progressively extended to agriculture. Some branches of agriculture, such as dairying and poultry-keeping, are amenable to greater control on the factors of production than is the growing of crops.

Traditional agriculture as practised in developing countries, such as in most parts of India, is subsistence agriculture—a way of life—and the productivity concept, i.e., getting the maximum output per unit of input, is, therefore, absent from this type of agriculture. In the case of developed economies, and where farming is organised as an industry, almost the entire output is sold in the market, and sales off the farm represent the output. In traditional agriculture, inputs have their origin in the farm itself, such as residues of crops, organic wastes of cattle used on the farm, and seed kept back from the previous crop. In commercial farming, most of the inputs come from outside the farm, such as chemical fertilisers and pesticides from the chemical industry, agricultural machinery from engineering firms, and improved seed (generally hybrid seed) purchased from specialised seed-producing firms. In the case of commercial farms producing mainly for the market, increasing productivity is, therefore, reflected in the form of lower units costs.

Management Approach

The application of the productivity concept to agriculture, in fact, involves the farm management approach. The first and foremost necessity, therefore, is a sound accounting system to assess the profitability from each unit (person, crop, field, animal, and machine). We then need direct labour simplification through the analysis and modification of individual jobs, reduction of inputs, ironing out labour by some rearrangements of the plants and jobs, and cutting down on labour or material requirements, and, as a final step, general reorganisation of such items as equipment and buildings, and eventually the farming system as a whole.

On most Indian farms, the entire area is put under one or more crops according to crop rotation evolved as a result of experience over centuries. A farm management approach will involve putting together many and differing agricultural enterprises into an effective overall economic unit. For example, in a certain area it may be more profitable for the farmer to put part of his land under a cereal

crop, another part under a commercial crop, such as cotton or sugarcane, and a third part under horticultural crops, or fodder for the maintenance of working livestock or milch cattle. These differing enterprises may, in a particular situation, be complementary to each other, resulting in more efficient utilisation of labour and other inputs—for example, by growing a leguminous fodder crop in a rotation or in a part of the farm the soil may be enriched, and, therefore, require less nutrients for the succeeding crop.

Productivity will naturally vary according to the state of the arts. A new variety of hybrid seed, concentrated fertiliser, a more effective pesticide, or a more durable or efficient tractor, with better implements, may increase productivity. Continuous increases in productivity, therefore, depend, apart from better management, upon a continuous output of research in agricultural science, chemistry, and engineering.

In developing countries where the population pressure has not yet been felt, the response to increasing demands for food and fibre takes the form of increasing generally the most readily available factors of production, viz., land and labour. If the population is so small that labour itself is a bottleneck, mechanisation may be introduced at an early stage to cultivate additional areas of land. Where the additional supply of land is exhausted, as in the case of India, the concentration is on productivity per unit of land, and the input of labour is increased, capital being a limiting factor. In developed countries, where both land and labour are limiting factors, the supply of capital is increased, and attention is directed to productivity both per unit of labour as well as the unit of capital. In highly mechanised agriculture, labour becomes an insignificant part of the total investment in the farm, and all research is concentrated on securing increasing returns to a unit of capital. As agriculture steps out from the shackles of tradition and takes on a greater market-orientation, it is necessary

A REASON FOR "FAILURE" TO CARRY OUT LAND REFORMS

President Radhakrishnan has attributed the failure of the Government to carry out land reforms in the country to vested interests created against such reforms.

Speaking at a function at Wardha some time back, he asked "Why is it that our country with vast resources is facing the food problem? Why is it that our legislators have not been able to implement land reforms?" He was of the view that the legislators were placing the economic interest above ethical values whenever some conflict arose between the two.

"We are unable to introduce radical land reforms. We have abolished Zemindari, Mirasdari, but landlords are still there. Our legislators are unable to pass the necessary legislation, because they are strongly entrenched in it."

to draw attention to idea of productivity in agriculture in its comprehensive aspect, viz., securing the maximum input per unit of resources employed on the farm.

Let us take the simplest concept of productivity which is relevant to our present conditions, viz., productivity per acre. It is well-known that per acre yields of principal crops in India are exceedingly low compared to yields in most other countries. The following table* gives the yields per hectare of major crops in India:

TABLE I

Yield per hectare in kg of major crops

Commodity/Group	1961-62	1962-63	1963-64	Average
Rice	1016	914	1029	986
Wheat	725	713	762	733
Other cereals	515	558	539	537
Pulses	491	477	415	461
Food grains	703	676	686	688
Sugarcane (Gur)	4187	4186	4633	4335
Cotton (Lint)	104	122	123	116
Jute (Fibre)	1240	1152	1244	1212
Groundnut	729	702	778	736
Oilseeds	490	481	488	486

As compared to the yield of 986 kg/ha. in India, the average yield of rice is 3187 kg/ha. in Japan. Yield rate of wheat is also very low as compared to other advanced countries, being less than half the yield rate in the USA. The position is the same for most other crops.

Under the scheme of simple fertiliser trials and of the model agronomic experiments, initiated by the ICAR in several States, some data are available regarding the output per unit of some of the modern inputs used in scientific agriculture. These data have been published in a booklet entitled 'Yardsticks of additional production of certain food grains, commercial and oilseeds crops' by the Institute of Agricultural Research Statistics in 1964. Further analysis of later experiments, with a wider coverage, is under way. The published results show that the average response to a tonne of nitrogen is 10.8 tonnes of rice. In the case of irrigated wheat, the response per tonne of nitrogen is 14.1 tonnes of wheat. In money terms, Panse has calculated that at the recommended levels, profit per acre for rice and irrigated wheat on the application of nitrogen will be Rs. 39 and Rs. 61 respectively, ignoring the additional labour necessary for the application of the fertiliser. He has shown that whereas in India the response to a kg of nitrogen when applied at 20 to 25 kg per acre to rice is 9 kg, it is 13 kg in Japan. In the case of wheat, while it is 11.4 kg in India, the corresponding figures for the USA and Britain are 19 kg and 12 kg respectively.

There are some unknown factors in the soil-water complex in India which prevent a high response to application of chemical fertilisers. Many foreign observers have remarked that soil and water management is a very much neglected subject in India, and more research work is necessary for creating conditions in the root zone of plants to activate the nitrifying bacteria and ensure a larger uptake of plant nutrients by the growing crop.

The much higher prices of fertilisers

* SOURCE: Area, production and average yield per hectare of principal crops in India 1949-50 to 1963-64 (Summary Tables) issued by the Economics & Statistical Adviser to Government of India, Ministry of Food and Agriculture, September 1964.

in India, as compared to those in Japan and most Western countries, reduce the net return per rupee invested in chemical fertilisers, and makes a change-over to chemical fertilisers much less attractive in this country.

Input of Labour

There is little material available so far to form any idea about productivity per man-hour or per unit of inputs other than land, and a considerable amount of field investigation will be necessary before adequate data can be forthcoming. The farm management studies show that the number of units of labour employed per unit of land is positively correlated with the yield per unit of land, which is to be expected. A recent study shows that Japan's labour input per acre in man-hours is between two and three times that of India, although Japanese agriculture, in spite of its being small-scale agriculture, is fairly machanised. There is reason to believe that agricultural implements, whether used with bullock or manpower, are more efficient in Japan than in India, and the amount of effective labour input per acre in Japan would, if the quality of labour were taken into account, be much higher than in India. There is obviously a lesson to be drawn here in regard to the reported unemployment and under-employment of agricultural labour in this country. Another factor which possibly adversely affects productivity per acre in India is the fact that even in irrigated areas, for various reasons into which it is not possible to go here for limitation of space, land is not kept continuously under the crop, thus leading to idle labour time and deterioration of the soil due to alternate wetting and desiccation. The rapid increase in area rendered unfit for cultivation in canal systems due to the rise of salts by capillary action has been attributed to the practice of leaving lands fallow during the hot and dry summer months.

. . . There is a long way to go before Indian agriculture emerges from subsistence to commercial level . . . The application of productivity principles to agriculture . . . should commence in those circumstances where one can exercise the maximum control over production factors . . .

An insight into some productivity aspects of Indian agriculture is afforded by the farm management studies taken up in seven typical regions in the country, viz., Bombay (at present Maharashtra), Madras, Punjab, Uttar Pradesh, West Bengal, Madhya Pradesh (at present in Maharashtra) and Orissa, from 1954-55. These farm management studies were carried out in selected districts according to both the cost accounting and survey methods of investigation. Most of these studies show that, according to the cost 'C' basis which includes the imputed cost of family labour and that received in exchange, in addition to all items of cost paid for in cash, not excluding imputed or actual rent and interest on fixed and

working capital, the value of the output per acre only marginally exceeds the value of inputs, thus showing a very low or negative return per unit of resources employed. These data relate to a period before chemical fertilisers and other outside farm inputs began to be employed on any significant scale in Indian agriculture. On the whole they tend to show that there is a long way to go before Indian agriculture emerges from subsistence to commercial level.

It is obvious that the application of the productivity principles to agriculture, so as to bring about an efficient allocation of resources, should commence in those circumstances where one can exercise the maximum control over production factors. These conditions can most readily be found in farms attached to Agricultural Universities, Colleges and Research Institutes, and seed production units of State Governments. These farms should, therefore, provide a lead in demonstrating how the most scarce resource of land should be employed in our situation with maximum efficiency. Incidentally, figures given in a recent lecture by Dr David W Hopper of the Ford Foundation tend to show that it is frequently not so employed. It would be interesting to extend the study to the total complex of inputs, and to make a comparison of productivity per unit of different inputs and as a whole in government farms and those of progressive farmers. Such a study might provide some answer to the question why scientific agriculture is not being adopted as rapidly as is desired.

Can Agriculture be made a Central Subject?

Can the food problem be solved if agriculture is made a Central subject? The answer to this question will always be divided.

A suggestion that agriculture should be made a Central subject, by amending the Constitution, was made by Mr AD Mani (Ind.) in the Rajya Sabha in December last.

Mr C Subramaniam, Union Food Minister, "totally rejected" the demand and said: "If this is done it will only create more difficulties between the Centre and the States, instead of improving the situation on the agricultural front which will only make it deteriorate."

Inaugurating the Farm Management Course organised by the Indian Society of Agricultural Economics at the Centenary Buildings of the University of Madras, Dr A Lakshmanaswami Mudaliar, Vice-Chancellor, expressed the view that agricultural production and distribution must be in the hands of the State, and not the Centre. He felt that one central agency for the whole country would not be able to control the prices of different agricultural commodities.

PL TANDON

Chairman
Hindustan Lever Ltd.

Hindustan Lever's Projects Yield Substantial Results

In the context of the India-wide drive for greater output, Hindustan Lever has been feeding farmers with techniques and supplies of inputs, and teaching them how to use them, to increase the per acre yield of the commodities in which the company has been specially interested. PL Tandon describes some of the firm's projects, particularly the processing industries, the factors contributing to their success, and the role of extension, and points out that very basic to the problem of agricultural productivity is the improvement of the farmer's managerial skills, so that he begins to plan his operations to achieve greater profits.

THE FARMER uses a wide range of resources in his business; he either owns or rents them. Besides supplying his own labour, he provides management. The function of management in farming, which is one of continuous decision-making and choosing between alternatives, is in no way different from the decision-making function exercised in modern industry. Therefore, improvement of the managerial skills of the farmer is very basic to the problem of farm productivity, so that the farmer begins to plan his operations to achieve greater profits.

The approach to management development in farming has got to be different from that of industry. The fruits of scientific research have to be carried to the farmer to suit his own abilities, and at his own level. Because the transformation from traditional agriculture to scientific farming would really mean a

departure from looking backwards to tradition for guidance, to science and technology, which, in fact, is to look ahead. It is here that the role of extension becomes extremely important. In other words, there should be a constant flow of research information in farm technology, and a well-trained body of extension workers should be able to carry farm technology to the farmer.

Processing Industries

As agriculture is increasingly being dependent upon cash inputs, like chemical fertilisers and plant protection materials, which have to be provided by organised industry, greater attempts have to be made to increase the supplies of the inputs. In order to meet the growing needs, we need to develop several types of financial institutions simultaneously, because the job would be too difficult for cooperatives alone to handle.

The development of processing industries, like the ones we have undertaken in recent years, would really help bringing all these factors into play simultaneously. In the absence of financial institutions, industry itself may have to be a pioneer in advancing loans for increasing production as we have been attempting in this direction. Coupled with a proper organisation for marketing and distribution, production becomes more profitable as our experience has shown.

Processed Vegetables

Hindustan Lever's entry into the field of processed vegetables began as early as 1959. With a humble beginning, the project now has 4,000 acres of land area operated by over a thousand farmers. This dehydrated vegetable plant is by far the only one of its kind in the country currently processing peas, onions, potatoes, cabbage, carrot, and Sarson Ka Saag (mustard leaves). Of these, peas have the widest market so far. With Hindustan Lever setting up agro-industrial enterprises around Ghaziabad and Etah in the UP there are signs of the traditional methods slowly giving way to modern farming practices. The success of an agricultural enterprise depends on careful planning of production of proper varieties, and harvesting at the required stage of tenderness, and transporting it on time to the processing plant. The dehydrated vegetable enterprise has called for cooperation of hundreds of farmers who contract for supplying peas. The key practices which have contributed to

Farmers Responsive to Productivity Approach

That the farmers are responsive to the productivity approach is clear from the interesting results which M/s Hindustan Lever has secured through its valuable experiments.

Referring to this at the Agricultural Productivity Conference organised by the NPC, Dr PS Lokanathan mentioned that the company presented the farmers in three blocks of 20 acres each in UP with free supplies of good quality seeds, fertilisers, and pesticides; the company's agricultural staff made sure that the optimum quantity of these resources were, in fact, used by the farmers, and the results have been astonishingly good. We also have the results of the progressive farmers which show that their output is three times the average output.

doubling of pea yields, from a low level of 1,650 lb per acre, are :

a) Use of improved and chemically-treated seeds.

b) A higher seed rate of about 100 lb per acre as compared to the normal rate of 50 to 60 lb. An adequate plant population is necessary for achieving high yields.

c) Application of adequate rates of chemical fertilisers (10 lb of ammonium sulphate and 100 lb of super phosphate), and

d) Prophylactic plant protection measures.

The cost of these improved practices amount to Rs. 45 per acre. With an additional investment of Rs. 45, the yield per acre has been nearly doubled to 3,300 lb, and the net income per acre has gone up from Rs. 132 an acre to Rs. 219. In short, an additional investment of Rs. 45 per acre fetched an additional return of Rs. 87; or a little over 93 per cent!

Price Factor

In the absence of well-developed financial institutions in the area, we have been providing the farmers with seeds, fertilisers, and pesticides on a loan basis. As the vegetable operation is exposed to high risks, because of the vagaries of the monsoon, and wide price fluctuations, the price becomes a very important factor influencing the farmers' decision to plant. The farmer contracts to sell all his production at a pre-determined price. This pre-determined price has imparted considerable stability to his operation.

Planting and harvesting of fresh tender peas involves careful planning, because the dates of planting as well as the harvest periods have to be staggered in such a way that there is a continuous flow of the crop into the factory over as long a period as possible. To such of the farmers who need labour, we provide labour for harvesting operations. Since the farmer would find it difficult to transport the produce, we provide the transportation at a reasonable cost.

In the absence of adequate research information in the area of input-output data, we have a small but efficient research group which conducts experiments in the areas of (a) varietal trials, (b) fertiliser trials at different levels, (c) experiments in evolving frost-resistant varieties, (d) plant protection trials, and (e) composite trials. The results of our research are carried to the farmer through our extension staff.

Our groundnut demonstration project, which made a beginning during 1964 in Etah and Aligarh Districts, is really an attempt to introduce a new crop rotation. From an average yield of about 700 lb the demonstration plots have yielded an average of 1,500 lb per acre. This extension scheme has not only demonstrated the high potential of UP in groundnut production, but also the possibility of getting a higher yield of the wheat crop which follows Kharif groundnut. The critical factor which has contributed to the success of the new crop rotation is the advancement of the planting time by a month. This rotation, when widely accepted by farmers, would replace bajra/jowar followed by wheat rotation, and probably would be the most remunerative rotation in the region. As in the case of peas and other vegetables, the key practices which have doubled yield per acre are : (a) Use of improved and chemically-treated seeds, (b) Chemical fertilisers (120 lb of super phosphate and 50 lb of ammonium sulphate), (c) Prophylactic plant protection measures, and (d) One irrigation at the time of planting. These

resources are provided to the farmers free of charge.

Our dairy enterprise at Etah, UP, is a complex operation. It is designed to produce a variety of products from buffalo milk. The problems we face are: (a) to collect and convey milk to the factory, and (b) to help the farmer to increase his milk production. To do this we have 50 collection centres located in the region. Our main concern has been to see that the milk yield per animal is increased substantially. To increase milk production, the following schemes have been implemented:

1. As there is need to augment the dairy cattle population in the region, the farmers are being assisted by way of loans to buy the animals, and to buy the necessary feed.
2. In order to upgrade the cattle, a breeding programme is to be implemented.
3. In the absence of extensive natural pastures, a programme to develop green fodder is under way.
4. The farmers are provided with high-grade and scientifically prepared cattle feed on a loan basis, free of interest.

With the implementation of these measures, there is an indication that milk production in the area is gradually going up.

Feedingstuffs Enterprise

Our animal feedingstuffs enterprise is concerned with the manufacture of poultryfeed and cattlefeed. In order to support the fast-growing poultry population, we felt it is essential to have a scientifically prepared feed. In conjunction with our dairy and other related enterprises, our poultryfeed and animal feedingstuffs manufacturing had to emerge naturally. In a short time, our poultryfeed has become popular among the farmers because of its usefulness and its tangible contribution in increasing egg production.

The answer to the problem of farm productivity seems to depend on the implementation of a number of factors simultaneously. There is a high degree of interdependence between development of management skills, use of farm technology, and moving more resources into farming. In the process of transforming traditional farming into scientific agriculture, organised industry faces a challenge and an opportunity. It is a challenge because suitable techniques have to be evolved to meet the sociological make-up of the farming community. It is an opportunity because industry will have increased supplies of raw materials which are essential to keep its wheels moving.

Bowles Suggests Pattern

The US Ambassador in India, Mr Chester Bowles, speaking at the Mysore University some time back, outlined the pattern of agriculture which India should adopt.

This pattern may be summarised broadly as: (1) large holdings should be gradually abolished, the owners of such holdings being asked to sell their lands to their tenants and landless labourers on easy terms—proceeds of the sales to be invested in the shares of small industries, (2) the tenancy laws must be strengthened and vigorously enforced, and (3) the tenancy reforms are not a real substitute for permanent peasant ownership covering the entire cultivated lands of the country.

SHERMAN E JOHNSON

Dy Administrator for Foreign Economics
US Department of Agriculture

Steps for Output-increasing Improvements

In discussing the problem of achieving higher food output in India, the author suggests a number of measures to obtain some significant production increase in the immediate future. These include "continued support of prices for food grains at levels that will make it profitable to carry out simple improvements", price incentives to encourage better harvesting and threshing practices, pest control, and timely credit on reasonable terms. The lessons learnt in the Package Programme areas should be applied to other districts, and, simultaneously with these short-term measures, he suggests that India should look beyond the Fourth Plan period to continuous increases in production, though this would call for "research breakthroughs" on food grain varieties adapted to heavy fertilisation.

INDIA must accelerate the rate of increase in food production in order to keep pace with the demands resulting from rapid growth of population and the higher purchasing power generated by the development and defence programmes. Unless a rapid and continuous expansion of food production is achieved, India will be facing a chronic food shortage. It appears that the annual rate of increase in food grains, the major source of India's food, will need to be about twice the rate of recent years in order to avoid a chronic food shortage.

There is general agreement that food shortages retard economic growth. A laggard agricultural sector will not contribute its proportionate share to national output, and scarcity of food supplies will retard growth in other sectors. The widening gap between current production and market demands cannot be filled by commercial imports, because of the scarcity of

foreign exchange. And although food aid shipments are helpful, they cannot be supplied in sufficient volume to fill the prospective gap. How to achieve a rapid expansion of food production is, therefore, India's pressing productivity problem.

If we consider the means to achieve higher food output we find some similarity between expansion in agriculture and in heavy industry, but also very significant differences. Development programmes in both agriculture and industry require national recognition of the need, and then forceful action to initiate and sustain expansion. Both sectors require leadership of a high order, and trained manpower to get the job done. But if these requisites are present, the differences between agriculture and heavy industry begin to emerge.

A steel mill is a big undertaking. When a site has been located with easy access to fuel and iron ore, as well as facilities for distributing the products, materials can be allocated for construction, and experienced personnel hired to supervise both construction and early operation. Once the supervisors and workers in a steel mill have been trained for their new occupations, they have made a complete break with their former cultural and occupational environment. The jobs are specialised and repetitive, which facilitates supervision.

In agriculture, the work varies with the seasons, and must be adapted to sudden changes in weather conditions. The cultivators continue to live in the old village with its traditional farming methods. The villagers, who are sufficiently venturesome to try out new methods, not only take financial risks, but may also encounter ridicule from neighbours. To help the venturesome breakthrough from the closed circle of village culture, and traditional farming, requires leadership of a high order. Knowledge of new methods must be brought to the village by trained agricultural workers who can inspire local leaders to initiate changes. Enough such breakthroughs have been accomplished in the Intensive Agricultural Districts Programme and in other projects in India, to demonstrate that it can be done, but "adoption breakthroughs" require time for achievement.

Group Farming

The small scale of our operations in agriculture is a great obstacle to rapid adoption of output-increasing improvements. Significant increases in total output will be obtained only if cultivators on several million farms are convinced that changes are desirable.

Group farming organised along cooperative lines has been suggested as a means of overcoming the disadvantages of small-scale operations. But joint operation does not result in more land resources per family. Also, it may be difficult to obtain a competent manager of the combined unit. If losses are incurred, they will be suffered by all members of the group, whereas a mistaken decision on a small unit will affect only the fortunes of that operating family. Moreover, security of tenure on even a small parcel of land can be a considerable spur to productivity.

Radical restructuring of agriculture in India, except as needed to provide equitable sharing of returns by tenants, is likely to retard rather than accelerate increases in food production. The fact that food is produced by some 60 million farm families mostly in very small units is, therefore, one of the main considerations in outlining a food expansion programme. It is necessary to realise that large numbers of cultivators will need to be convinced that they will benefit from the changes in

... Assurance to producers of continued support of prices for food grains, at levels that will make it profitable to carry out simple improvements, is the most powerful immediate tool for promoting increased output ...

farming that will increase food production.

If we take an inventory of the resources available to raise output, we see an abundance of labour skilled in traditional methods of farming, but very unskilled and unacquainted with the improved technology necessary for rapid increases in food production. In contrast, there is a serious shortage of trained manpower which possesses sufficient knowledge of practical agriculture to help cultivators determine how new and production-increasing technology can be fitted into their farming operations.

Little Additional Land

India has little extra land available for her development. Therefore, the increased output must come largely from higher production per acre. How can this be achieved? Luckily, India's resources of soil, water, and climatic conditions are capable of producing much more per acre with application of locally suitable combinations of chemical fertiliser, improved seed, better tillage, and water management.

Growing two or more crops a year on the same land is one of the most promising ways of increasing output per acre. Frequently, however, this is possible only on irrigated land. But India has undertaken several large-scale irrigation projects, and tubewell and other minor irrigation structures have potentialities for increasing output in many areas. Some of the irrigated land has not yet been fully developed, and multiple cropping has not become a common practice. Some increase in output can be expected from this source as fuller use is made of irrigation facilities.

The scarcity of capital for investment in agriculture necessitates assignment of investment priorities. Capital goods which must be imported require the use of scarce foreign exchange. Agriculture must compete for such capital with development demands from other sectors of the economy. The highest returns on capital invested in agriculture are likely to be obtained on operating capital in the form of fertiliser, pesticides, improved seed, and simple equipment. But these materials must be available for use by cultivators. This means that fertiliser and pesticides plants will need to be constructed in India to provide domestic sources of these essential farm inputs. Foreign exchange will have to be allocated for the import of the necessary construction materials.

Scarcity of land resources, per farm family and for the nation, emphasises the importance of adopting measures that will increase output per acre. Agricultural output can be maximised if cultivators can

be assisted in the achieving of effective combinations of scarce inputs—management, land, and capital—along with full utilisation of the abundant supply of unskilled labour. Additional inputs of management and capital will then be utilised for the introduction of improved technology, which involves locally adapted combinations of fertiliser, pesticides, and other inputs needed to increase yields per acre.

Significant increases in output per acre can only be obtained by the adoption of suitable combinations of output-increasing technology. But they involve much more complex operations than traditional agriculture. Time, effort, and materials are needed to expand food production in this way. But there is so little time. More food is needed now, and next year, and the year after that. We, therefore, need to raise the question as to what can be done to obtain some increase in food output in the immediate future. Can large numbers of cultivators be induced to respond to urgent needs by making somewhat minor changes in their operations at the same time as more fundamental changes are being made on farms where intensive programmes are under way? Perhaps the following measures could be undertaken to stimulate food production in a large number of districts :

1. Fortunately, there is plenty of evidence to indicate that cultivators in India do respond to the profit motive. They shift from food grains to cash crops in response to changes in price relationships. Therefore, assurance to producers of continued support of prices for food grains at levels that will make it profitable to carry out simple improvements is the most powerful immediate tool for promoting increased output. Cultivators can produce a little more per acre even under traditional methods if they find it profitable to do so. They can till the ground more thoroughly, make more careful use of irrigation water, control weeds more effectively, and harvest the crop more carefully.
2. Considerable waste of food grains occurs both in harvesting and storage. Price incentives will encourage better harvesting and threshing practices. Better protection against weather and vermin will save much food now lost in storage. Cultivators can be given assistance in providing more suitable home storage; and more adequate market storage and processing facilities can be provided.
3. Pest control is important both in production of crops and in their storage after harvest. Protection of stored grain against pest damage can be organised more readily than control of pests in growing crops. It appears, however, that some simple crop pest control programmes could be initiated

... If the needed supplies, marketing and credit facilities, were available, and if outstanding district project directors were selected and adequate training given to the supporting staff, it should be possible to obtain very significant increases in the output of food grains over a five-year period ...

even with limited supervision and help to cultivators. Rodent control might be one example of a feasible programme.

4. Apparently, some cultivators (outside of the "package districts"), who have had experience in effective use of chemical fertiliser, have not been able to obtain adequate and timely supplies. This raises the key question of the availability of supplies for adoption of improved technology, wherever cultivators are disposed to adopt production-increasing improvements. They cannot be expected to increase their use of new methods if supplies are not available, in adequate quantity, and at the time they are needed.

5. Wherever tillers are in a position to adopt new technology, timely credit, on reasonable terms, is needed to stimulate the required investment.

Some of the steps which have been listed could be undertaken in a large number of districts, chiefly with the available agricultural staff. Experience in the "Package Programme" districts indicates, however, that most cultivators will need assistance in learning how to use chemical fertiliser and pesticides in combinations with other improvements that are adapted to local conditions, and that result in large increases in output. This learning process takes time. It also requires skilled leadership and trained workers who know how to grow paddy and other food grains with improved methods under conditions adapted to the local area.

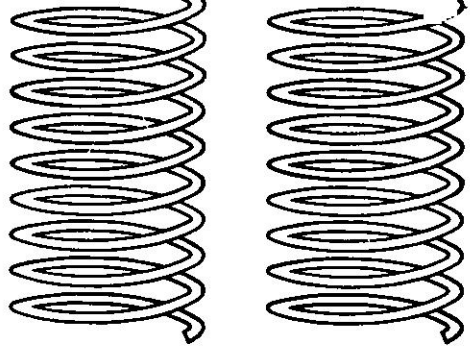
Intensive Cultivation

Because of the scarcity of leadership and trained manpower, it might be desirable to begin the "Intensive Cultivation Programme" by selecting a limited number of districts for special attention of the type needed to obtain large increases in output. Selection would be based on determination of the greatest potentialities for rapid increases in output with concentrated effort. The lessons learned in the "package programme" would be applied in these additional districts. If the needed supplies, and marketing and credit facilities, were available, and if outstanding district project directors were selected and adequate training given to the supporting staff, it should be possible to obtain very significant increases in the output of food grains in these districts over a five-year period.

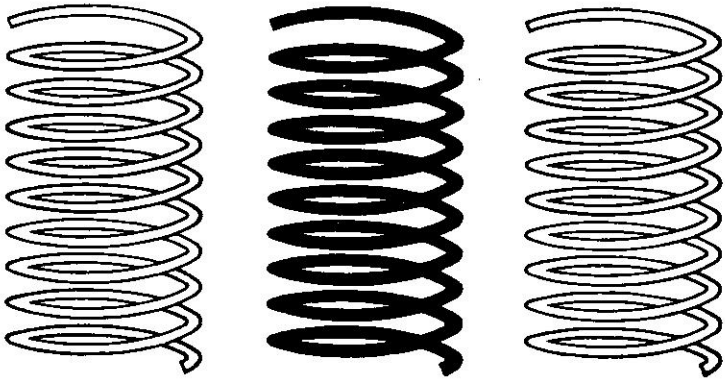
Adoption Centres

More districts would be added as soon as the requisite resources were available. "Adoption centres" might be established in the selected districts, where both professional agricultural workers and villagers could become familiar with new ways of farming. The increased output in these districts, together with some acceleration of output in other areas, would provide significant increases in food output in the Fourth Plan period.

But India must look beyond the Fourth Plan period to continuous increases in food production. This will require "research breakthroughs" on food grain varieties adapted to heavy fertilisation. Drainage and salinity control programmes also will have to be undertaken. And large-scale "adoption breakthroughs" will be necessary to achieve general adoption of improved technology along the lines pioneered in the Package Districts. Universal elementary education is necessary for continued improvement, and special emphasis is needed on the training of village-reared youth who are dedicated to assisting farm families in modernising their operations. An early beginning on these programmes is essential for the continued improvement of Indian agriculture.



WHICH ONE STANDS OUT ?



THE COVENTRY SPRING

BECAUSE OF ITS UNIQUE QUALITY

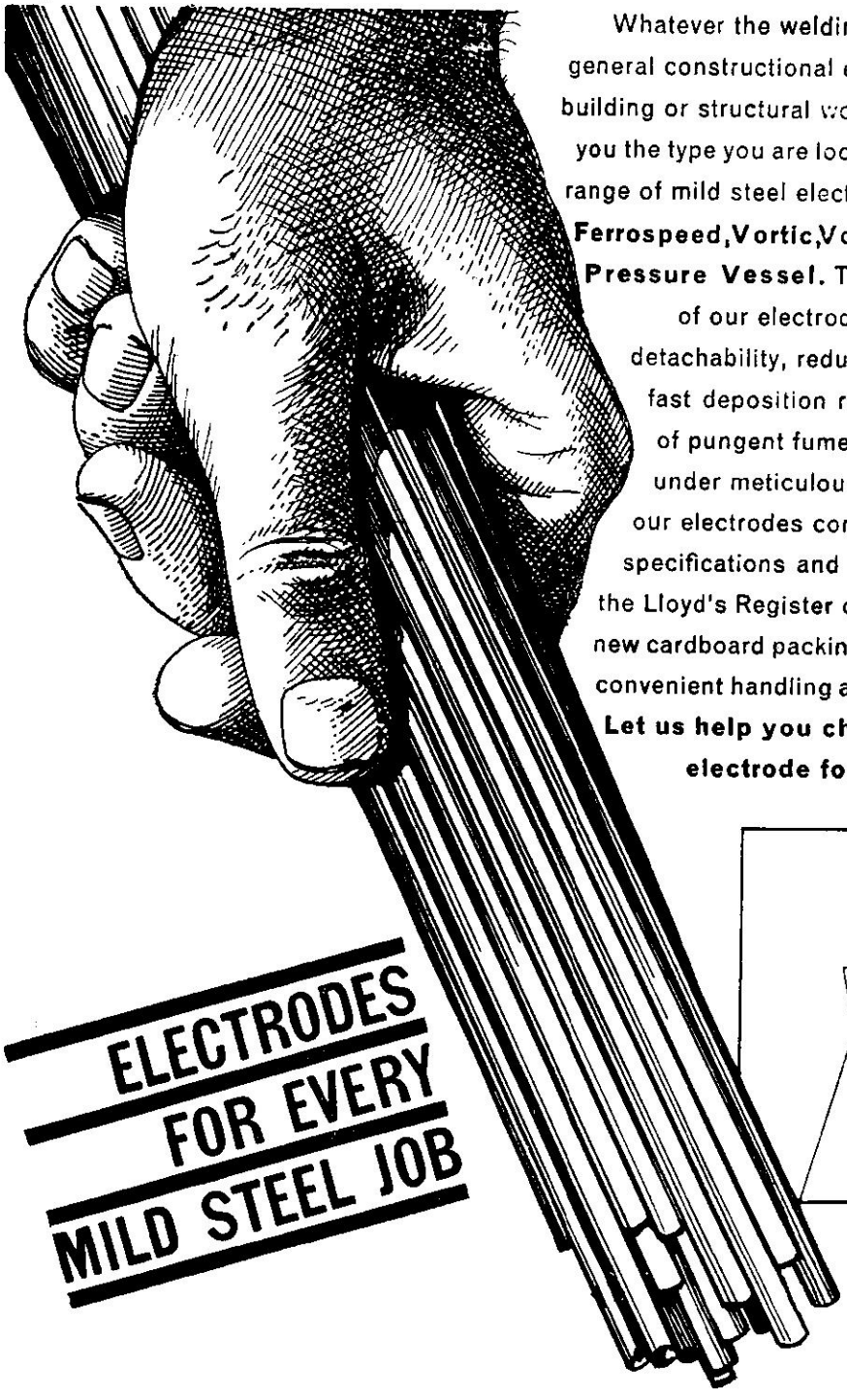
Here's why ? Engineering skill, backed by a rare combination of up-to-date equipment and ideas give Coventry's helical and laminated springs outstanding quality. Plus, the minutest quality checks guarantee a product really superior. Remember, Coventry is unique because of quality.

COVENTRY SPRING

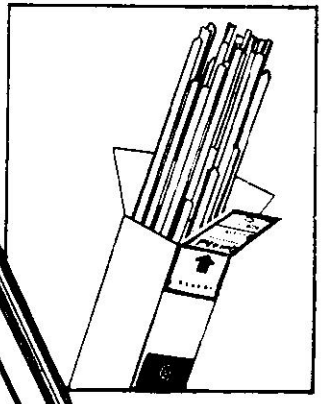
COVENTRY SPRING & ENGINEERING CO. (PRIVATE) LTD.

Spring Makers and Designers

23, Ganesh Chandra Avenue, Calcutta-13



Whatever the welding requirement—general constructional engineering, ship building or structural work—we can offer you the type you are looking for from our range of mild steel electrodes—**Radian, Ferrospeed, Vortic, Vordian, Ferron 5, Pressure Vessel.** The main features of our electrodes are easy slag detachability, reduced spatter loss, fast deposition rate and absence of pungent fumes. Manufactured under meticulous quality control, our electrodes conform to IS & BS specifications and are approved by the Lloyd's Register of Shipping. Our new cardboard packing is designed for convenient handling and easy storage. **Let us help you choose the right electrode for the right job.**



ELECTRODES FOR EVERY MILD STEEL JOB

IOC-106

For all welding enquiries please write to IOL INDIAN OXYGEN LIMITED

Everyone in the village knows the E.I.D.-Parry Fertiliser Salesman. They know that he is not merely a Salesman but an expert on modern farming and he is backed by E. I. D.-Parry's expert Field Advisory Service.

The Salesman visits the villages regularly, goes out into the fields, talks to his farmer friends and gives them advice on all agronomic matters and pest control problems so that they can get the best result from their land and more money at the end of the Harvest. His farmer friends have come to depend on him so much that today he is an integral part of the farming community.

E. I. D.-Parry Ltd., their Fertiliser and Pesticide Salesmen and their Distributors firmly believe that the best way to serve the country is by helping the farmers to increase their yield and thereby make available more food—for more food is the foremost problem of the day.

E.I.D.-PARRY LTD. Dare House, Madras-1.

Parry's
FIRST IN THE FIELD

This is the E.I.D.-Parry Fertiliser Salesman with his friends



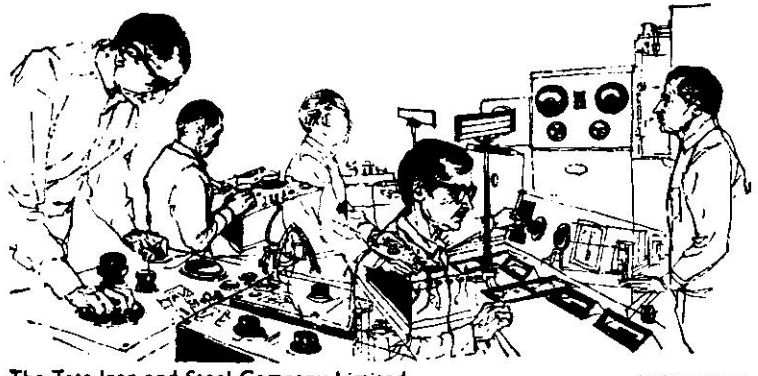
FDS-EID 498

Special steel for special tasks

In 1946, The Tata Iron and Steel Company started making dynamo grade electrical steel sheets on a commercial scale for the first time in India and are still the only manufacturers in the country. The indigenous production of these steel sheets, the basic raw material for the electrical industry, helped to bring about a phenomenal expansion of the fan and electric motor industries, and gave a fillip to the manufacture of switchgears, radio receivers, chokes for fluorescent lights, etc.

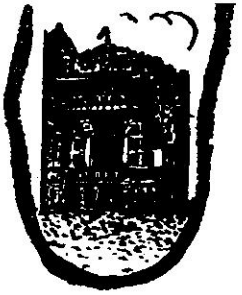
The manufacture of dynamo grade electrical steel sheets in India was made possible by the pioneering work done at the Research and Control Laboratories, Jamshedpur. Started in a small way in 1925, the Research and Control Laboratories today have three fully-equipped divisions —Chemical, Metallurgical and Refractories—where trained metallurgists carry on research on Indian steel-making materials, help meet operational problems and keep a check on the quality of the steel produced.

TATA STEEL

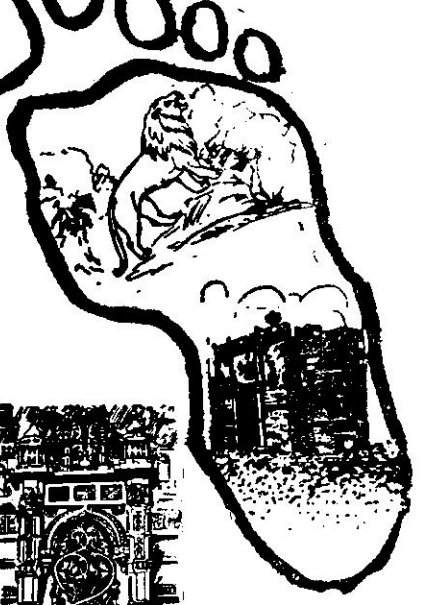


The Tata Iron and Steel Company Limited

JWTTN 2068A



as you tour india









visit

GUJARAT

It has a variety of sights as varied as human interest can be.

For those with a taste for architecture the monuments of Ahmedabad and the marble temples of Palitana are of novel interest.

Gujarat also prides itself in the Gir forest, the only natural preserve of the Asiatic lion. Visitors from abroad make it a point to admire the lion in its wild freedom - why don't you ?



Issued by:- **THE DIRECTOR OF INFORMATION**
Government of Gujarat, Sachivalaya, Ahmedabad

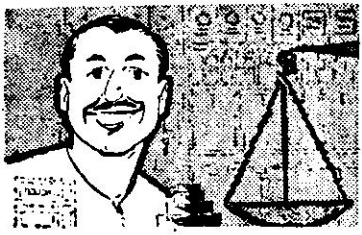
T-63/i

METRIC SYSTEM · THE ONLY LEGAL SYSTEM

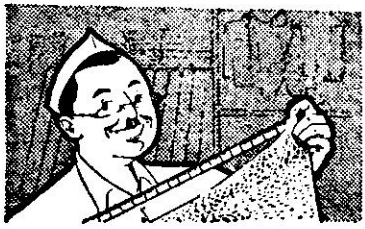
Metric System *is the only* Legal System

buy always in

Kilograms



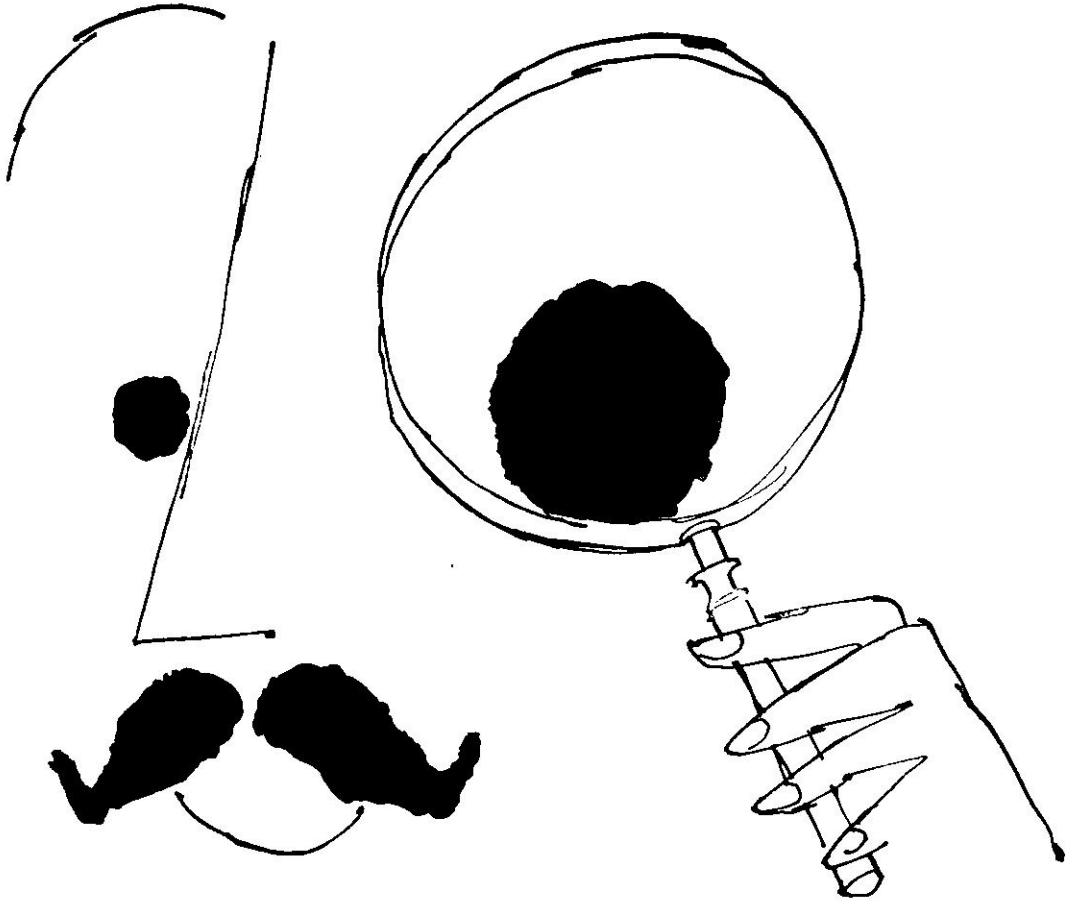
Metres



Litres



DA 64/676



In Leathers of India's Finest Tannage

Bata Ambassador is masculine, modern and in unmistakable good taste. It is correct in colour, pattern and model. Built over exclusive lasts to ensure perfect fit—
in lighter leathers of India's finest tannage.

Bata
AMBASSADOR



Style (54)

THE INDIAN IRON & STEEL CO., LTD.

WORKS : BURNPUR & KULTI (WEST BENGAL)

PRODUCTS :

Rolled Steel Products :— Blooms, Billets, Slabs, Rails, Structural Sections, Rounds, Squares, Flats, Black Sheets Galvanized Plain Sheets, Corrugated Sheets * Spun Iron Pipes, Vertically Cast Iron Pipes, Sand Stowing Pipes, Iron Castings, Steel Castings, Non-Ferrous Castings * Hard Coke, Ammonium Sulphate, Sulphuric Acid, Benzol Products.

IISCO

Managing Agents

MARTIN BURN LTD.

MARTIN BURN HOUSE, 12 MISSION ROW, CALCUTTA-1

Branches : NEW DELHI BOMBAY KANPUR PATNA

AGENTS IN SOUTH INDIA : THE SOUTH INDIAN EXPORT CO. LTD. MADRAS-1

IIC-89 A

ORION ULREY

Department of Agricultural Economics
Michigan State University

Rural Cooperatives Can Play a Major Role

The means for increasing farm output per acre, and per man, are legion. Orion Ulrey, an agricultural economist, proposes a combination of human and institutional factors to speed up the expansion of farm output now needed in India. The cooperatives have a great potential for developing and utilising the human, physical, and economic resources required to increase farm production and income. The author discusses two different schemes or patterns of cooperatives in rural development, both of which are now operating in India. He points out that the pattern evolved by the Kaira District Cooperative Producers' Union at Anand has "extensive potential application elsewhere."

I HAVE observed examples in India of both high and low farm output per acre and per man. A few examples are:

1. Two varieties of sweet potatoes, which were grown under traditional conditions by villagers near Ranchi in Bihar, yielded from 50 to 70 maunds per acre. When 242 pounds of plant food per acre were added and good practices were employed, the yield was 510 maunds which was equivalent in food energy, and even more in food nutrients, to yields of 125 maunds of rice.

2. The yield of **para** grass on 480 acres at the Aarey Milk Colony, near Bombay, was around 115 tons of green matter per acre, or about 15 tons of dry matter with a protein content of 16-18 per cent. I suspect that considerably more food, and much more nutrition, can be produced from forage, cows and milk

than by food crops, such as rice, on much of the land where water is available throughout the year.

3. The yield of rice was 50-60 maunds per acre where good technology was applied by villagers in Bihar, as compared with only 10-12 maunds per acre on similar land of their neighbours using traditional methods.

4. A small dam built near Ranchi in 1956-57 created a 150-acre lake with water adequate for all-year irrigation of 3,500 acres. Five years later the farm output had risen only 10-15 per cent as compared with a potential increase of at least 300-400 per cent.

5. A farm near Hazaribagh, with over 800 acres of improved land, had adopted excellent conservation practices, and constructed artificial lakes adequate to irrigate all the land. The output was less than one-fourth of the potential because of shortages of technical know-how and management.

These are only a few of my many score observations in India which suggest that the means for increasing her farm productivity per acre and per man are legion.

The productivity of land in parts of India seems to be very great when modern technology and management, including water control, are properly applied. The response from various inputs, individually and in combination, seems to be at least as high as in temperate zones. In addition, two or three crops a year are possible in India. This paper, however, is limited to an analysis which deals primarily with the villager as a human factor, the cooperative as an institutional factor, and the pattern of rural development—as a combination of inputs which has great potential for increasing farm productivity in India today.

The Community Development Scheme and Farm Production: The broad scheme of agricultural extension and community development (CD), which had been spread to all the blocks of the country by the end of 1964, has been designed to develop, mobilise, and utilise the resources to increase farm output by many methods. These include educating of officers and technicians providing of information to villagers on improved technology, and the supplying of inputs for farm use. The results have been disappointing as production has been expanding at only approximately the same rate as the population increase. Attempts are now being made under the intensive district programme to increase materially the use of improved technology and supplies. I hope the results will not be disappointing.

CD Programme

The CD programme has many merits and limitations some of which are listed here in order to explain the basis for the modifications proposed later in this paper. The **merits of CD** include:

1. Scope is nation-wide as it is designed to reach all villagers.
2. Expansion has been rapid since 1952; beginnings have been made in each of the 5,220 blocks of the nation.
3. Motivation and procedures employed are basically democratic.
4. The multiservice approach requires team operations among the block officers, and with village level workers.
5. Education and training of block officers and village level workers are emphasised.
6. CD is recognised as basic in the national five-year development plans.

The **shortcomings and difficulties** include:

1. Most block officers and village level workers are very inexperienced.
2. Restrictive official and operational

procedures and regulations often retard the programme.

3. Officers are frequently unwilling to admit their own shortcomings in skills, knowledge and judgment, and mistakes in action.

Training of Villagers

4. The attitudes and habits of the villagers are traditional and conservative.
5. There are frequent conflicts between the personal and social objectives on the part of both officers and villagers.
6. Educational and training procedures used by officers with villagers are often ineffective.
7. Participation of educated youth in the CD programme is seldom sought.
8. The training and use of villagers in the programme are not adequate.
9. The limited social and working relations among the traditional villagers who are members of caste groups, and consequently the infrequency of community cooperation, makes the job of the development officer very difficult.
10. The common policy of initiating development programme through the village leaders, when they are also the landlords and money-lenders, retards effective participation by the middle and lower income groups of villagers, who constitute the big majority of villagers.
11. Evaluation and participation processes are not adequately used.
12. The pace of the programme in reaching the villagers and obtaining their participation is too slow.
13. The present pattern of community development does not obtain the industry, the motivation, the integrity, and performance of officers which are possible and necessary in view of the emerging critical problems. In general, the programmes of community development in India are too slow considering the rapid expansion of population under way, the rising economic and social expectations which tend to exceed technical progress, and the inevitable political uncertainties raised by such conditions.

The programmes have not been satisfactory, especially from the block headquarters to the villagers. The latter have not been adequately used in demonstrating improved methods, in teaching their neighbours, and in developing and utilising the cooperative as an agency of rural development.

The present general scheme of CD should make much progress in five to 10 decades in completing the job of basic rural development. However, the issues and troubles which face India, today and in the near future, make it necessary that progress be maximised during this generation. I am referring to the general results from CD since I realise that the speed and quality of progress has been very creditable in certain areas. I believe that the speed of expansion of farm output is directly related to the efficiency in use of villagers, educated youth, and the cooperatives.

The actions and suggestions which are outlined below are derived largely

. . . Multi-approach is necessary in village programmes such as economic, education, health, government, agriculture, and small industry. Success in one phase tends to strengthen the work in another . . .

from my experience of four years in examining CD in the blocks and villages of India, and in discussing the operations and administration with scores of officers; and from my first-hand investigation of the operations and services in rural development of the Academy for Rural Development at Comilla, East Pakistan, the Moshavim cooperative system in Israel, and the general agricultural cooperatives of Yugoslavia.

Fundamentals and Principles for Rural Development: The following are fundamentals and principles which have proven sound in rural development projects, and should be further tested in CD in India, at the block and village levels.

1. **An area training and development centre** which also integrates the educational and economic services for villagers.
2. The **use of village cooperatives and other organisations** to provide groups to evaluate ideas, educate members, and initiate local projects; and to obtain information on procedures, projects, communication methods, etc., on rural development.
3. **Villagers as teachers of other villagers** selected by and from, and responsible to, the village organisation.
4. **Repetitive training of the villagers who serve as leaders and teachers,** perhaps once a week, month after month, until conditions suggest modifications.
5. **Multi-approach in village programmes** such as economic, education, health, government, agriculture, and small industry. Success in one phase tends to strengthen the work in another.
6. **Continuous evaluation and research** at the village level, especially on the economic, social, and human problems which may either stimulate or retard progress.
7. **Maximum autonomy, responsibility and flexibility in the area institutions** since considerable experimentation is necessary to assure development of effective procedures. Responsibility also brings motivation and innovations.
8. **Procedures which democratise human relations** and encourage group action.
9. **A constructive environment, system or pattern** which tends to build understanding, industry, integrity, motivation, and high performance on the part of both villagers and officers.
10. **Emphasis on the development of the human resources of the villages** which will make possible the more effective use of outside professional services, and of science and technology.
11. **Outside assistance in personnel, funds, supplies, and ideas** to help in finding the effective means for modernising traditional villages.

Improving Community Development at the Block and Village Levels (See paper, "Improving Community Development in India at the Block and Village Levels," by O Ulrey, **Agricultural Economics** 945, Mar. 10, 1964): The modifications of the CD programme to expedite rural progress in India include:

A. Establish CD block training and development centres: The CD block headquarters now contain facilities for the development of extension officers and their staffs, and also now provide many services needed by villagers. I would add facilities for a training centre for villagers, central cooperative for the block, a cooperative bank or a branch of one, and a demonstration and training farm.

The present staff of the block seems adequate to handle the training and development centre scheme, except for the addition of a social scientist who understands research and evaluation. The entire staff, and especially the block development officer and the cooperative officer, would need special preparation,

which would come partly from experience in the initial experimental centres.

The **training centre** would serve village leaders and technicians by providing training and assistance for co-operative organisers, managers, and accountants; farmer and women extension teachers and demonstrators; family planning promoters and teachers; midwives and village doctors; religious leaders; public works chairmen, research and evaluation fieldmen; officers of panchayats; skilled workers such as mechanics and tractor operators; and for other functional workers as needed in the villages.

The centre would also become an active segment of the CD block for planning of rural development projects involving cooperatives, agriculture, public works, education, etc.

In a training and development centre serving a block of perhaps 100 villages, the participation of village leaders should reach 300 per week in one year, 600 in two years, and 900 in three years—for the educational and service jobs to assist other villages. Such a participation should tend to maximise the speed of change in the traditional villages.

Research and evaluation should be an essential part of the training and development centre from the beginning to obtain information on the social, economic, and human factors which stimulate or impede local progress; to discover the attitudes towards, and the effects of, various techniques and projects; and to obtain the best facts for planning and programming.

The **significant contributions of the centre** would be:

1. They will make extensive use of the slumbering talents of the villagers in solving their family and local problems by furthering individual and group self-help. The initial villagers who participate actively in the programmes will be from the middle-income groups rather than those without resources, or those at the top of the village socio-economic structure.

Exchange of Ideas

2. Extensive use is to be made of cooperatives which are needed both for building the economic base of the rural society and for the rapid development of the people, partly by providing an exchange of ideas and mutual moral support of those willing to risk a trial of "the new."

3. The rural development projects will obtain the integrated use of the various existing agencies of education and development in training, extension, and research—at the village level.

4. The pattern emphasises both the development of human resources and the creation of physical and economic resources. Human development, especially in rural areas, is very important for maximising the use of science and technology, and consequently the farm and total rural output.

5. The activities of the centre will be focussed on young adults and out of school youth of the villages, who possess the energy and potential motivation to make effective use of the outside services.

B. **Develop village cooperatives:** The cooperatives which are to be developed must have certain features which are decidedly different from most of the quasi-cooperatives now existing in the villages of India. Consequently, some of the essential new features are outlined below.

1. The **village cooperative** is for playing a major role in transforming the traditional and subsistence village

economy into a progressive modern community. The multipurpose cooperative thus brings the small farmers together, and promotes joint action in the creation and use of storage facilities, marketing and buying, transportation of products and supplies, and the use of modern techniques and equipment. The objective is to develop efficient, successful, and independent village cooperatives which require a minimum of governmental assistance even during the initial period.

... If the village cooperatives are to play a significant role in rural development, they must operate under high standards ...

If the village cooperatives are to play a significant role in rural development, they must operate under high standards such as the following **organisation and operating practices,** which must be adopted by a given society before it is formally accepted by the central cooperative for the block.

1. Organise, elect officers, and later become registered.
2. Hold weekly meetings, with compulsory* membership attendance, and keep records.
3. Each member makes cash and in-kind savings regularly, regardless of how small the deposits may be.
4. Select a trusted member as the organiser and manager, who must attend regular meetings at the training and development centre.
5. Appoint a person to keep records, agree to have him trained at the training centre, and pay him to keep good accounts.
6. Do joint planning and engage in joint efforts.
7. Make joint use of supervised credit based on farm and village plans.
8. Adopt improved farming practices and skills, and use improved machines.
9. Join the central cooperative for credit, purchasing, marketing, training, and for educational materials.
10. Engage in membership discussions, and thus participate in policy-making for the total cooperative programme.

Adherence to these 10 points of policy requires considerable self and group discipline by the members which is necessary to establish confidence, efficiency and self-dependence—essential characteristics of successful village cooperative society.

The village cooperative groups evaluate ideas and proposals, promote and direct economic and educational projects; select and direct functional leaders who are trained by the training and development centres; and make use of the educational and development officers of the blocks who service their villages.

The cooperatives provide a better role for the village level workers (VLW). They would become primarily organisers and promoters rather than technical specialists. As the cooperatives become established, the VLWs would

* How do we make it compulsory?—**Editor.**

work extensively with such groups on rural development—would attend meetings, explain projects, and assist in the servicing of the cooperatives in their **halkas.** They would help in the planning and conduct of evaluation research studies. Their work would become increasingly effective as the cooperative groups in the villages gain experience and influence. To date, the VLWs have been handicapped by the shortage or lack of active village groups organised to expedite the various extension projects.

Credit and Capital

2. The **central cooperative** for the block provides many essential services in the organisation and operation of the village primary societies such as—a centre for training and education of the cooperative organisers; accountants and other service persons in the village cooperatives; a centre for the renting and servicing of farm and transportation equipment; a secure and workable plan and facilities for encouraging savings, for increasing capital for farming, and the wise use of credit; facilities and programmes for group storage, buying, and marketing; and assistance in conducting programmes of agricultural extension and demonstration in the villages.

3. A **cooperative bank** is needed to cooperate with the existing local and outside financial agencies to provide the credit and capital needed in the block area, and especially for the development projects. Initially, the cooperative bank may be necessary to provide the banking services for the central and primary cooperatives and the villagers with membership in local societies. There are some advantages in locating the central cooperative and the cooperative bank convenient to the development and training centre.

C. **Provide resources and assistance needed for the modified programme of CD blocks:** Extra finance and personnel will be needed in the programme of establishing training and development centres, and in developing cooperatives especially during the experimental period. The extra costs should soon be compensated by the larger output of farm and other products, and by village services resulting from the extensive participation of villagers in the development projects. These additional investment costs will be required eventually with the economic growth of the block area. In fact, under the modifications suggested, a larger share of the development and investment costs will be paid for by the villagers because of their increasing production. Some of the additional resources, services, and facilities required are:

1. Assistance from the administrative and technical officers at higher levels.
2. Financing of the new facilities needed for training, marketing, purchasing, and banking.
3. Assistance in research on and evaluation of the socio-economic-educational issues related to the projects in the block.
4. Funds for rural development as the villagers become prepared to make efficient use of investment funds.
5. Training of villagers for the skilled and technical jobs which will be needed.

Youth Corps Scheme

The colleges, universities, and many governmental agencies should be able to provide a variety of services to support and strengthen the block training and development centres. I would favour the location of the initial experimental training and development centres in blocks near the agricultural colleges and universities, and the placing of responsibilities with these educational institutions to service such centres.

A **youth corps group,** recruited for

assistance in the educational and social development of both rural and urban areas, could be effectively used on the projects of the CD centres and blocks. A training programme, for college and university youth of several months, would be necessary to provide the skills and motivation for effective work. Perhaps a period of constructive work should be one of the basic requirements for a degree from many of the college programmes. The youth corps scheme is comparable to that of the Peace Corps programme of the United States, and of youth work programmes of other countries—which have been received with high favour in the developing nations.

The Kaira District Cooperative Milk Producers' Union, an Agency for Increasing Farm Productivity: The Cooperative Union at Anand has been an effective agency for developing the dairy industry and the rural economy in Gujarat State since 1946 as will be shown in the following brief analysis.

History of the District Cooperative: The Cooperative Union was organised soon after the City of Bombay launched a plan in 1945 to remove the cows from the streets, and to obtain a regular supply of good quality milk from outside. The first shipments of milk to Bombay were made by the new Cooperative in 1948. In recent years milk has been shipped by rail in insulated tank cars to the Aarey Milk Colony, a Government-private project near Bombay, where milk has been pasteurised, bottled, and distributed to consumers during short periods twice daily through several hundred government milk stores.

The value of milk and products handled by the Cooperative grew from Rs. 7.4 million in 1955-56 to Rs. 60.3 million in 1963-64, or 820 per cent in eight years. The volume per villager increased from Rs. 321 to Rs. 918, the number of local societies rose from 64 to 378, and the number of farmer members grew from 22,800 to 65,000 during the same period.

As the membership and volume grew during the early 'fifties, the surplus milk also increased during the flush winter months. A modern receiving and manufacturing plant was opened in October 1955 to handle the winter surplus, and to produce canned butter, ghee, and milk powder. The plant was expanded in 1958 to manufacture sweetened condensed milk, and again in 1960 to produce baby foods and cheese. During 1962-63 about 55 per cent of the supply was used in manufactured products. The dairy plant facilities were again doubled in 1964.

First in India

The dairy plant was the first in India to manufacture milk powder, condensed milk and baby foods, and probably the first anywhere to dry, and also to produce cheese from buffalo milk.

Almost all of the original capital and much technical assistance for developing the facilities of the Cooperative Union came from a number of agencies including the Government of India, Bombay and later Gujarat State; the Government of New Zealand under the Colombo Plan; the United Nations Childrens' Fund and the Oxford Famine Relief Fund; and the US-AID Mission to India. The equity of the farmer-owners has been steadily increased by regular deductions from the milk payments and from the net operating margin. The equity of members apparently was around 47 per cent of the Rs. 31.3 million investment on Mar. 31, 1964.

Village cooperatives: The Cooperative Union organised local village societies to perform a variety of services including the collection and paying for milk, and the promotion of various educational and technical services. The member

owners of buffaloes purchase a Rs. 5 or Rs. 10 share of stock, and pay an entrance fee of Re. 1 in the village cooperative. Each local purchases a share of Rs. 100 in the Cooperative Union. The paid staff of three to six persons includes a secretary who weighs and grades the milk, a clerk who serves as a cashier, and a person who collects samples and checks the butter fat content of each delivery. The members receive payment of Rs. 2 to Rs. 4 a day for milk from the previous delivery.

The cans of milk from each village are picked up twice daily, soon after local collections. The price of milk is based on the butterfat content, and is the same for all distances. In order to discourage adulteration each delivery is tested. Each can of milk received by the Cooperative Union is graded into good and sour on the basis of smell. The latter commands a lower price. The Cooperative Union returns a patronage refund annually in cash to each village society. The locals use this refund and their net earnings for reserves and new buildings, cash refunds to dairymen, and for various social welfare activities such as schools, libraries, youth programmes, water supply, roads, clinics, and health centres.

Services for rural development in the District: The Cooperative Union has provided the facilities and organisation for the collecting and processing of milk, and the marketing of dairy products. Beyond this, the Cooperative has provided a variety of services which have stimulated and made possible many phases of the economic, educational, and social development of village life. The Cooperative Union has provided or assisted the locals with many significant services.

1. The **breeding programme** included two artificial breeding centres with 83 bulls in 1963, sub-centres in three-fourths of the villages, and also training of secretaries of locals to inseminate the buffaloes.

2. The **veterinary programme** consisted of 15 veterinarians and 55 supervisors and stockmen, five mobile dispensaries, and first aid veterinary centres in most of the locals in early 1964.

3. **Dairy production facilities in the villages:** Cement floors were provided for the buffaloes and diesel engines and pumps for the village tubewells. The latter provided sanitary water for villagers, and water for washing the buffaloes regularly and for irrigation of crops.

4. **Improvement of roads to villages:** The Cooperative Union purchased heavy earth-moving equipment which was used for levelling land, cleaning ditches, deep ploughing of heavy land, and also in building roads to villages so that milk could be picked up by trucks and tractors throughout the year.

5. **Collection stations in villages:** The building and equipment were planned and partly financed by the Cooperative Union. The original hand-operated butterfat testing equipment and the testing materials were provided by the Central.

Promotion of Feed Crops

6. The **feed improvement programme** includes the promotion of feed crops, both legumes and fodder; the handling of supplemental feeds, and the construction of a feed mixing plant early in 1964 to provide formula feeds.

7. **Development of markets for supplemental farm enterprises:** A lime juice factory was opened in 1962 to process juice to be sold in bulk. The price was increased from around Rs. 1.50 to Rs. 4 per maund. Plans were under way in early 1964 to provide a canning and bottling plant for fruit, a plant to obtain oil from the seeds and rinds,

and a plant to prepare banana dried milk.

8. **Assistance to villagers to obtain credit and insurance**: The Cooperative Union assisted the dairymen to obtain loans from the District Central Cooperative Bank, and an insurance scheme for cattle which was set up by the Union Cooperative Insurance Society. The veterinarians of the central cooperative certify the health of the buffaloes, and the secretaries of the locals serve as agents of the insurance business.

9. **Assistance in development of local industries**, such as village water works, the making of concrete poles and pipes and the establishment of factories to produce tiles and cables. These plants furnish products needed in the area, and jobs for surplus labour.

10. **Education and training of members and staff**: The field staff, consisting of a director and 20 supervisors in 1963, assist the villagers in operating and managing the dairy and other farm enterprises. A lady extension specialist assists the women and children, who normally care for the buffaloes, through educational meetings and observation trips. The employees of the locals are given technical training for their jobs.

11. **Local service institution for villagers:** The Cooperative Union and the village societies have provided financial assistance personnel and influence to develop schools, libraries, clinics, and youth centres.

12. **Other services of the cooperatives:** The operations of the Cooperative Union and the village cooperatives also have contributed in the development of the villagers and their institutions, and to the nation as follows: (a) By playing a leading role in changing the traditional habits and beliefs of villagers towards the acceptance of modern techniques and ideas; (b) By providing leadership experience and understanding by villagers of democratic practices and policies which are useful in other phases of rural life, e.g., participation in and the strengthening of local governments; (c) By actual demonstration of the benefits resulting from the application of modern science, technology, and management to conditions in rural India; (d) By training a technical and managerial staff which has been used to assist rural development elsewhere in Gujarat State and India, and abroad; (e) By raising the levels of business ethics and human relations, and the social consciousness of the villagers in the District through the operations of the cooperatives; and (f) By savings in foreign exchange on dairy products imported, which were estimated at Rs. 25 million in 1962-63.

Assistance given by the Cooperative Union: As pointed out above, the Cooperative Union has received financial and planning assistance from many agencies in developing the facilities and organisation of the cooperatives. The Union has taken a lead in determining a pattern of dairy and rural development which seems to be reproducible in other parts of India. Assistance given by the Union includes:

1. Erection of milk plants and formation of the cooperative structure at Ahmedabad, Rajkot, Baroda, Mehrana, Surat, and Baroch. These milk plants and the associated district milk producers' unions in Gujarat State, undoubtedly, will create a regional dairy federation which can provide other essential services such as plant inspection and quality control, uniform quality and brands, and central sales agency.

2. Consultation on milk plants for other states, providing a training centre at Anand for trainees from all over India on applied dairy technology, and on the operation and management of dairy plants and cooperatives.

3. Training centre for two batches of trainees annually from African and Asian countries under the FAO Programme.

Plans for expansion: In 1963, the

...Traditional villagers will rapidly respond to projects, services, and outside assistance when they are certain the objective is to improve their economic conditions and village life...

Cooperative Union initiated a seven-year plan, estimated to cost Rs. 38.5 million, to double the milk production per buffalo in the District. The plan includes programmes for animal breeding, nutrition, health and hygiene, livestock marketing, and extension education.

The reasons for the success of the cooperative dairy production, processing and marketing scheme, and the associated rural development in the Kaira District probably include: (1) Leadership and management which have been strongly motivated, deeply concerned and of superior ability from both the cooperatives and the governments. Engineers and dairy technologists played important roles in developing the services of the cooperative dairy plants. (2) Industrious villagers who owned and operated farms on land with considerable production potential. (3) Development around a product, milk, which provided a daily income to the farmers, about which the villagers had some production experience and know-how, and for which there was a high potential demand in available markets. Consequently the majority of the villagers could quickly participate in the cooperatives. (4) Outside assistance from the State and the Government of India, and from foreign development agencies, along with freedom in the management and operations of the dairy cooperative. The rural development pattern is an excellent example of the cooperation between governmental agencies and private enterprise. The government agencies provided finance, technical consultation, and regular encouragement. The cooperative leaders provided motivation, initiative, and management under conditions which permitted freedom and centred responsibility. (5) Important role played in social welfare and general development of villages—using a part of net returns to assist schools, libraries, health centres, youth activities, and to improve water supplies and roads—which served to win the loyalty and support of members and other villagers.

Final Observations: The changes suggested for improving the community development at the block and village levels place high emphasis upon the human factor, and upon the cooperative as an agency to develop and utilise the slumbering potential of the villager. The fundamentals and principles outlined in this pattern of rural development must eventually be adopted in many sections of India if increased farm output and the speed of rural progress are really to be maximised.

The pattern evolved in the Kaira District, largely through the organisation and service development of the Milk Producers' Union, has extensive potential application elsewhere. The programme of the Cooperative Union has clearly demonstrated that traditional villagers will rapidly respond to projects, services and outside assistance when they are certain the objective is to improve their economic conditions and village life. Specialised commodity cooperatives could take the lead in rural development in many other areas of the sub-continent.

Many of the present plans of rural development "place the cart before the horse." The patterns suggested above locate the horse in its proper place —or perhaps we should say "put the cooperatives in their proper place."

VERNON W RUTTAN

International Rice Research Institute
Manila

Output & Productivity Growth in S.-E Asian Agriculture

A pressing need to increase output per hectare exists in countries with a high density of population. Vernon W Ruttan, who refers to the demographic and other forces which will result in a rapid growth in the demand for farm output in most South-East Asian countries, presents an analysis to aid in devising a strategy for achieving production increases. He expresses the view that "the contribution of food economy to national economic growth will be greatest if the agricultural output growth is achieved through rapid increases in output per unit of land area, and through any moderate increases in capital inputs per unit of output."

DURING the next several decades demographic and economic forces will result in exceptionally rapid increases in the demand for agricultural output in South-East Asia.

Population in most countries of the region is now expanding at the rate of two to four per cent per year. In many countries of the region—Burma, India, Indonesia, Pakistan, for example—population growth rates are likely to reach even higher levels in the immediate future as birth rates remain high and death rates continue to decline. The demand for agricultural output generated by population growth is reinforced by the relatively high response of food consumption to rising per capita income levels in South-East Asia. At present income levels, a rise in per capita income of 10 per cent results in a rise of per capita food consumption of

about five to seven per cent in most of the countries of the region.

The rapid growth of population in urban areas imposes further demands on the food economy by increasing the proportion of total food production that is consumed outside the area where it is produced and must pass through wholesale and retail channels. Increased demand for foreign exchange adds to the pressure to expand agricultural production at a rate exceeding the rate of growth of domestic demand in order to achieve higher foreign exchange earning or to reduce the loss of foreign exchange for food imports.

The Objective

The total effect of these pressures is a growth in the demand for agricultural output of three to five per cent per year in most countries of South-East Asia. Failure to achieve such a rate of growth in agricultural output will inhibit the rate of national and regional economic development by increasing the price of food relative to the prices of other commodities and by diverting foreign exchange earnings to current consumption rather than investment. As the pace of total economic development in the region accelerates, the objective for the agricultural sector should be to achieve a rate of output growth sufficient to

(a) permit a reduction in the prices of agricultural raw materials and food products relative to the other prices in the domestic market;

(b) maintain or expand contributions of the agricultural sector to the nation's balance of trade; and

(c) release increasing numbers of workers for employment in the industrial, trade, and service sectors of the economy.

The contribution of food economy to national economic growth will be greatest if the agricultural output growth is achieved through rapid increases in output per unit of land area, and through only moderate increases in capital inputs per unit of output. Output increases achieved through higher land productivity—the introduction of higher yielding crop varieties, for example—or through practices which result in greater labour intensity—reduction in seasonal underemployment by double cropping, for example—typically require a smaller diversion of national capital formation into the agricultural sector than increases in output achieved by opening up new land areas or introduction of capital-intensive systems of farming. The increases in total and family income generated by such processes increase the ability of the agricultural sector to absorb the output of the expanding non-farm sector without imposing higher costs on the non-farm sector through rising raw materials and food prices.

An agricultural output growth rate of three to five per cent per year is high by almost any criterion. The annual rate of output growth in the United States has not exceeded three per cent for a sustained period since 1900. Only a few countries in South-East Asia have been able to achieve rates in this range since the period of rapid recovery in agricultural production immediately after World War II.

Research at IRRI

The general framework within which agricultural output and productivity growth can contribute to national economic development provides only minimal guidance for the specific agricultural research, education, and investment programme decisions that must be made by public agencies and individuals for individual countries, regions, and farms in South-East Asia.

These decisions must be made in the

context of particular physical environment, level of technology, and social organisation. They require information about the sources of output growth, including specific environmental, technological, and organisational trends and potentials. They require information about the relative productivity or efficiency of alternative modifications in the level of technology. They require information on the aggregate supply, demand, and input-output relationships which reflect the behaviour of regional, national, and international economic systems. And they require information on the processes involved in successfully introducing modifications in the level of technology or social organisation.

Sources of Output Growth

Information on past trends and the potential contribution of the several components of output growth can be usefully organised in a hierarchical format such as in Fig. 1. The solid lines indicate the dominant relationships. The dotted lines indicate some of the more important patterns of interaction. Fig. 1 should be regarded as an illustration rather than as a complete model.

Although changes at the higher levels of aggregation are functions of changes occurring at lower levels, most studies conducted within this framework focus on a relatively narrow range in the total sequence.[1 9 11 16]

The primary objective of this type of analysis is to aid in devising a strategy for achieving production increases. The evaluation of the relative importance of the potential contribution of each component is the first step in the development of a strategy to utilise efficiently scarce research and extension staff, capital equipment, and investment funds.

The approach outlined in this section does not provide sufficient information for rational agricultural development decisions. Information on the potential contribution to output growth resulting from "bottleneck" solutions or "breakthroughs" must be supplemented by information or judgments with respect to the resources required to make the "breakthroughs" and to support their application. An efficiency criterion is required.

Decisions with respect to the degree of emphasis that policy makers, farmers, and research workers should place on alternative means of achieving national, regional, and individual farm output growth or research objectives require information not only on the potential contribution of a particular growth factor or source, but also on the cost or effort required to achieve the output growth or research objective. This implies some measure of the productivity or efficiency of the particular activity—an evaluation of the output or product of the activity in relation to the total set of inputs or cost required to achieve the objective.

Although partial efficiency measures such as the yield per hectare, output per man-hour, or weight added per unit of feed, are frequently used, such measures tend to overstate the contribution of the particular input and ignore the contribution of associated inputs. An efficiency measure should be based on the change in output with respect to the change in the total set of inputs utilised to achieve the output growth.

At the experimental or farm level, this means measuring the value of the additional output and the additional costs associated with the introduction of new or improved inputs, such as a new rice variety or a new insecticide, or with the introduction of changed cultural practices or management systems. Analysis of this type is necessary if research results are to

be used as a basis for recommendations to farmers.[7 13]

Evaluation of Costs

At the project or regional level, this implies a careful evaluation of the costs and returns to alternative public investment activities in both the agricultural and non-agricultural sectors.[13] The productivity of capital investment in irrigation systems designed to permit double cropping of rice should, for example, be evaluated in relation to public investment in transportation and power. Choice among alternative project locations, designs, and management systems involves the application of both technical and economic criteria.

At the national level, the efficiency criterion implies an evaluation of agricultural investment or development activities in terms of changes in total productivity or output per unit of total input. For some problems, it is sufficient to focus on the efficiency with which the conventional inputs employed by the private sector—frequently summarised in terms of land, labour, capital equipment, buildings and current operating expenses[8 18]—are utilised. For other purposes, primary attention may be focussed on the use of inputs contributed by the public sector—expenditures on education, research and development, transportation, and others.[6 18] Such guides are essential if rational public investment decisions are to be made in the process of planning for national agricultural development.

. . . The return which a nation or a region receives on its investment in agricultural research and development is frequently influenced by its propensity to make investments, or to bring about institutional modifications, in other areas of activity . . .

Information with respect to research and development potentials and with respect to the efficiency of alternative research, development, and production activities must be coupled with an understanding of the behaviour of the economic system if useful projections of the effect of technological and institutional changes are to be made.[5]

Input-output relationships and also production functions, discussed under the previous two sub-headings, must be supplemented with information pertaining to (a) factor supply relationships, which describe the behaviour of the suppliers of inputs used in agriculture; (b) product demand relationships, which describe the behaviour of marketing agencies and consumers; and (c) the spatial dimensions of economic activity, including transportation systems and costs, climate, soil and other geographic variables, and the concentration and level of non-farm economic activity.[3 4 12]

The behaviour of the economic system described by such relationships may sharply modify utilisation of the results of agricultural research and development. Farm practices which are clearly profitable to the individual producer in a situation marked by mainly high paddy prices, high land

prices, high wage rates, and low fertiliser and capital equipment prices, as in Japan for example, are frequently not profitable in areas characterised by relatively low paddy prices, low land prices, low wage rates, and high fertiliser and capital equipment prices such as the rice exporting countries of South-East Asia.[13]

Differential rates of productivity growth which change the relative profitability of rice and commercial crop production or which permit traditional rice importing countries to become self-sufficient can have important repercussions on both internal price relationships and trade patterns among the nations of South-East Asia.[2 17] In the Philippines, for example, a gain in rice yields of one cavan per hectare per year over the next five years would probably be sufficient to eliminate the need for rice imports.

Development Processes

The rate at which technological change in agriculture modifies the behaviour and performance of the economic system in South-East Asia will be influenced by the rate at which other development processes are occurring throughout the region.[5 6 10 14 15 19]

The resort to relatively sophisticated production practices is frequently feasible only after the rural population has achieved a relatively high level of literacy and general education. The response to price incentives is frequently limited by inadequate rural adult education activities; poor transportation facilities; and failure to achieve political and administrative stability. The manner in which production costs and output are shared among operators, landlords, and labourers frequently modifies the incentives to adopt new technology. Innovations in household technology may be necessary to free a higher proportion of family labour time for field activities.

The effectiveness of local and national credit institutions influences the level of saving and rate of investment in rural areas. Limitations in the size of the market may result in imperfections in price determination which discourage efficient production. The level of development in the non-farm sector is frequently an important determinant of the price of farm labour and of the availability and price of the operating expense items (fertiliser, insecticides) and capital equipment that must be purchased from the non-farm sector.

The return which a nation or a region receives on its investment in agricultural research and development is frequently influenced, therefore, by its propensity to make investments, or to bring about institutional modifications, in other areas of activity. These investments or institutional changes may be consciously implemented, as in the case of the development of rural banking systems and land reform in some South-East Asian countries, or they may occur as the result of modifications of individual or firm behaviour patterns in response to the generalised set of technological, economic, and social forces acting on communities and individuals. The contrast between conscious social change and a less conscious evolutionary pattern is in part comparable to the contrast between the unplanned technological change facilitated by craftsmen and inventors in the past, and the kind of rational purposeful technological change resulting from investment in research institutions that has been adopted in most countries in recent years.

REFERENCES

1 BREIMYER, HF, "Sources of Our Increasing Food Supply", **Journal of Farm Economics,** Vol. 36, No. 2, May 1954, pp. 228-242.

2 BHAGWATI, J, "Immiserising Growth: A Geometrical Note", **Review of Economic Studies,** Vol. 25, June 1958.

3 FOX, KA, "The Study of Interactions Between Agriculture And The Non-Farm Economy: Local, Regional and National" **Journal of Farm Economics,** Vol. 44, No. 1, February 1962, pp. 1-34.

4 GOREUX, LM, "Economic Growth and Commodity Projections", **Monthly Bulletin of Agricultural Economics and Statistics** (FAO), Vol. 10, No. 718, July-August, 1961, pp. 1-17.

5 GEORGESCU-ROEGEN, N, "Economic Theory and Agrarian Economics", **Oxford Economic Papers,** Vol. 12, No. 1-3, Feb.-Oct. 1960, pp. 1-40.

6 GRILICHES, ZVI, "Research Costs and Social Returns: Hybrid Corn and Related Innovations", **Journal of Political Economy,** Vol. 66, No. 5, October 1958, pp. 419-431.

7 HEADY, EO, **Agricultural Production Functions,** Iowa State University Press, Ames, 1961.

8 HSIEH, SL and LEE, TH, **An Analytical Review of Agricultural Development in Taiwan: An Input-Output and Productivity Approach,** Chinese-American Joint Commission on Rural Reconstruction, Economic Digest Series, No. 12, Taipei Taiwan, July 1958.

9 JOHNSON, D and GUSTAFSON, RL, **Grain Yields and the American Food Supply,** University of Chicago Press, Chicago, 1962.

10 KATZ, ELIHU, HAMILTON, H and LEVIN, ML, "Traditions of Research on the Diffusion of Innovation," **American Sociological Review,** Vol. 28, No. 2, April 1963, pp. 237-252.

11 KRISHNA, RAJ, "A Note on the Elasticity of the Marketable Surplus of a Subsistence Crop", **Indian Journal of Agricultural Economics,** Vol. 17, No. 3, July-September 1962.

12 KRUTILLA, JV and OTTO ECKSTEIN, **Multiple Purpose River Development,** Johns Hopkins, Baltimore, 1958.

13 MELLOR, JW, "The Contrasting Response of Rice to Nitrogen: India and the United States", **Journal of Farm Economics** (forthcoming).

14 MOSHER, AT, **Interrelationships Between Agricultural Development, Social Organisation, and Personal Attitudes and Values,** New York State College of Agriculture, Comparative Extension Publication No. 12, Cornell University, June 1960.

15 OPPENFELD, HC, IGLESIA, JC STA., and LIBRERO, F, "Results of A Study of Adoption of Better Farm Practices in the Philippines", **Indian Journal of Agricultural Economics,** Vol. 17, No. 4, October-December 1962.

16 PADMANABHAN, SY, "Estimating Losses from Rice Blast Disease in India', Paper presented at a **Symposium on Rice Blast Disease,** IRRI, Los Banos, July 7-12, 1963. Also, KAZUO, GOTO, 'Estimating Losses from Rice Blast in Japan", Paper presented at a **Symposium on Rice Blast Disease,** IRRI, Los Banos, July 7-12, 1963.

17 PREBISH, RAUL, **The Economic Development of Latin America and Its Principal Problems,** Economic Commission for Latin America, United Nations Department of Economic Affairs, Lake Success, 1950.

18 RUTTAN, VW, "The Contribution of Technological Change to Farm Output, 1950-75", **Review of Economics and Statistics,** Vol. 38, No. 1, February 1956, pp. 61-69.

19 RUTTAN, VW, "Research on the Economics of Technological Change in American Agriculture", **Journal of Farm Economics,** Vol. 42, No. 4, November 1960, pp. 735-754.

IRRI Agricultural Economics Staff Publications and Reports

Reprints

RUTTAN, VW, "Land Reform and National Economic Development" in GP Sicat (ed), **The Philippine Economy** in the 1960's, University of the Philippines, Institute of Economic Development and Research, Diliman, 1964, pp. 92-119.

RUTTAN, VW, "Productivity Models of Economic Growth," **The Philippine Statistician** (October 1964).

EA SAXON

Senior Project Officer
Bureau of Agricultural Economics
Australia

Special Concepts of Productivity

Enumerating the several aspects or special concepts of productivity, the author discusses the extent of their application, and mentions the possible ways of achieving the goal of increased farm output. The general principles set out may need to be adapted in accordance with the prevailing conditions and the nature of the existing statistics. Attention is drawn to many of the difficulties and dangers likely to be encountered in any attempt to assess changes in agricultural productivity. Of special interest are the illustrations cited from experience in Australia, where, in recent years, there has been an increase in agricultural productivity.

THE YEARS since the end of World War II have been characterised by greater and more conscious efforts by the world's peoples to secure higher standards of living. Countries in various stages of economic development, and with widely differing political philosophies, are striving, each in its own way, to increase the welfare of their people. While some have been more successful than others, all realise that their goal can be reached only if they can achieve an increased command over goods and services, either by way of local production or by trade and exchange.

In this context of the world-wide drive for greater output, the word "productivity" is encouraged with increasing frequency. Unfortunately, however, the concepts to which this word is applied are many and varied, while the instances where those using it define clearly what they mean are all too few. One extreme of this looseness of expression is the not infrequent use of "productivity" to signify

"capacity to produce" or just merely "production."[1] It is clear that countries which are short of food, or other essential goods, should regard an advance in production as a worth-while achievement in itself. In fact, there are many instances where increased production must be a national goal, irrespective of other considerations. However, it is a fallacy to regard an increase in output of certain products (or even of all products taken together) as sufficient evidence of an increase in **productivity.**

A Physical Concept

Another example of loose thinking in this context is a tendency to regard increased profitability of a productive enterprise as evidence of higher productivity. While an improvement in productivity may often be expected to result in a corresponding improvement in profitability, it is not valid to assume that such a casual relationship would operate in reverse. Productivity is essentially a physical concept, where profitability involves, in addition, the notion of price. It will be readily appreciated that a farmer does not necessarily demonstrate increased productivity if he manages to increase his earnings during a famine!

Basically, productivity is a physical relationship between output and the inputs which give rise to that output.[2] Within the broad limits of definitions, (see References—2), there are several aspects or special concepts of productivity. These may be summarised thus: 1. Gross or net; 2. Total or partial; 3. Average or marginal.

1. Gross and net productivity: Gross productivity of agriculture is the ratio of total output to all inputs including intermediate products such as fertilisers, fuel, and other materials produced by non-rural industries. Net productivity is the ratio of the physical counterpart of value added by the processes of farm production to factor inputs only (i.e., labour and capital, including land). Thus intermediate products are excluded from both the numerator and the denominator of the productivity ratio.

The real product of an economy as a whole is in terms of final products only—the intermediate goods and services being netted out through a combination of the outputs and inputs of individual industries. However, industry output, including the output of agriculture, is frequently measured gross. In primitive agriculture, gross output is often very little more than value added, since off-farm inputs are small if non-economic inputs, such as rain, are ignored. In more highly developed agricultures, on the other hand, intermediate products may comprise half the total inputs, so that a measure of gross productivity may be influenced by trends in other industries as much as by those in agriculture itself. A table on page 125 of **The State of Food and Agriculture, 1963,** published by the Food and Agriculture Organisation of United Nations, reveals that purchases from non-agricultural sectors and abroad represented as much as 15 per cent of the gross agricultural output in the United Kingdom, compared with only 8 per cent in Greece and Spain.

In the less developed countries of Asia and Africa, the percentage would be even lower, and any difference between gross and net productivity would tend to be small. In general, it seems preferable to use the gross measurement, as this enables account to be taken of changes in the efficiency with which farmers combine purchased inputs with factor inputs—changes which cannot be ignored in any objective assessment of productivity trends.

2. Total and partial productivity: Total productivity is frequently used in the same sense as gross productivity discussed above, but it is possible to speak

of total net as well as of total gross productivity. The point of the distinction between total and partial productivity is that output is related in the first case to a combination of inputs (either including or excluding intermediate products), and in the second case to individual inputs separately.

The concept of total productivity is not difficult to state, but it is much more difficult to construct a suitable measure. The problems of measuring and aggregating farm outputs are often formidable, but the corresponding problems of aggregating farm inputs defy solution in many countries. For this reason, partial productivity ratios are often used to link output (either total or of specific products) with a single input (or group of inputs) associated with that output. These partial ratios can be very useful tools for analysis, provided those using them remember that they are partial, and do not treat them as though they faithfully reflect productivity in the more general sense. The best known partial productivity ratios are: (a) Productivity of labour; (b) productivity of capital; and (c) productivity of land.

... It is preferable to measure labour output in man-hours ... Since output per person is one of the major determinants of the general level of economic welfare in a country, labour productivity is a significant yardstick of economic progress ...

Similar ratios may also be calculated for intermediate products, either singly (e.g., for fertiliser) or as a group, but they will have very limited meaning in practice. These ratios are discussed in detail later in this article, and attention is drawn to the dangers of drawing conclusions from any one of them without due regard to the others.

Marginal Productivity

3. **Average & marginal productivity:** The total and partial productivity ratios just described refer to average productivity only. Marginal productivity generally refers to the change in output associated with a small change in one input, given that all other inputs are constant. It is also possible to calculate the marginal productivity of all inputs, assuming that these are applied in constant proportions.

It may be argued, with theoretical backing, that all marginal products should be looked at rather than average products.[3] However, marginal productivity calculations are dependent on the establishment of appropriate production functions, and this is possible only where reasonably comprehensive and reliable data on farm inputs are available. Inadequacy of data means that marginal productivities canot be calculated with a satisfactory degree of accuracy for the majority of countries. For this reason, only limited mention is made of marginal productivity in this paper. Comparisons of change in total output, with changes in one or more associated inputs between

two points of time, preserve something of the concept of marginal productivity in that the average productivity of some increment or decrement in inputs may be examined. Such comparisons are often more meaningful than average ratios calculated from total output and input data, although it is usually not possible to separate increases in production due and higher productivity from these due to changes in scale of operations which result from increased inputs.

The best known, and most useful, of these ratios is **labour productivity or output** per unit of associated labour. It is preferable to measure labour input in man-hours, but in the majority of cases the number of man-hours worked cannot be estimated with sufficient accuracy for this purpose. However, since hours customarily worked by farm people each year in most countries change only slowly over time, use of the number of persons in the farm labour force is generally an acceptable alternative for analysis covering periods of a few years only.

Since output per person is one of the major determinants of the general level of economic welfare in a country, "labour productivity is a significant yardstick of economic progress."[4] It is also significant in relation to wage rates, income distribution, and occupational distribution of the labour force. Further, in countries at an early stage of economic development, labour is by far the dominant input, so that trends in labour productivity may give a reasonable indication of overall productivity trends. However, if there is any substitution of other inputs for labour over time, or if the quality of labour increases as a result of training, better nutrition, or other causes, labour productivity will contain an upward bias which must be allowed for if labour productivity is to be used as an indicator of total productivity.

Productivity of capital is really a useful ratio for some purposes, although statistics of capital used in agriculture are too scanty in most countries to enable satisfactory ratios to be calculated. A further problem is the fact that definitions of farm capital are by no means uniform, so that care must be taken in using ratios purporting to measure "productivity of capital". Some writers include in their concept of "capital" all inputs other than labour, and real estate, while others include land together with all the means of production other than labour and intermediate products.[5]

The concept of capital favoured in this article includes livestock, land improvements, machinery and equipment, but excludes land, working capital, and public investment in the rural infra-structure (e.g., in roads, research, education and public utilities, all of which may make an important contribution to output). A significant portion of farm capital, especially in the less developed countries, comprises non-monetary investment resulting from years of labour by the farmers themselves (e.g., terraces, irrigation channels, buildings). While these should conceptually be included as capital, it is often impossible to do so adequately, so that the precise concept of capital used is usually determined by availability of data.

Diverse Trends

In countries where farm capital is being rapidly expanded, the apparent productivity of capital may fall. This does not necessarily mean that investment is unprofitable; it may merely indicate a change in basic production functions wherein capital is substituted for other factors, or where the contribution of capital relative to other factors in the production process is increased. Thus capital may be substituted for labour, producing an apparent downward trend in the productivity of capital, and an

upward trend in that of labour without any change in total productivity. In such an event, the diverse trends are merely two results of the same cause, and in the absence of further information, neither will tell anything meaningful about changes in the productivity of agriculture.

Productivity of land is a further partial ratio sometimes used to compare "productivity" between countries and regions, or within countries over time. Its appeal lies mainly in the fact that reasonably complete data on land use are available in most countries, and that the total area of agricultural land does not change much over time, especially in the "older" countries.

Three Difficulties

In countries with a high density of population, there is often a pressing national need to increase output per hectare. This is often expressed as a need to increase "productivity." Sometimes yields may be increased—perhaps substantially —by improvements in methods of cultivation and conservation, better seeds, reduction of waste, and other techniques involving changes in ways in which inputs are used, rather than changes in the volume of inputs. Such increases may well represent a true increase in productivity, but the notable increases in yields which have been achieved in some countries (e.g., Japan and the Netherlands) do not necessarily represent increases in productivity of land itself; they are almost always a result of increases or changes in the quality of other factors applied to land, so that what is observed is derived productivity rather than the inherent productivity of land. In fact, a stage may well be reached when increases in output per hectare are possible only at the cost of a more than proportional increase in inputs, resulting in a lower total productivity.

There are three further difficulties in measuring the productivity of land.

(a) Land is not homogeneous, and some areas are inherently capable of greater production than others, given that other inputs are the same.

(b) It is difficult to separate land from improvements such as clearing, drainage, and irrigation channels which are more appropriately treated as capital. This particular problem has led many writers to include land as part of capital.

(c) Output per hectare in physical terms can be increased by changing the pattern of production in favour of those products which produce the highest yields. While this may give an increase in the physical ratio of output to land or even of output to all resources combined, this increase has no economic significance unless the products are what are needed, and actually add sufficiently to the total satisfaction of human wants in the country concerned.

Rather similar arguments can be applied to livestock units (e.g., increased milk per cow is not by itself a proof of increased productivity). This leads to the conclusion that land and livestock units themselves are generally only minor variables in the overall production functions which explain agricultural output.

Common Feature

The common feature of these partial productivity ratios is that they each relate **total** output to something less than the total of associated inputs. This may lead users of such ratios to attribute all changes in the total output solely to changes in the input under examination. This would be valid if it were known that all other factors had remained unchanged, but this is rarely the case in practice.

As a result of changes in technology,

... Countries chronically short of farm products may need to provide their farmers with the means and incentives to produce more from a given land area even where this is only possible with substantial increase in inputs other than land...

in the relative cost of inputs and in "know how" among farmers, substitutions between inputs are continually taking place. The substitution of capital for labour has already been mentioned. Capital may also be substituted for land in the sense that capital works may enable a farmer to produce more from a given area. Again purchased inputs may be substituted for land, labour, or sometimes capital (e.g., fertiliser for land, chemical weedicides for labour).

"Partial productivity ratio, while useful to measure the saving in particular inputs achieved over time, do not measure overall changes in productive efficiency, since they are affected by changes in the composition of inputs."[6] However, if appropriate ratios can be calculated for all major inputs, these can be combined into a meaningful ratio for total productivity (either gross or net) by taking a weighted average, using weights reflecting the relative importance of each input. This assumes, of course, that appropriate weights can be determined. Alternatively, output and inputs can be totalled separately, and ratios for total productivity obtained. This again requires the use of appropriate weights to enable the various unlike components of output and input to be combined. It is theoretically desirable to weight outputs by product prices at factor cost, and to weight inputs by factor price. However, in practice, market prices are in many cases the best approximation available. .

Calculations of Changes

To compare total productivity in a given year with that in a selected base year, the following particulars are needed:

(a) prices for all outputs and inputs in the base year;

(b) volume of each output and input item, in the base and given years.

Calculations of changes in productivity are based on the equality of total output and total input in the base year. If factor prices and costs are used, this equality is established by definition. If prices are used such that there is a difference between the estimated values of output and input, this difference must be included as part of the payment for one of the input factors (e.g., as reward for management), and held constant over the years of the comparison. The sum of the various inputs in a given year, weighted by base year prices, gives a measure of what these

resources would have produced, had technical and other conditions of efficiency remained unchanged. By dividing this into actual output valued at base year prices, it is possible to assess changes in the efficiency with which the factors are utilised in the process of production, i.e., changes in productivity.

This procedure brings the user up against the familiar index number problem, since the relative importance of outputs (whether judged by value or otherwise) does not remain constant. The resultant bias may be reduced by taking account of given year prices as well as base year prices in calculating weights. "But it should be borne in mind that proportionate changes in productivity cannot be measured uniquely, and the changes... are, to some extent, a function of the weighting conventions used."[7]

Changes in productivity measured in this way incorporate the results of changes in scale as well as innovations affecting the technical efficiency with which inputs are combined in the production process. In its narrower sense, productivity is concerned only with changes in production resulting from the more efficient utilisation of a fixed quantum of inputs. Any increase in production resulting from an increase in inputs is a scale effect, not a change in productivity. In practice, changes in scale and productivity are so interwoven that it is usually not possible to separate them, but it is well to remember that while economies of scale may be essential to enable an industry to be competitive, such economies are not synonymous with increased productivity in a rigidly defined sense.

Application of Concepts

From the foregoing it will be obvious that there is no unique definition of agricultural productivity satisfactory for all purposes. There are various ways in which the term may legitimately be used, so that there is always a need for its use to be accompanied by a precise definition.

It follows from what has been said above that if increased production is a national aim, an increase in "pure" productivity is not the only way in which this aim can be achieved. Countries chronically short of farm products may need to provide their farmers with the means and incentives to produce more from a given land area even where this is only possible with substantial increase in inputs other than land. In fact, in some circumstances, production per hectare can and must be increased at the cost of possible decline in total productivity in agriculture. However, even in such extreme instances, there is usually a net gain in total national welfare.

Means to Achieve Goal

In summary, then, possible means of achieving the goal of increased farm output include:

(a) an increase in scale (i.e., in volume of inputs);

(b) substitution of more productive for less productive inputs (or an increase in quality of inputs);

(c) an increase in the efficiency of utilisation of resources (productivity proper);

(d) changes in composition of output resulting in a greater total output from a given quantum of inputs (opinions differ as to whether this may validly be considered as increased productivity);

(e) the influence of more favourable weather and also other random variables.

In analysing productivity changes in any particular situation, the general principles stated here may need to be adapted

in accordance with existing conditions, and the nature of the existing statistics. In other words, a study of productivity will usually require a compromise between aims and available means, and no hard and fast rules can be laid down on procedures. It is important, however, to be clear on principles and concepts.

Australian Experience

Many of the problems of definition and paucity of data referred to above have been encountered by the author in a rather modest and incomplete attempt to assess the extent of any recent increase in agricultural productivity in Australia. It was clear enough that Australian rural production had increased in relation to labour employed, but it was also well known that the amount of capital and the volume of intermediate products used in rural industries had also increased considerably. It could be safely said that since 1939 a declining number of persons employed, supported by increased machinery and other capital equipment, and using greater quantities of fertiliser and other off-farm inputs, had succeeded in producing a substantially increased total output from a virtually unchanged land base. However, it was not possible to deduce from this the extent of any increase in total productivity.

In order to attempt an analysis of productivity, it was necessary first to examine the statistical data which were available and relevant to the problem. These comprise:

(a) A base-weight aggregative index of the quantum of farm production (Base : Average 1936-37 to 1938-39 =100).

(b) Census data for rural employment, supplemented by some statistics of persons working on rural holdings on March 31 each year.

(c) Annual or triennial statistics for some of the important machinery and equipment on farms (e.g., tractors, ploughs, harvesters).

(d) Area of land used for crops, improved pasture, and other purposes.

(e) Annual particulars of livestock numbers.

(f) Annual statistics of fertiliser sales and usage.

Besides the above details collected by the Commonwealth Statistician from all farms, sample surveys conducted by the Bureau of Agricultural Economics, State Departments of Agriculture, and some other bodies provide supplementary information on farmers' use of capital and off-farm inputs.

Using these statistics, it was possible to compare changes in output with changes in labour and some capital items (including land and livestock). However, since statistics relating to capital and off-farm inputs in Australia are far from complete, quite an amount of estimation was necessary.

From published statistics and various

... It is far better to supplement available statistics with reasoned estimates in order to relate output to total inputs than to ... accept increased output alone, or output per person as sufficient evidence of the increased productivity which every country is striving to achieve ...

estimates made or collated by the author, several series of index numbers relating to Australian farm output and the associated inputs were constructed. These, in turn, were used to calculate a set of total and partial productivity ratios. The relevant series of figures from 1949-50 to 1963-64 are set out in Table I.

TABLE I

Estimated Changes in Output, Inputs and Productivity in Australian Rural Industries

(Index Number-Base: Average 1936-37 to 1938-39 = 100)

		INPUT INDEXES OF			PRODUCTIVITY INDEXES OF		
	Output*	**Labour**	**Capital**	**All Inputs*****	**Labour**	**Capital**	**All Inputs**
1949-50	111	91	115	114	122	97	97
1950-51	109	92	125	115	118	87	95
1951-52	111	91	130	128	122	85	87
1952-53	115	90	130	128	128	88	90
1953-54	122	90	140	133	136	87	92
1954-55	125	89	145	134	140	86	93
1955-56	128	88	154	135	145	83	95
1956-57	129	87	163	137	148	79	94
1957-58	135	86	170	139	157	79	97
1958-59	139	85	175	140	164	79	99
1959-60	149	84	185	144	177	81	103
1960-61	151	82	190	142	184	79	106
1961-62	159	82	190	143	194	84	111
1962-63	165	81	195	143	204	85	115
1963-64	174**	80	200	144	218	87	121

* Three-year moving average centred on given year
** Single year only
*** Derived as a weighted average of labour, capital and intermediate products

It will be seen that since labour employed in farming tended downward while output increased, the partial productivity ratio for labour approximately doubled over the period. On the other hand, capital employed on farms increased more rapidly than output, reflecting a substantial substitution of capital for labour following World War II. Consequently, the partial productivity ratio for capital showed a decline, especially in 1950s.

It must be emphasised that index numbers for farm capital are based on approximate data only, while changes in off-farm inputs were very difficult to estimate. As a result, the index numbers for all inputs are subject to an unknown margin of error. Subject to these qualifications, it appears that while partial productivity ratios for labour and capital have moved in opposite directions, gross productivity, after declining in the early 1950s is now about 20 per cent higher than in the immediate pre-war years. Net productivity would show a somewhat greater increase, since it is calculated after deducting off-farm inputs from both numerator and denominator of the gross productivity ratio.

This, on the face of it, indicates that there has been an increase in agricultural productivity in Australia in recent years. However, it must be remembered that there have also been considerable increases in scale (i.e., total inputs have increased), and more than the average number of favourable seasons, both of which have given a strong upward bias to apparent productivity. Some idea of the combined marginal effects of increases in scale and in total productivity is given by a coefficient obtained by calculating the regression of output on total inputs from 1948 to 1964. This shows that, over this period, each increase of one per cent in inputs was associated with an increase of approximately 1.4 per cent in output.

It is hoped that this article will have

drawn attention to many of the dangers and difficulties likely to be encountered in any attempt to assess changes in agricultural productivity. It is not intended by this to discourage research workers from attempting productivity analysis, but rather to suggest that careful definition of concepts and logical development of methods of approach will be well rewarded by the more meaningful results which will be obtained. Lack of data will always be a stumbling block, but it is far better to supplement available statistics with reasoned estimates in order to relate output to total inputs than to take the easy way out and simply accept increased output alone, or output per person as sufficient evidence of the increased productivity which every country is striving to achieve. This latter course may well amount to self-delusion, and fail to reveal the location of reparable weaknesses in the agricultural economy.

REFERENCES

1. For instance, a Staff Correspondent of the **Australian Financial Review** wrote in the issue of Dec. 1, 1964: "Fertiliser application and other investment improvements should increase farm productivity . . ."
2. Some authoritative definitions, differing slightly in detail and emphasis, are: A. "The term productivity is generally used rather broadly to denote the ratio of output to any or all associated inputs in real terms." (JW Kendrick, **Productivity Trends in the United States,** 1961, p. 6. The opening sentence of Kendrick's book reads "The story of productivity, the ratio of output to input, is at the heart of man's efforts to raise himself from poverty.") B. "Productivity is the relationship in physical quantities between input and output" (OECD: **Concepts of Productivity Measurement in Agriculture,** 1961, p. 9). C. "Productivity is a measure of the efficiency with which resources are converted into the commodities and services that men want" (S Fabricant, **Basic Facts on Productivity Change,** Occasional Paper No. 63, NBER, USA). These definitions are quite general, and although in this article the concepts are applied only to agriculture, they may equally well be applied to other industries.
3. See publication of National Bureau of Economic Research—**Output, Input and Productivity Measurement,** 1961. GJ Stigler says, on page 48, "So far as I know, not a single theoretical statement of any importance can be made about the average products of factors."
4. **The State of Food and Agriculture, 1963,** p. 98, published by FAO.
5. LOOMIS and BARTON, **Productivity of Agriculture,** USDA, 1961, p. 11.
6. KENDRICK, JW, **Productivity Trends in the United States,** 1961, p. 6.
7. **op. cit.,** p. 10.

Control of Weed

The control of weed in rice fields has been engaging the attention of agricultural experts in many countries. The International Rice Research Institute in the Philippines has been conducting research on this aspect, and has now developed a herbicide which will meet this very threat.

Testing of this under a variety of conditions is under way, according to a report in **The Financial Express.**

DH BUTANI

National Productivity Council

Application of Productivity Techniques

Characterising Indian agriculture today as "a sink of medieval techniques and ideas", this paper indicates the areas in which, and the techniques by which, a substantial beginning can be made in the application of productivity techniques to agriculture. The main cause of low productivity in agriculture, according to the author, is that men of enterprise and capital and education have been running away from the land. This current must be reversed, if we are to achieve anything in the field. The author makes a powerful plea for the introduction of Work Study in agriculture.

HISTORICALLY, the revolution in agriculture preceded the revolution in industry. Even now the application of productivity techniques to agriculture in the USA and the UK in terms of mechanisation, rationalisation, streamlining of operations, layouts, etc., is more thorough-going than even in some of the traditional industries of these countries. Agriculture, in these countries, is highly capital-intensive, and because population has been moving out of the rural areas on a very large scale, there is almost a compulsion to economise labour. Further, agriculture being thoroughly commercialised, there is almost a hair-splitting sense of cost consciousness. The cost, for example, of the various alternative feeds are meticulously calculated and measured in terms of additional meat, milk, etc.

It is obvious that in our country we are quite far from the position at which

large-scale application of productivity techniques can be made in the field of agriculture. While industry has made considerable headway since Independence, our agriculture remains, despite Community Development and Package Programmes, a sink of medieval techniques and ideas. Nevertheless, a beginning has to be made; and this paper is concerned with the areas in which, and the techniques by which, a substantial beginning can be made.

Agriculture, as we understand it in India, is really a series of industries, which, at the periphery, touches regular industry in a number of important ways. In fact, there is a two-way communication between agriculture and industry, because important inputs, such as implements, fertilisers, and pesticides, are manufactured by industry for consumption in agriculture. On the other hand, agriculture supplies the raw materials for industry, such as oilseeds, cotton, jute, and sugarcane. Even food grains are processed by industry through rice mills, wheat flour mills, etc.

It is at the peripheral strategic, confluence of industry and agriculture that the application of productivity techniques may begin. Sociologically also, this appears to be a sound proposition. As the contacts between industry and agriculture grow, productivity techniques will begin to pass from industry into agriculture, even as a matter of sheer community of interests. The Hindustan Lever case, so ably reported by its Chairman in this issue of the Journal, shows how the company is actually feeding farmers with techniques and supplies, and teaching them how to use them, to increase the per acre yield of the commodities in which the company is interested.

Sociologically, the position is really difficult. The main hurdle in the way of application of productivity techniques to agriculture arises from the fact that men of enterprise, money, talent, do not like to go and work on the land; in fact, men of enterprise and capital are running away from the land because industry offers opportunities which agriculture does not. Even agricultural graduates, extension workers, do not like to go to the rural areas.

We have to consider the basic fact that productivity techniques will not get into agriculture from the air but through the agency of enterprising men, both from the private sector as also from the Government. If we really desire a major breakthrough in the application of productivity techniques into agriculture, we must devise policies that bring enterprise to the land. We must give incentives to enterprising agriculturists and agricultural officers to come and work on the land, and make it worthwhile for them to do so.

Education

The second important sociological factor in the application of productivity techniques is education, both general and technical, including agricultural. Agriculture is the major industry of this country, contributing over 50 per cent to the national income. Eighty per cent of the people live in the rural areas. Yet their share in general and technical education is much smaller than these statistics indicate. Agriculture also does not get its due share of technical personnel. It is through these technical personnel that productivity techniques will come to agriculture. It should be a matter of policy to reserve a large part of technical manpower for agriculture.

This reservation, however, is not sufficient. Some incentives must be offered to these technical officers, as we offer special allowances to those who work in the hill or the tribal areas.

Further, we must try to develop

...Work Study is the parent of all productivity techniques... It is nothing but trained commonsense. Unless in its simplest form, it enters into the general consciousness of the agricultural people, hardly a beginning can be made in the application of other productivity techniques...

special personnel for agriculture through rural polytechnics. Rural polytechnics will serve a number of purposes. They will create an atmosphere in the countryside which will progressively help the rural people to industrialise agriculture and the rural crafts, for it must be said, in the clearest possible language, that the application of productivity techniques in agriculture frankly means the industrialisation of agriculture, with all that it implies in terms of rationalisation, mechanisation, cost consciousness, etc.

Materials Handling

These rural polytechnics will train the young agriculturists to work on the land with improved implements which they can handle, repair, and even make. Both in the UK and the USA, a tremendous amount of local research has gone into the making of farm implements. If we want to attain their levels of agricultural productivity, we have to train the rural people to work out their destiny, the same way. Ultimately, these rural polytechnics will furnish the productivity personnel that agriculture needs on a large scale.

Reverting to the application of productivity techniques to the industries touching agriculture at the periphery, we may here give a rough idea as to what it would mean in terms of techniques. The first technique that we can introduce readily is materials handling.

There is both ways a great amount of materials handling to and from the farm. Materials handling from the farm to the rice mills, the flour mills, the cotton and ginning mills, and the oil mills, can be organised with modern techniques from the industrial side itself; and these industries, particularly rice milling, can adopt techniques that lead to reduction of wastage in handling, processing, etc. The Fertiliser Corporation, the Foodgrains Corporation, and the Warehousing Corporation can also help in introducing modern techniques of materials handling. The industries that manufacture agricultural implements can also teach farmers how to use them. Some of them are already going that way as evidenced by the advertisements that now frequently appear in newspapers regarding tools and even cattle feeds.

Probably, what really needs a shakeup is the Government organisation in the rural areas. The actual fact is that

Government farms are only a solitary oasis in a vast desert. Some of the farms are pretty well kept, and are ideal from many points of view, but, socially and economically, they are really cut off from the surrounding areas.

Work Study

It is a fact worth recording that hardly any Work Study has been made of the many farms, big and small, that exist throughout the country. Since Work Study is the parent of all Productivity techniques, the first thing that we in NPC might do, is to help Government farms organise their own work study. Once the application of this technique reaches some level, the farmers of the surrounding areas could be invited for some sort of an appreciation course: for sociological studies of Indian farmers have established that Indian farmers are men of sound commonsense; and Work Study is nothing but trained commonsense. Unless Work Study, in its simplest form, enters into the general consciousness of the agricultural people, hardly a beginning can be made in the application of all the other productivity techniques.

In this context, attention may be drawn to the officially announced programme of the Union Ministry of Food and Agriculture which presented a document to Parliament in April 1961 stating the broad objective of the Government as doubling of agricultural output over the 15 years ending 1976. Probably, the idea is to increase in proportion, or more than in proportion, the inputs in terms of improved seeds, improved implements, fertilisers and pesticides, plus irrigation water, and the like. It needs to be recorded in the most emphatic manner that unless productivity is put in the application of all these inputs, we shall be as far from the targets or from a reasonably satisfactory state of affairs, as we are at the moment. The country has during the last 14 to 15 years invested a sum of Rs. 30,000 million in these various inputs, and in carrying these inputs to the field of agriculture. Yet, except in years of favourable weather, the country has had a rather difficult time. Productivity is the solution, and NPC is willing and anxious to help.

Work Study Leads to Rise in Farm Output in UK

The problem facing British farming is to produce more cheaply, and more efficiently, while maintaining and even improving quality. Work Study techniques have been applied successfully, and they have helped to improve methods of farming operation. The results of Work Study at the commercial growing section of Plant Protection Ltd., Fernhurst, Sussex—a subsidiary company of Imperial Chemical Industries—are better planning, costing and use of manpower, improved crops, reduction in hours and labour costs, with earnings more than doubled and the work made easier.

AV BHULESHKAR

Worcester College
Oxford

Productivity and Technical Change: A Theoretical Analysis

Dealing with the problem of productivity in agriculture, the writer discusses the many institutional and structural factors affecting it, the effects of continuous technical change in productive processes, the complex and controversial problem of measurement—there are as many productivity measures as the number of classes of inputs—, etc., and mentions that one of the economical means of increasing productivity is through high-yielding crop variations or varieties. Productivity in the agricultural sector has an important role to play in contributing to consumer welfare.

THE post-Independence decade has witnessed an upsurge of interest in productivity problems. With an endeavour to use resources to the full extent in order to uplift the agricultural sector, the problem of productivity has taken the central place of discussion, and is assuming increasing importance day by day in our developing economy. For, behind productivity lie all the dynamic forces of economic life—technological progress, accumulation of capital, entrepreneurial skill and ability, and, above all, the organisational and changing institutional pattern of Indian economy. It is very important to understand the exact relationship between productivity and these changing dynamic forces: movements of prices, rapid changes in technology, etc.

To some the term 'productivity' is the personal efficiency of labour; to others, it is output derived from an aggregate collection of resources, while some others are of the opinion that it is the yield per acre of land. In some cases, it has been

associated with time, in other it is linked with environment. However, if we are to measure the aggregative productive efficiency of our economy, its measurement can be brought about by social accounting and revolution in statistical technique.

In order to confine to agricultural productivity, we need to study the measuring of the productivity per acre of land, labour, and capital in the production function in a particular chosen farm. Thus, to have the best allocation of resources in our production process, there is need for extensive farm management studies through the methods of Budgeting and Planning at a micro level and with the help of linear programming at the macro level.

The main emphasis is on how to increase productivity in the agricultural sector by the provision of overheads or external economies. The development plans are also in keeping with the aim of increasing agricultural productivity through various measures. But the effort made through Community Development projects and National Extension Services is so pathetic that it is disappointing especially after a period of fifteen years of developmental planning.

Technical Change

There are many factors, like technical change, which affect productivity in agriculture. There is a relationship between productivity and technical change: as the economy develops, new techniques are invented. The factors determining the rate of introduction of new techniques, together with an analysis of the interrelations between movements of productivity, costs, prices, wages, and investment especially in the Indian agricultural sector requires a theoretical analysis. The interpretations of this analysis rest on empirical evidence available in a particular given situation. Statistical data collected on a particular farm through the Farm Management Studies will help us to throw light by theoretical analysis and interpretation on the factors which govern the productivity gains, and also the elements which hamper the improvements in productivity in the agricultural sector.

Continuous Processes

The vital problem in productivity analysis to be viewed while discussing the technical change is the element of continuous disturbance and slow adjustments. This peculiarity of slow-moving process in the agricultural sector is due to the inherent quality of inelasticity of factors of production to the change in price. But the techniques of production change with time for two reasons: increasing technical knowledge and changing factor prices. Both are continuous processes in time, and together give rise to a stream of new techniques: they follow each other not in quick succession, but sometimes occur simultaneously. This has been experienced in Machine Tractor Stations in USSR in the preliminary stages of their agricultural development.

Many experienced observers reckon the cumulative effect of small, unnoticed, or minor modifications and improvements as being equally as important as the more significant alterations usually regarded as innovations. The factor prices do change slowly and gradually, but continuously through time, and this alone is enough to produce a continuous stream of new production techniques. This process of alterations and renovations helps the decision-making farm greatly in producing good results out of its factors of production.

A crucial point to be noted is the delay in the utilisation of new techniques owing to the rigid institutional set-up in our agricultural sector. Thus it is obviously impossible to employ the long-period scheme for the analysis of technical change, and hence productivity, as the

long-period approach does not even take account of the adjustment process which leads to this delay. However, once we assume the existence of continuous disturbance and slow adjustment, the long period framework is inappropriate for analysis of the cost and price movements coupled with the technical change; as its basic tools, such as long-period supply functions, are ineffective in such circumstances, particularly in the agricultural sector.

Problem of Measurement

The interaction between new technical knowledge and changing factor prices go to determine the suitable production technique at each date. Here a real problem may arise because this continuous change in techniques is in alignment to a slow adjustment process caused by fixed factors of production in the agricultural sector. In such circumstances, the flow of new techniques outstrips the ability of the system to adjust, and a gap appears between "potential and actual technical change." But here we will have to resort to the empirical data in order to measure productivity on a particular farm. In the words of Harpal Singh, "The process of adjustment has, however, been a prolonged one in Indian agriculture. Once adjusted, the acceptance of change, necessitating a fresh adjustment, has been rather an arduous task... Changes introduced under dynamic situations become cases of maladjustment" (**Economic Weekly**, May 30, 1964, page 925).

The problem of measurement has created much confusion in the minds of the enumerator as to which factors of production should be taken as criteria to measure productivity in agriculture. There are as many productivity measures as the number of classes of inputs, such as 1. Output per human-hour; 2. Output per rupee worth of investment; and 3. Output measured in terms of per ton of rice, i.e., output per acre. Some regard labour productivity as the exact measurement of productivity; that output per man-hour reveals the correct picture. Although the measurement of productivity has a long tradition, it is regarded as the average physical product of conventional theory. In agriculture, it is a little difficult to refer to "output" in the sense of the volume of saleable goods and services produced by a farm. This aggregate increase in the output, however, may not give a correct picture of the idea of increase in productivity yield per acre of land; but it will help to measure the factors which cause increase in the aggregate output. One should also note that an increase in output does not necessarily imply an increase in the yield per acre in the agricultural sector, but it will help, to some extent, to measure productivity at a micro level on a particular farm.

In the initial stage of our analysis of the effects of technical change in productive processes, it is desirable to state a relationship between technical knowledge and the techniques of production at the disposal of the farm operators. For this, first, it is necessary to clarify what we mean by the range of alternative techniques implied by a given stock of knowledge; second, the nature of the interaction between economic choice and technical restraints; and finally, the most discussed question of unit of measurement for factors of production.

At any one level there exists a fund of knowledge which is concerned with the known technical facts, and has affinity between them, however much they differ in their exact nearness to production.

Further, the knowledge dealing with basic principles of physical phenomena concerns (a) the properties of land, (b) the laws of returns, and (c) the methodology of operations. The nature of organisation has also to be considered. At another level there is the knowledge concerned

with the application of these principles to the production function.

However, the use of fertilisers and manures on the actual operation of the farm, can be made with scientific technical knowledge so as to increase the rate of productivity. Knowledge of this character connects the gap between principles and practice; e.g., the transition from seed multiplication to the crop variation system, the application of the genetic theory to the breeding of new plants and seeds, or to subsidiary occupations such as poultry and dairy farming where the use of highly advanced technical knowledge can produce better quality of breeding. Finally, there is the knowledge concerning day-to-day operations of production, the rules and modes of operations, for a highly technical combination of productive activities on the farm can help to increase the rate of productivity in the agricultural sector. All these operations, accompanied by irrigation and power installations, can provide a touch of technical knowledge to farm operations.

Complex of Activities

The existence of different levels of technical knowledge raises a number of difficulties particularly in factor substitution, because farm operations comprise a complex of activities. First a choice must be made as to which of the numerous methods that are technically possible in principle are sufficiently commercially promising to be worth developing in detail. Caution on the part of the farm operator is indispensable, so that no serious damage is done to the fertility of farm land. No prudent farmer can go on cultivating the farm, where the techniques will prove uneconomic. Even at the early stage of using techniques, factor prices intrude to some extent. A farmer can reject a method which is, from the commercial point of view, impracticable to operate on a given size of farm unit. For example, though technically it is feasible to use lift-pumps on farm operations, the cost of this factor is higher than the water rates charged by the irrigational water system. Secondly, in the practices of terracing, ploughing, threshing, and transplanting processes, there are numerous alternatives which must be decided on the basis of cost—e.g., whether the machine tractor should be powered by electricity or diesel power, or whether bullock-drawn iron-plough should be used.

The use of such techniques depends upon the nature and size of the farm unit. The varying nature of the farm unit further restrains the use of technical devices in operational processes. In addition, the range of techniques available to the individual farmer as opposed to a co-operative farm is very often limited. He will try to select those techniques of combination in his production function, which will suit his production process.

In this transitional stage, a relatively narrow range of developed techniques is available to the farm operator; and the range of techniques depends upon the availability of machine tools in the market. Secondly, though operational tools such as tractors, bull-dozers, and threshers are at their disposal, lack of informative knowledge regarding utilisation restrains their

... It is difficult to measure labour productivity in Indian agriculture, as there are different categories, strata, and classes of labourers ...

use. Again, the costs and factor prices influence the range of equipment to be designed for operational use. Labour-saving techniques restrain the use of highly technical feasible combinations on the production function owing to the availability of surplus manpower in our economy.

Production Functions

The dichotomy of two equilibria, viz., of aggregate demand and supply, and the market demand and supply, involves additional decisions on the part of the farm operator regarding the selection of alternative techniques and a combination of the factors of production. The dilemma is further aggravated, if the cost of the farming operations, as it should be, is proportionately less. Even if the increase in income is high in the short period, and factors of production of new techniques are sizable in relation to the farm unit, the farm operator will be unwilling in the long period, to undertake all the disproportionate risks involved.

In the long period, the alternative concept of a range of techniques which could be formulated with a given stock of knowledge, the production function, includes all possible designs, but it should be technically feasible, and immune from the prior influence of factor prices. This is all consistent with known technical facts, and ever-growing production possibilities, provided that the details of technological knowledge are linked with production possibilities on the farm. These production possibilities are concerned with energy, which may be derived from animals, manpower, machines, and natural resources such as wind, water, and fertility of land. This energy could be utilised through all the processes of production, assuming the technological knowledge on the part of the farm operator.

Thus the production function may be defined in terms of alternative techniques at each date, and as a continuous flow of new technical knowledge is opened up on the basis of technical alternatives, or due to alignments of widespread techniques, a series of new dated production functions should emerge. This series of production functions may be related to productivity, and may assist as a tool for analysing the way in which technical advances could make available new levels of productivity. In this process, the factor substitution will depend upon the alternative line of development opened to the farm operator strictly on the basis of cost. To use these best technical alternatives for factor combination in productive activities, relative factor prices are in the nature of signposts representing broad influences, which help to determine the way in which technological knowledge can be applied to the production function.

In a production function, to give concrete shape to the functioning process, and to relate factors of production and productivity of factors, it is necessary to have units of measurement of each factor. The measurement of labour input requires homogeneity in the labour market, and thus it can be calculated in man-hours. It is difficult to measure labour productivity in Indian agriculture, as there are different categories, strata, and classes of labourers. For wage paid employment, the measurement of productivity on farms can be assessed through man-hours of work. In the case of family labour, labour productivity will have to be interpreted in this spirit, otherwise we attribute them undue significance. Though quantitative information on labour productivity can be made available through the working of the economic system in the process of movement, indirectly such measurement of productivity is often related to the economic efficiency of labour input in the economic system. There is confusion running through current Indian economic commentary concerning the improvement of labour productivity. One hears that,

because labour is abundant, raising labour productivity is far less important than boosting the output per acre in agriculture. Here the problem of efficient organisation on the farm unit is as crucial as the yield per acre on land. But it is forgotten that economic progress is absolutely dependent upon the growth in the total labour productivity.

The Real Problem

Furthermore, it is necessary for the measurement of labour productivity that the relationship of improvement of labour productivity to employment, and to the efficiency of land use and capital use, is considered. In India, where there is overcrowding of agriculture and a low supply price, the introduction of labour-saving techniques, which fail to contribute in particular for the improvement of labour productivity on the farm, is not at all advisable. Most particular advances in labour productivity, of course, are apt to put some people, either in the innovating establishment or of its competitors, out of work temporarily, and/or force them to change jobs. This is unsettling and socially costly; it is however good if such competitive feeling arises among the labourers. This will not only help to bring radical improvement in labour productivity, but also encourage incentive to produce more output.

The problem in Indian agriculture is one of unskilled labour, and continuing displacement of inferior processes and products by superior ones owing to gradual transferring of a self-subsisting economy to a commercial one. Further, this inherently dislocating aspect of all particular improvements in labour productivity can cause serious trouble only in an economy where there is lack of effective demand or inadequate alternative opportunities. This is the problem of re-employment of displaced workers which the Indian economy is facing in this era. The real problem, therefore, is that which particular improvements in labour productivity can pose for employment opportunities available in the agricultural sector. However, this can be mitigated through the construction of overhead facilities, such as bunding, construction of roads, fencing, reclamation of land, and big engineering projects.

The major problem is measurement of capital. As a preliminary to the consideration of this complex and controversial question, consider the circumstances in which the production function is relevant. There is a technique involved to canalise capital investment in the

... If productivity is judged in terms of per capita incomes, and standard of living or well-being, our economy has, on the whole, remained more or less stagnant, because the basic conditions under which an economy can continuously expand have been lacking ...

productive activities on farms. Therefore the choice between alternative techniques can only take place prior to the act of investment. Once the appropriate technique has been decided on, and investment has taken place in the necessary equipment, the production function is no longer relevant. From there on, throughout the life of the equipment, factor substitution is of the short-term variety, limited by the nature of the equipment, and not by the restraints of technical knowledge.

The question faced by the enumerator is how to measure the productivity of different types of capital components in the production process. It can be assessed on aggregative level, and will depend upon the marginal efficiency of the capital of that particular unit. For this ex-ante, not ex-post, investment is to be taken as the criterion, while judging the productivity of that particular unit on farms. For overtime analysis, where it is important to avoid the distortions of price changes, each technique may be described by the real investment or, more precisely, the initial outlay at constant prices of the necessary building of farm implements stock, such as tractors, levellers, and bulldozers.

The only logically consistent or coherent means of treating this time element in technique decisions is to measure capital in two dimensions :

(a) An initial real investment.

(b) The life of this investment technique decisions then involve choosing the optimum combination of capital equipment and other factors of production and the optimum life of these equipments.

Factors Affecting Productivity

If productivity is judged in terms of per capita incomes, and standard of living or well-being, our economy has, on the whole, remained more or less stagnant, because the basic conditions under which an economy can continuously expand have been lacking. The retrogression led to a decline in productivity per person engaged in agriculture; the adverse effect was perhaps softened, to some extent, by the shock-absorbing capacity of the old institution of the joint family. The result was a continuous increase in under-employment, and the growth of an attitude of "pathetic contentment" on the part of the people. There was, however, little overall economic improvement during the 19th century, and so the conditions in the agricultural sector deteriorated sharply.

The backwardness of Indian economy can still be seen in its unbalanced occupational structure---about 67 per cent of the population engaged in agriculture, 13 per cent in industry, some eight per cent in trade and transport, and 11 per cent in profession and services, including domestic services.

A Pre-condition

It is said that "productivity per worker in organised industry, commercial and transport is about three times that in agriculture," and this calls for immediate action on the part of the Government. It is argued that removal of the excess labour is a pre-condition for raising agricultural productivity. For example, in agriculture, men can work on improving the land with the use of local non-scarce resources, and negligible equipment like shovels, baskets, wheel barrows, casts, and hoist, which can be produced by labour, and involve only marginal use of scarce local resources including contour-bunding, terracing and levelling, drainage, irrigation ditches, minor canals, digging wells, fencing, making local roads, making fertiliser coke from green manure, and dried leaves. All this could help in improving productivity on farms, provided serious consideration

TABLE II

Percentage Annual Average Rate of Increase or Decrease in Area and Productivity of Important Crops in the First and Second Five-Year Plans

	FIRST PLAN		SECOND PLAN	
Crops	**Area**	**Productivity**	**Area**	**Productivity**
Rice	+ 0.5	+1.8	+1.2	+2.5
Jowar	+ 1.9	—2.2	—0.1	+8.1
Wheat	+ 4.5	+0.6	+1.0	+3.6
ALL CEREALS	+ 1.8	+0.6	+0.6	+3.0
Pulses	+ 2.8	+0.2	Neg	+1.8
ALL FOOD GRAINS	+ 0.2	+0.5	+0.5	+3.0
Groundnut	+ 4.9	—2.2	+4.4	—0.1
All Oilseeds	+ 3.2	—1.5	+2.4	+1.6
Cotton	+10.7	—1.0	—1.1	+8.0
Jute	+ 8.2	—1.5	—2.6	+0.6
Sugarcane	+ 4.2	—0.7	+5.4	+2.9
ALL NON-FOOD GRAINS	+ 5.1	—1.4	+1.3	+3.3
ALL CROPS	+ 2.5	+0.3	+0.6	+3.2

is given to effective organisation in our agricultural sector.

One of the most economical means of increasing productivity is through high-yielding crop variations or varieties, and yet, this valuable source of increasing productivity has been neglected as will be evident from the fact that the acreage of grain crops planted of improved varieties is estimated at only 12 per cent to 20 per cent of the total. It cannot be argued that the major handicap in the programme of seed multiplication and supply is the lack of funds and knowledge.

Productivity in agricultural sector has a vital role to play in contributing to consumer welfare. It may well start a chain reaction under which the flow of savings will be continuous. This increased savings capacity, again, will be reinvested in farm operations, further leading to a multiplier effect on national welfare; and it may enable us to eradicate the submarginal farm unit in the agricultural industry.

KS SURYANARAYANA

Head & Hony Director
Dept of Agricultural Economics
AP Agricultural University

Management Under Current Farming Conditions

The author brings out a few concepts of farm productivity, and discusses related problems, giving a few empirical applications with reference to the data he had collected in the Telengana region of Andhra Pradesh. The productivity relationships worked out show that "both labour efficiency and land productivity were falling with an expansion in farm size measured in terms of the respective input." It is stated that there is no evidence of increasing productivity of management: "In fact, managerial ability is a bottleneck under the current conditions of farming." Also, says the author, output per acre, under the present circumstances, seems a more meaningful measure of success in farming than other criteria.

FARMING in India is often said to be a deficit enterprise. The yield per acre, per man-hour, or even per unit of capital invested does not seem to leave enough over cost. This margin over cost (in physical or monetary terms) is really the objective for maximisation. The question is: Do farmers try to seek this goal? If not, what other objective or motivation prompts the farmer to pursue his vocation, and why?

As is well known, a farm does not mean the same thing everywhere. A farm in the Indo-Gangetic plain is not the same thing as a farm in Telengana, for example. The crop-mix is totally different. The motivation of the farmer, however, is the same. Under present-day conditions, he wants to subsist on his farm: that is his primary objective. Economic profit is not of much concern to him, provided he and his family members find work on the farm, however small its acreage might be. Questions arise: Does it pay to produce paddy or jowar, or how much of jowar or tobacco to produce, or is it worthwhile to apply

ammonium sulphate or groundnut cake, or employ hired labour. These are not irrelevant to his farming situation. To what extent, however, the farmer comes to grips with problems of this kind, and what makes him decide to follow a particular practice in preference to another, remains a question.

Usually, in the generality of cases, decisions regarding farm organisation and operation do not necessarily follow rational decision-making processes, and even the managerial processes are of a rather crude nature. Elements of risk and uncertainty are totally absorbed by the farmers themselves (unlike in industry) who are mostly self-employed workers. Management, by and large, is restricted to supervisory services on the farm. This rather limits the size of farm operation. Yet, a two-acre farm operator does not require a fifth of the supervisory work of a 10-acre farm. In fact, the small farmer does more work of personal supervision than is necessary. Alongside supervision, he also contributes his own physical labour to farm work. Thus, there appears to be quite some surfeit of labour, including management inputs, especially on the smaller farms, and a rather poor quality of management and labour inputs on the larger farms. For it is generally considered that the quality of hired labour (the proportion of which to total labour employed increases with expansion in farm acreage) is inferior to that of farm-family labour, and that the production of managerial services does not involve any cost as such.

How then is it possible to measure productivity on the farms? What are the relevant concepts of farm profit and farm costs? Traditionally, the economic concept of profit as a surplus over cost has little use under a "Way of life" aspect of farming of the subsistance type, where a high degree of non-monetised sector prevails with a predominant bias towards production of food crops over commercial or money crops. If farming is to serve this end, what matters is the overall net gains (monetary and non-monetary) to the farmer. So long as all that is produced on the farm, and consumed on the farm, does not figure in the farmer's calculations, and, likewise, all that is incurred by way of expenses in kind are also not to be taken into account in arriving at the overall outcome of farming, there is little point in talking of productivity. Incidentally, it is the expenses in kind that form a larger part of the total farm expenses (the contribution of unpaid family labour being the heaviest), while the cash expenses on the farm are as low as could be possible. Hence, it is the difference between these two components of costs (cash expenses less kind expenses) that a farmer wishes to minimise.

In terms of returns, it is net income, in cash and kind, obtained from the farm that a farmer seeks to maximise. The optimal level of income perhaps is

...So long as all that is produced on the farm, and consumed on the farm, does not figure in the farmer's calculations, and likewise, all that is incurred by way of expenses in kind are also not to be taken into account in arriving at the overall outcome of farming, there is little point in talking of productivity...

given by one of constancy of residuary income per unit of residuary cost, as defined above.

Clearly, this sort of farm accounting of profit does not strictly follow the principles of commercial practice. However, it implicitly takes note of a judicious economic principle of farm operation when a farmer seeks to employ more and more of the factor that is more freely available to him, and tends to use sparingly the factor that is really scarce to him. In other words, the average or the majority farmer in our country is limited by both land and capital, which, to him, are the scarce factors. So, he tries to employ as few inputs of these scarce factors as possible, while liberalising the use of his family labour inputs which, to him, are the most freely available factor, apart from management which is a bottleneck in our farm production. It is small wonder, therefore, that generality of farming under Indian conditions seems to present a picture of diminishing returns to both individual factors and to scale.

Let us now consider the measures of efficiency of farming. Efficiency and capacity (farm size) together constitute the two dimensions of productivity. As a measure of farm productivity, the output per acre, and for factor efficiency the output per man, may be considered. These two measures implicitly reflect the outcome of managerial inputs also.

To illustrate, let the output per acre be assumed to be rising with the expansion of farm size. What then happens to the output per man? Does it rise or fall? In fact, it can be shown to be falling for additional doses of labour inputs per acre. This can be expressed as a simple production function relationship of the Cobb-Douglas form, which gives a linear relationship in terms of the logarithms of output per acre related to logarithms of labour inputs per acre. If we describe the output per man as "Efficiency of labour," it goes on falling as can be seen from the derived co-efficient obtained from the following relation:

$$\text{Log } y = \log a + b \log x \qquad \ldots(1)$$

where y = output in rupees per acre, and x = labour inputs per acre. Putting y/x = Y, equation (1) becomes

$$\begin{aligned} \text{Log } Y &= \log y - \log x \\ &= \log a + b \log x - \log x \\ &= \log a + (b-1) \log x \ldots(2) \end{aligned}$$

Here, the coefficient 'b' gives the elasticity of productivity with respect to labour. That is, the output per acre either increases, remains constant, or decreases, as the labour input per acre is increased. Thus, if this coefficient is greater than unity, we have increasing labour productivity, constant productivity if equal to unity, and diminishing productivity if less than unity. The coefficient 'b-1' is, however, negative for all values of 'b' equal to less than unity, indicating that labour efficiency (b-1) falls off as labour input per acre increases. Comparisons of labour productivity and labour efficiency between regions, between types of farms, and between farms of different size-type combinations can be obtained by fitting a regression equation of the form in (1), and by deriving (2) therefrom. Similar relationships can also be used to study the efficiency of other factors, by taking one at a time, or by considering all the factors together through a multiple regression equation of the form:

$$\text{Log } y = \log a + b \log x_1 + c \log x_2 + d \log x_3 \qquad \ldots(3)$$

where y = output in rupees per acre, x_1 = land in acres, x_2 = labour input in man-days per acre, and x_3 = capital services in rupees per acre. Here "b, c, and d" are the partial regression coefficients, and indicate respectively the production elasticities with respect to land, labour, or capital. In this form of the function the returns to scale are

given by (1+b) for the farm as a whole. Thus we get a measure of returns to scale which may show either diminishing, constant, or increasing returns according as the scale coefficient (e) is less than, equal to, or greater than unity. Thus, the productivity of land is not the outcome of returns obtained from just the land factor, but is due to all factors in combination. Incidentally, a rough measure of the efficiency of management can be obtained through a consideration of the production elasticity of management which is given by the difference between unity and the scale coefficient, i.e., 1–e= –b. My studies show that the returns to individual factors as also to scale were significantly diminishing, thus bringing out the crucial importance of the management factor under conditions of Telengana farming, regardless of the type or size of the farms studied.

II

In this section we shall consider some empirical application of factor productivity. A study of the Telengana farms shows that while the output per acre would increase by 0.75 per cent for a one per cent increase in labour input per acre, the same increase would bring down the output per man by 0.25 per cent, using the equations of the form (1) and (2). Here, an implicit assumption is that all other relevant factors of production vary in the same proportion. This association was found to be significant as seen from the correlation coefficient which was 0.78 for the sample of 196 farms studied.

A comparison of these productivity relationships by type of farms showed that labour productivity was relatively high in the case of mixed farms, as compared to wet or dry farms: that is to say, a one per cent increase in labour inputs per acre on mixed farms would increase the output per acre by 0.83 per cent, while it was only 0.58 per cent on wet farms, and 0.69 per cent on dry farms. Labour efficiency (b–1) decreased comparatively less on mixed farms. The respective correlation coefficients were all found to be significant (viz., 0.78 for mixed farms, 0.77 for wet farms, and 0.73 for dry farms).

Likewise, the productivity of capital inputs was the highest on mixed farms (b=0.73), as compared to wet farms (0.13), dry farms (0.66), and 0.66 for all farms combined. On the other hand, land productivity, i.e, output per acre relating to farm size (acreage), was found to be decreasing with expansion in acreage. It decreased rather sharply on mixed farms (–0.69) relative to wet farms (–0.44), dry farms (–0.65), and all farms combined (–0.64). In other words, the output per acre would be raised if

...Both labour efficiency and land productivity were falling with an expansion in farm size (measured in terms of the respective input). The decline in output per acre as farm acreage increased, and the decline in output per man when labour input per acre increased, correspond to real situations...

the acreage is reduced rather than increased, showing that land productivity would be increased on the smaller farms rather than on the large farms. All the correlation coefficients were found to be highly significant, and hence the variables studied measure a high degree of the variations in the output per acre.

It will be of interest to note that these productivity relationships were worked out after taking into account the variations in the fertility of the land factor by standardising the data of inputs and outputs through an index of fertility. Despite this, it is clearly seen from the foregoing relationships that both labour efficiency and land productivity were falling with an expansion in farm size (measured in terms of the respective input). The decline in output per acre as farm acreage increased, and the decline in output per man when labour input per acre increased, correspond to real situations. It is only capital input, as might be expected, that gives rise to an increase in output per acre for additional doses of capital. This, however, is a scarce factor to the average farmer, and its expansion is rather limited. Also, there is no evidence of increasing productivity of management; in fact management is a bottleneck under the current conditions of farming. There is much scope for its improvement through the supply of agricultural extension services, and education.

Such studies, as these, relating to productivity measurement are expected to give an insight into the efficiency with which farm resources are utilised. Under the present circumstances, output per acre seems a more meaningful measure of success in farming than other criteria. Under conditions of Indian farming, farmers try to maximise their returns not by increasing farm size (acreage), but by intensifying the use of labour, i.e., by using more and more labour inputs on the same piece of land, which incidentally explains the fall in labour efficiency when related to output per man. Since family labour is the more freely available resource at the disposal of the farmer with no alternative sources of employment (the opportunity cost of family labour is almost zero), the farmer sacrifices somewhat the output per man in his efforts to maximise output per acre, and thus to increase the overall outcome of his farming.

New Variety of Paddy

About 20 lakh acres of land is proposed to be brought under cultivation with the new variety of paddy known as "Taichung Native I" by the 1966 kharif season.

The new variety, imported from the Philippines for multiplication of seeds, is estimated to give an average yield of 7,000 lb per acre, which is about 90 per cent more than the yield obtained in India from other improved varieties of paddy seeds. About 160 acres of land, in almost all the rice producing States, has been covered with the imported seed, and the yield is considered sufficient to be introduced in over 40,000 acres by the next sowing season.

Dr GV Chalam, Deputy Agricultural Commissioner in the Ministry of Agriculture, who selected the new variety for cultivation in India, said the introduction of Taichung Native I would lead to a "revolution" in paddy cultivation.







ORIZONS MING

India's principal effort under her Five-Year Plans is to increase food produc and farm incomes, to improve rural living conditions, etc. Various steps h been taken in this direction, and agriculture is really on the march. Pict published in this issue depict the new horizons in farming. On this page— LEFT, a farmer on the march to his field; BOTTOM, Ploughing in progress field near Delhi, and, TOP RIGHT, a new variety of wheat, evolved by I which shows promise of higher and better yield per acre



Transplantation of paddy in South India

Harvesting, with hand sickle, in progress





Left :

A rich yield, indeed! These two South Indian women, with stocks of paddy cut after harvesting, are happy that the produce from their field this year is much better than that of last year

Bottom :

Threshing and winnowing operation in a village near Delhi. Threshing is being done by walking cattle (tied to a small roller) over grain stalks. Grain is separated from the chaff by tossing it into the air for the wind to blow the chaff away.







Land under reclamation and mechanised operation to render it fit for cultivation. Tractors, the modern device for reclamation, are being used in various parts of India to bring more land under cultivation.

More Pictures on Pages 313-316, 413-416, & 465-472

GLEN T BARTON
and
DONALD D DUROST

Economic Research Service
US Department of Agriculture

Contribution of Productivity to Growth in US Farm Output

Farm output in the United States is nearly six times what it was a hundred years ago. The breakthrough changes in farming, however, have been particularly pronounced during the post-war period when productivity became an increasingly important source of growth in farm output. This paper briefly describes the concept and nature of the measure of overall, or aggregate, productivity developed by the US Department of Agriculture, and, by means of the index of aggregate productivity and closely related data, puts some of the recent changes in agricultural productivity in the proper perspective. The authors have analysed the contribution of productivity to the growth in farm output, the sources and causes of productivity growth, the changing composition of inputs, and the rates of change in output, inputs, and productivity over the last hundred years.

FARMING in the USA changed rapidly during the last 15 years. These changes often are described as a technological revolution. Farm output increased substantially during the period; even more remarkable, however, were the rapid changes in the composition of inputs used in farm production. Use of farm labour decreased sharply, total farmland remained almost unchanged, while farmers used increasingly greater amounts of non-farm inputs.

An important feature of technological revolution in farming is the rise in resource productivity—output per unit of input. The growth in productivity appears spectacular when farm output is related to inputs of farm origin. However, because

of the sharply divergent trends in inputs of farm labour, farmland, and non-farm inputs, perspective is gained by relating farm output to aggregate inputs. Chief attention in this article is given to the latter measure of overall productivity of US agriculture.

Overall Productivity

The measure[1] of overall productivity is calculated by dividing an index of farm output by an index of total inputs used by farmers.[2]

Conceptually, all of agriculture is regarded as one large farm in developing the indexes of farm output and total inputs. The farm output series measures "gross" output of agriculture, as no deductions are made for value of intermediate products used in production. Double counting of production of feed crops is avoided through the use of product-added factors in combining production of crops and livestock. The input series is consistent with the concept of farm output in that farm value of inter-farm transfers of feed, seed, and livestock are excluded. Non-farm inputs, such as transportation, associated with these transfers are included as inputs.

Both the farm output and input series measure physical volume, as price weights are held constant and only quantities are allowed to vary from year to year. Both series measure physical volume in the restricted sense that they include only outputs and inputs having an economic value.

Tangible Inputs

The input series measures annual inputs associated with the yearly output of farm products.[3] Thus annual input services of capital items are included in terms of depreciation and interest on investment. Only tangible inputs committed to agricultural production by farmers are included. Capital inputs from public investment in research, education, transportation, etc., are largely excluded.

Average market prices in specified weight periods from the basic weights used in constructing both the farm output and input indexes. Final indexes, with a common reference base of 100, were developed for both series by the use of overlapping calculations for terminal years of weighting sub-periods. This system of weighting was chosen chiefly to minimise weight correlation bias inherent in the divergent trends in quantities and prices of the various inputs.

Weights for non-purchased inputs were derived by assigning to them the same price per unit as was paid for similar inputs purchased. The same technique was used for items of farm output not sold.

In constructing both series, the quantity-price totals were calculated for individual items of input and output. This permits construction of sub-indexes of inputs and output, and aids materially in appraising changes in overall productivity.

The measure of overall productivity should not be interpreted solely as an index of changes in farm technology. Net

...The rise in US farm output has outrun growth in population which currently is about 4.7 times that of 1870. Additional inputs are more important than growth in productivity in attaining the long-term increase in output...

changes in the output-input ratio also reflect changes in scale and specialisation, variations in weather, and other factors.

Farm output in the USA is now more than 5.5 times as great as a century ago. This rise in output has outrun growth in US population which currently is about 4.7 times that of 1870 (Table I). Extra inputs were much more important than growth in productivity in attaining the long-term increase in output.[4]

The pattern of change in inputs, productivity, and farm output was not uniform over the period 1870-1963. To put productivity changes over the last 15 years into historical perspective, the 1870-1963 period can conveniently be divided into three periods: 1870-1920, 1920-1940, and 1940-63. These correspond roughly to the period from the Civil War to the end of World War I, the period between World Wars I and II, and World War II and post-war period. The logic of the choice of the three broad periods is reinforced when we examine some of the broad changes in composition of agricultural inputs over the last century.

The increase in farm output from 1870 to 1920 was based chiefly on use of additional inputs of land, labour, and capital (Table II). Total inputs in 1920 were 2¼ times the amount used in 1870; by comparison, total inputs increased by only 10 per cent from 1920 to 1963.

US agriculture in 1870 depended primarily on inputs of farm origin. Farm labour accounted for about two-thirds of the total inputs, and farm real estate (services of land and buildings) for nearly 20 per cent. Capital inputs made up less than 20 per cent of the total.

Although the use of each of the three

TABLE I

Farm output, inputs, and productivity, in USA, 1870-1963

(Index numbers, 1870=100)

Year	Total inputs	Productivity	Farm output	US population*
1870	100	100	100	100
1880	129	120	155	126
1890	154	120	185	158
1900	178	135	240	191
1910	200	128	255	232
1920**	223	125	278	267
1930	237	133	315	309
1940	234	150	352	331
1950	249	176	437	380
1960	247	213	527	451
1963	249	225	560	472

* Index of population for year shown.

** Indexes of inputs, productivity, and farm output are three-year averages centred on year shown, 1920 to 1960; other indexes are for year shown.

TABLE II

Annual rates of change in use of labour, land and capital, United States agriculture, 1870-1963

Period	AVERAGE ANNUAL RATE OF CHANGE IN Labour per cent	Real estate per cent	Other inputs per cent
1870-1900	1.56	2.20	3.10
1900-1910	.55	1.64	2.37
1910-1920*	.29	.26	2.97
1920-1930	0	0	1.66
1930-1940	—1.28	.17	1.14
1940-1950	—2.67	.50	4.94
1950-1963	—4.25	.33	2.50

* Calculations based on three-year averages centred on year shown, 1920 to 1950. Calculations in other cases based on data for year shown.

broad groups in inputs increased from 1870 to 1920, the rate of increase was not uniform. By 1920 farm labour accounted for only one half of the total inputs, the share of capital inputs rose to one-third, and inputs of farm real estate made up the same proportion as in 1870. The end of World War I marked the beginning of substantial substitution of capital for both farm labour and farmland in US agriculture. The use of farm labour reached a peak in 1920, and the bulk of the increase in real estate inputs occurred by that date.

Farm labour inputs fell moderately during the inter-war period, 1920-40, and inputs of real estate remained about constant. Capital inputs continued to rise, and by 1940 matched farm labour in accounting for more than 40 per cent of the total inputs.

Substitution of capital inputs for farm labour and farmland continued rapidly during the period following 1940. Inputs of farm real estate increased at a nominal rate over the entire period. In other respects, however, the period of the agricultural "revolution" (1950-63), was markedly different from World War II, and the immediate post-war period, 1945-50.

Capital inputs rose at an average annual rate of nearly five per cent from 1940 to 1950. This was the greatest rate of change recorded in any of the periods shown in Table II, and was about double the rate recorded in 1950-63. Rapid acceleration in the rate of decrease in farm labour inputs set in after 1940. The rate of decrease was 2.7 per cent from 1940 to 1950. From 1950 to 1963, however, the drop in labour use occurred at the unprecedented rate of 4.2 per cent. By 1963, farm labour made up less than 25 per cent of the total inputs, and the share of capital inputs had risen to an all-time record of more than 60 per cent. Inputs of real estate still accounted for around 15 per cent of the total—a share that has held relatively constant since 1870.

Rise in Output

Differences among the three broad periods of productivity changes show up when we examine the relative contribution of changes in productivity to the long-term rise in farm output. Increase in output per unit of input accounted for about one-third of the growth in farm output from 1870 to 1900 (Table III). In the two decades following 1900, however, productivity decreased moderately, and the entire rise in farm output was based on greater use of inputs. For the entire period, 1870-1920, productivity gains had a minor role in expanding output.

Additional inputs and increasing

TABLE III

Sources and annual rates of change in farm output, inputs, and productivity, United States, 1870-1963*

Period	CHANGE IN OUTPUT DUE TO CHANGE IN		AVERAGE ANNUAL RATE OF CHANGE IN		
	Inputs per cent	Productivity per cent	Total inputs per cent	Productivity per cent	Farm output per cent
1870-1900	65	35	1.94	1.01	2.96
1900-1910	190	—90	1.17	—.53	.61
1910-1920	127	—27	1.09	—.02	.87
1920-1930	50	50	.61	.62	1.32
1930-1940	—10	110	—.14	1.21	1.12
1940-1950	27	73	.62	1.64	2.19
1950-1963	0	100	0	1.93	1.93

* Calculations based on data in Table I.

productivity were equally important in raising farm output from 1920-30. During the 1930s, a period of major drought and depression, all of the moderate growth in output resulted from increase in productivity. Thus, productivity gains were far more important in explaining growth in farm output from 1920 to 1940 than in the period from 1870 to 1920.

Productivity became an increasingly important source of growth in farm output after 1940. A rise in output per unit of input accounted for three-fourths of the sharp increase in farm output during the decade of the 1940s. Continued rapid growth in farm output since 1950 is based solely on gains in productivity.

A comparison of the rates of increase in productivity also reveals differences among the three broad periods of productivity change. The output per unit of input rose at an average annual rate of one per cent from 1870 to 1900, but decreased 0.5 per cent per year in the first decade after 1900, and showed little change from 1910 to 1920. Thereafter, the increase in productivity accelerated steadily. Since 1950—the period of the so-called revolution in US agriculture—productivity has risen at a record rate of nearly two per cent annually.

Productivity Gains

The major source of productivity gains in US agriculture has been improved technology based on research. The foundation for the present broad programme of public research in the USA was laid in the 19th century. The year 1862 marked the establishment of the Land-Grant Colleges and the US Department of Agriculture. In 1887, the State Experiment Stations were started under the Hatch Act. Over the years, public and private research has provided an increasing flow of new technologies applicable to US farms.

It is impossible, in a summary article to enumerate all of the important agricultural innovations of the last century. However, highlights of the major new technologies can be noted for each of the three broad periods of productivity change.

Changes in machinery and cultural practices contributed to modest, but still important, gains in productivity in the last three decades of the 19th century. As

...Chemicals had their greatest impact on farm production in the period after 1950. A dominant feature was the large increase in the use of chemical fertilisers, which contributed greatly to the upsurge in crop yields. The rate of increase in crop production per acre from 1950 to 1963 was several times that recorded from 1940 to 1950...

noted previously, however, extra inputs of labour and capital, and expansion of the total agricultural plant as new lands were opened up in the West, dominated the picture from 1870 to 1920. New technologies bore fruit on US farms mainly after World War I.

Mechanisation

Mechanisation of farming was the major feature of the inter-war period, 1920-40. The chief development was the substitution of mechanical power in the form of tractors, trucks, and automobiles for animal power of horses and mules. This period also marked the beginning of substantial substitution of capital for farm labour. Machinery and petroleum products emerged as major non-farm inputs for agriculture.

Mechanisation, particularly of harvest operations, continued in the period after 1940. The use of technologies which increased crop yields, however, was the main feature of this period. Average crop production per acre changed little from 1870 to the beginning of World War II. But crop yields rose by about 10 per cent during the 1940s, and increased by more than 40 per cent from 1950 to 1963. Rapid acceleration in the use of chemical fertilisers paralleled the upsurge in crop production per acre.

Research results have no impact on agricultural productivity unless the new technologies are adopted by farmers. Hence, we must look to other factors to explain the causes of rising productivity.

Many interrelated factors explain the rate of adoption of technology by US farmers. Education, adequacy of economic institutions, and economic incentives are among the most important. The Federal-State Extension Service, which was started in 1914, was a major step in farmers' education. The Extension Service was expanded during the 1930s in connexion with the initiation of various Federal farm programmes. Direct educational programmes for farmers were buttressed by the system of public schools in the USA.

The development over the years of adequate economic institutions encouraged the adoption of new technologies by farmers. Both public and private credit agencies were important in this regard, as

were tenure institutions. The growth of an adequate marketing and transportation system in the USA not only enabled farmers to market their products quickly and efficiently, but also made possible timely movement to farmers of the non-farm inputs which have played an increasingly important role in gains in agricultural productivity.

Economic Incentive

A dominant economic incentive to the adoption of new technology was the long-run rise in the price of human labour. Throughout the economic growth of the USA, per capita incomes in the non-farm sectors of the economy have been greater than those in most of agriculture. When ample non-farm employment opportunities existed, migration of workers from farms was rapid. The increasing price of labour was a powerful incentive to farm mechanisation and adoption of other labour-saving technologies. This also helps explain some of the important structural changes in US agriculture. Commercial farms decreased in number, and increased in average size. These structural changes have been especially rapid in the last 15 years, and have tended to concentrate control of farm resources in the hands of relatively more aggressive and progressive operators of large family farms. This, in turn, is contributing to more rapid adoption of technology.

Farm price support programmes also have contributed to the increase in productivity of US agriculture, chiefly through reduction of risk of disastrously low prices. Price programmes have encouraged farmers to make investments, and to use output-increasing technology to a greater extent than they would without programmes. Precise measures of the impact of the price programmes on productivity are not available.

Chemical fertiliser, pesticides, and other non-farm inputs have proved to be good "buys" for US farmers. Prevailing price-cost relationships, and the production response associated with the increasing use of these non-farm inputs generally have enabled individual farmers to lower the unit costs of production, and increase profits from their farming operations. Opportunities for lowering marginal unit costs of production on individual farms continue to provide strong economic incentives for the adoption of new technology.

Farming in USA has experienced a technological revolution since 1950 in the form of rapid acceleration of changes already under way during previous periods. Three of the inter-related facets of the revolution are :

1. The overall productivity of agriculture increased at a record rate from 1950 to 1963. This rate of increase in output per unit of input was the end result of an acceleration in the productivity ratio which has been under way since the end of World War I.

2. An outstanding feature of the revolution was the very rapid rate of decrease in the use of labour on farms. The rate of decline in labour inputs from 1950 to 1963 far exceeded the large annual reduction from 1940 to 1950. Again, it must be remembered that the stage was set in an earlier period for substantial reduction in the use of farm labour. A landmark in this regard was the rapid mechanisation of farming which started following World War I.

3. Chemicals had their greatest impact on farm production in the period after 1950. A dominant feature was the large increase in the use of chemical fertilisers, which contributed greatly to the upsurge in crop yields. The rate of increase in crop production per acre from 1950 to 1963 was several times that recorded from 1940 to 1950. Compared with the relative stability of average crop yields over the 70-year period from 1870 to 1940, the increase

in crop production per acre since 1950 is truly revolutionary.

The technological revolution from 1959 to 1963 was based on results of public and private research which had strong roots in earlier periods. Similarly, the favourable conditions for the adoption of technology by farmers—a combination of educational and institutional reserves, and economic incentives—resulted in large part from public and private actions taken much earlier.

REFERENCES

1. A more detailed discussion of the productivity measure is given in the following :

LOOMIS, RA and BARTON, GT: **Productivity of Agriculture,** United States, 1870-1958. US Dept. Agr. Tech. Bul. 1238, April 1961.

BARTON, GT and DUROST, DD: "The New USDA Index of Inputs," **Jour. Farm Econ.,** Vol XLII, No. 5, December 1960.

GRILICHES, ZVI: "Measuring Inputs in Agriculture—A Critical Survey, "**Journ. Farm Econ.,** Vol. XLII, No. 5, December 1960.

GRILICHES, ZVI: "Agricultural Productivity: A Progress Report," in **Productivity Measurement Review,** OECD No. 32, February 1963.

2. This gives a measure of average, not marginal, productivity.

3. Labour inputs are estimates of man-hours actually used on farms. Input services of real estate and of capital items, such as farm machinery, reflect estimates of inputs available for use by farmers. Inputs of fertiliser and other current operating inputs are quantities actually used.

4. These long-term comparisons provide only approximations of change owing to problems of measurement of output and inputs. The use of several weight periods in constructing the indexes of farm output and total inputs leads to one of the measurement problems.

'Essential Condition' of Prosperous Agriculture

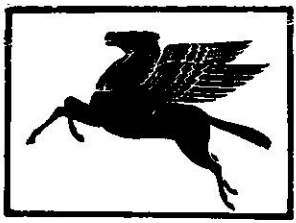
As far back as 1944 Sir John Russell emphasised the importance of mixed farming for a country like India.

In a broadcast in the BBC series on Indian agriculture, he said: "To a country such as India, especially with its high density of agricultural population, the general adoption of mixed farming is the essential condition of prosperous agriculture. This should not, however, mean that we can afford to produce less of food grains, or even very much less of commercial crops. To take food grains first, the war has demonstrated that this country does not produce enough for its people even at the present inadequate level of consumption. In an ideal world, it may be to India's advantage to take up mainly the production of protective foods, importing food grains cheaply from Australia or Argentina, where extensive cereal cultivation can be practised more economically."

Superphosphate and mixed fertilizers are vital for agricultural prosperity. PHOSPHANIL (Superphosphate) ITANIL and AMOPHOSPHANIL (mixed fertilizers) help production of bumper crops.

To be most productive, become regular users of PHOSPHANIL, ITANIL and AMOPHOSPHANIL.

For details write to :—



The Anil Starch Products Ltd.,

Managing Agents :

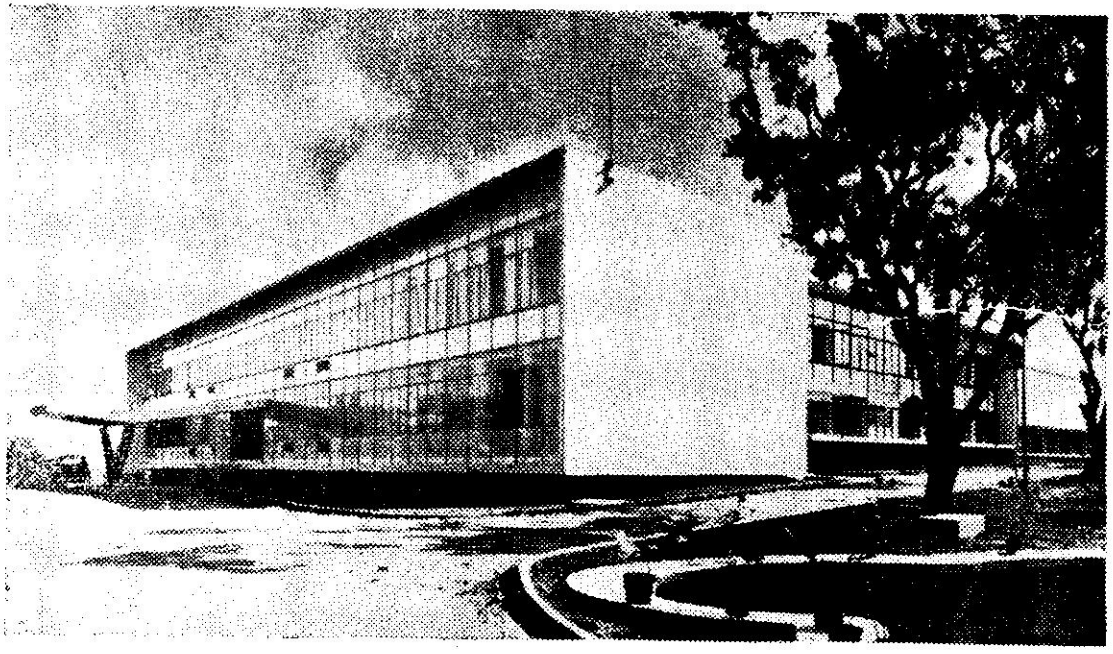
Kasturbhai Lalbhai & Company,

Anil Road, P.B. No. 1062,
AHMEDABAD-2.

Phone : **24916-17-18**

Gram : **'NILA'**

A radio a minute



Increasing productivity over the years has transformed National-EKCO.

It was a small pioneering company manufacturing the first Indian radio...and it had only a rented workshop in a flat. *Now* it has the largest radio factory in India with the most modern equipment and many facilities for the workers.

A radio a minute is the result of up-to-date work methods...maximum efficiency of operations...a good product designed specially for our difficult climate.

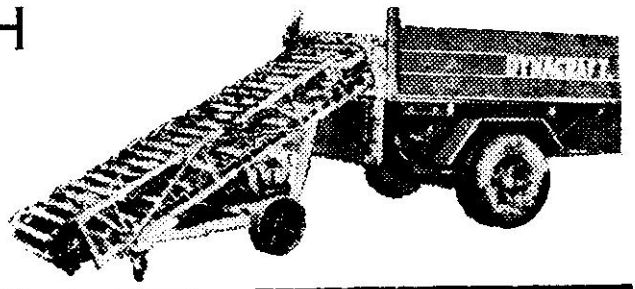
A huge internal and export market waits to be exploited—but future productivity at National-EKCO's new factory will meet all demands substantially.

Why not increase *your* Productivity also by providing music to your workers with a National-EKCO Radio while they work or relax.

THE NATIONAL EKCO RADIO & ENGINEERING CO. LTD.
Ewart House, Bruce Street, Fort, Bombay 1.

JWT-NE.2518

SAVE TIME
SAVE LABOUR
WITH



DYNACRAFT PORTABLE SLAT CONVEYOR

The Dynacraft Portable Slat Conveyor can transport loads—either way—at the rate of 600 units per hour. And each unit load is the equivalent of 250 lbs. The Dynacraft Portable Conveyor is suitable for delivery heights ranging from 12 ft. to 30 ft. What a saving of time...labour...space...and money! The normal chain speed of this unit is 30 ft. per minute and the minimum feed height is approximately 14". The delivery height can be suitably adjusted by means of a manually operated winch. The chassis is mounted on pneumatic rubber or steel wheels, as desired. For easy movement, swivelling castor wheels are fitted at the end. Although the standard drive is by means of electric motor, units with diesel and petrol engines can also be provided.

DYNACRAFT MACHINE CO. PVT. LTD.
Andheri, Bombay 58 AS.
Sole Distributors:
Tractors (India) Ltd. 1 Taratolla Road, Garden Reach, Calcutta 24.

Shilpi:DYN-228A

MPS/BM-6



SHELL MOULDED CASTINGS

- Excellent Finish
- Decreased Scrap & swarf returns
- Improved physical properties
- Minimum machining Costs

Bombay Metal & Alloys Mfg. Co. Private Ltd.

Post Box 6210, Bombay-10. Telephones: 76104-76105-76106

Branches at 33, Chittaranjan Avenue, Calcutta-12 Ph: 235533

and 8, Sembudoss Street, Madras-1 Ph: 23037

GG *your Guarantee for Good performance*

VALVES ■ NON-FERROUS ALLOYS ■ CASTINGS

'I sit on the grass,' the poet says,
'and gaze upon the sky...'

'The sky opens, the wind runs wild,
laughter passes over the earth.'

This was the world in Tagore's vision.
This is the world that man strives for
— a little less care, a little more joy.



HINDUSTAN LEVER LIMITED

PR. 20-50

WHAT HAPPENS WHEN YOU DIAL A CALL?



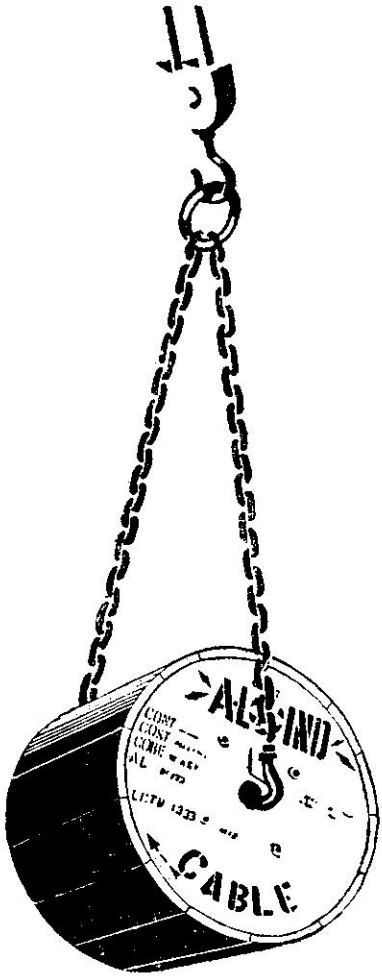
When you dial a call the Automatic telephone exchange comes to your help. The Automatic telephone exchange is a mechanical brain that replaces the manual telephone operator. It has three main functions. (1) to find out whether the number you dial is engaged. (2) to connect you to the number if the line is free and (3) to inform the dialled party that a telephone call is waiting for him.

The Automatic telephone exchange does these three jobs very efficiently, in fact a thousand times better than a manual operator. The 100,000 telephones in Calcutta and the 85,000 telephones in Bombay are completely operated by Automatic telephone exchanges.

The automatic dialling system manufactured by ITI is now being used on trunk lines as well. Single and multi link operator dialling systems have been installed in most major exchanges. Direct subscriber trunk dialling systems are also functioning between Jaipur, Delhi, Agra, Lucknow and Kanpur. This facility will soon be available on most trunk lines when the coaxial cable network is completed.

INDIAN TELEPHONE INDUSTRIES LIMITED,
BANGALORE – 16

ASP ITI-58



PIONEER and LEADER

THE Aluminium Industries Limited, Kundara, or ALIND—to use the abbreviated name by which the company is better known throughout the country—is a pioneer and large-scale producer of aluminium conductors.

Since the Company got itself established in 1950, not only has the initial installed capacity of conductor manufacture gone up from a bare 1,500 tons to 13,000 tons a year, but new, if related lines, have also been developed.

ALIND "FIRSTS"

Indeed the last fifteen years have witnessed several dramatic developments that merely to recount them—without any verbal frills and furbelows—will be to recapture the company's own first, fine, careless rapture!

In 1955, for instance, a continuous casting and rod-rolling mill—the famous Properzi Process—was added to facilities at Kundara. Yet another one—an improved model—will soon be installed.

In 1957, the Company commissioned its plant for the manufacture of covered (insulated) aluminium conductors. The range includes both weather-proof wires and building wires.

In late 1961, the Company established a core-wire mill at Kundara with Japanese technical collaboration. This is yet another Alind "first", as high-tensile, galvanised steelwire — the ACSR core — is now, for the first time being made in the country.

A SOLIDAL aluminium-conductored low voltage underground cable plant is a recent addition to facilities at Kundara.

QUALITY CONTROL

Under its roof, Alind also makes all the necessary transmission and distribution line accessories.

In the manufacture of ACSR—as indeed, in all its other lines—Alind exercises strict "Quality Control" at all stages of production. Alind was among the first few cable manufacturers to apply for a licence to use the ISI certification mark, and the very first to get it.

An Electrical Development Laboratory fitted up with the latest gadgets in testing equipment ensures quality of the aluminium metal and the soundness of the plastic insulation

CUSTOMERS

Alind's impressive catalogue of customers includes such famous names as Bhakra-Nangal, Bhilai, Chambal, Dhuvaran, DVC, Hirakud, Kothagurda, Koyna, Kundah, Periyar, Poringalkuthu, Rihand, Sabarigiri, Sharavathi and Talcher — also several State Electricity Boards, private electric supply companies and industrial undertakings

The worth of Alind conductors has been demonstrated not only in India, but in neighbouring tropical countries like Burma, Nepal, Saudi Arabia and West Indies.

Through its network of agents, distributors and dealers, both in India and abroad, Alind can offer service facilities second to none.



ALIND
where forward-thinking is a force of habit

THE ALUMINIUM INDUSTRIES LIMITED

Regd. Office: Kundara (Kerala) — INDIA

Plants at: Kundara, Hirakud, Hyderabad

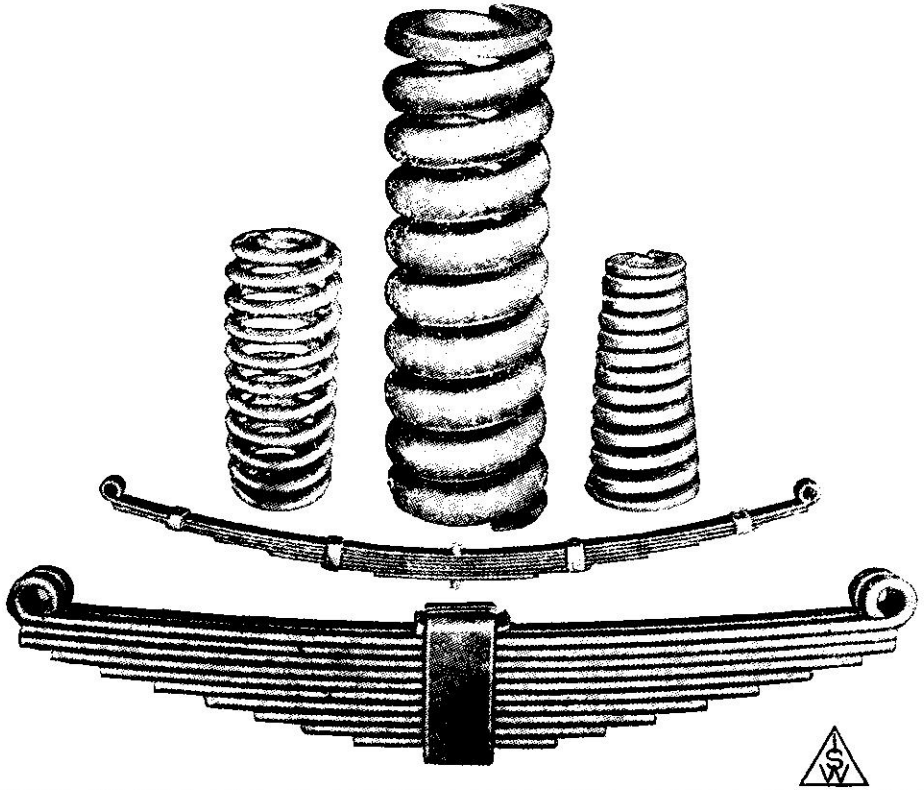
Mg. Agents: SESHASAYEE BROS. (TRAV.) PRIVATE LIMITED

AL/63-FA

for railways and the automotive industry

SPRINGS

- Manufactured by the most modern methods
- Tested at every stage of manufacture
- Guaranteed conformity to Indian Railways Specifications and Customer's Specifications
- Dependable for long service



THE INDIAN STANDARD WAGON CO. LTD.

BURNPUR

Managing Agents : MARTIN BURN LIMITED
Martin Burn House, 12, Mission Row, Calcutta 1
Branches : New Delhi Bombay Kanpur Patna
Agents in South India : The South Indian Export Co, Ltd., Madras 1

MSWC-20

BI BRAGINSKII

and

D DUMNOV

Chief, Section on Statistics
Scientific Research Economic Institute
of Gosplan, USSR

Department of Agricultural Statistics
USSR Central Statistical Board

Labour Productivity in the USSR and the USA

Russia has much less favourable climatic conditions than the USA, and this should be remembered in comparing labour productivity in Russian and American agriculture. The authors analyse the peculiar social and economic conditions under which agriculture has developed in the two great countries, with stress on the factors which have led to economical methods of farming. Between 1910 and 1959 the average labour productivity in US farming almost tripled. In Russia, survivals of feudalism and serfdom greatly hampered the development of productive forces in agriculture, and labour productivity is about one-third of the US level. The authors drive home the point that the differences in agricultural labour productivity between the USSR and the USA are decisively influenced by the differing levels of mechanisation and electrification of agriculture in the two countries.

IN ANALYSING the present position and prospects of economic competition between the USSR and the USA in agriculture, we must not forget that although in scale, multiplicity of crops, and diversity of soil and climatic conditions, agriculture in the USA is most closely comparable to our own, nonetheless US climatic conditions are immeasurably more favourable to agriculture than in the USSR. This must be remembered in comparing labour productivity in Soviet and American agriculture. First of all, however, we must briefly analyse the social and economic conditions under which the productive forces in US agriculture have developed.

As a result of specific historical circumstances, labour productivity in US agriculture far exceeded that of all European countries for many decades, let alone that of the economically backward pre-revolutionary Russia. Agriculture

in the USA developed in newly settled regions, without feudal survivals, and under conditions of a relative abundance of land, low prices, and a shortage of labour. All this stimulated the use of machinery, and economical methods of farming particularly livestock farming.

Greater Return

Thanks to favourable climatic conditions, and abundance of highly fertile land, the US farmer used relatively little fertiliser, and received a much greater return per unit of labour than the peasant of France, Germany, Italy, or Britain, where the survivals of feudalism and serfdom made themselves felt. In Russia, these survivals greatly hampered the development of productive forces in agriculture. Labour productivity in farming was particularly low. Before the Revolution (in 1913) 75 per cent of the gainfully employed population of Russia worked in agriculture; in the USA, in 1910, only a little over 30 per cent of the gainfully employed population worked in agriculture and produced a much higher level of output.

As we know, the growth of labour productivity in capitalist agriculture is a deeply antagonistic process. Higher labour productivity on the big farms brings ruin to the mass of small farmers. Between 1910 and 1959 the average labour productivity in US farming almost tripled. This led to the impoverishment and pauperisation of hundreds of thousands of farm families. Between 1945 and 1958 alone the number of farms in the USA dropped from six million to 4.7 million, and the farm population from 25.3 million to 21.4 million.[1] The increase in labour productivity on US farms is being effected more and more through back-breaking intensification of labour. The working day on US farms is very long, and the output quotas exceedingly high, and farm owners use only physically strong and experienced persons as farm labourers, dooming the less capable and older workers to chronic unemployment.

Constant fear of unemployment and ruin forces the hired labourers and small farmers to work beyond their strength. But the increase in labour productivity benefits only the monopolies, and capitalist farmers.

An entirely different situation exists in the USSR. The growth of labour productivity in Soviet agriculture leads to substantial increases in living standards both in the city and the countryside. Between 1940 and 1959 labour productivity in the socialised economy of the collective farms registered a 77 per cent increase. During the same period the average real incomes of the peasants increased 2.2 times (calculated per working person). In 1965, labour productivity on the collective farms should be about twice the 1958 level, with at least a 40 per cent rise in collective farmers' real income.

The advantages of the planned socialist economy make for a steady and rapid growth of labour productivity in all branches, including agriculture. But at present the USSR is still considerably behind the USA in agricultural labour productivity. However, the lag is less pronounced than the enemies of socialism would have us believe. Bourgeois statisticians and economists, in comparing labour productivity in the USSR and in the capitalist countries, resort to falsification, and often use obviously absurd figures. Thus, the report of the Joint Economic Committee of the US Congress, **A Comparison of the Economic Growth of the Soviet Union and the United States**, make the claim that labour productivity in US farming is between eight and 12 times the Soviet level. The same figure is repeated by **Fortune**, and other journals. Analysis of the statistical

material on agriculture in the USSR and the USA shows that these figures have nothing in common with the facts.

US farmers operate on a capitalist basis, under conditions of keen competition, and the ruthless exploitation of labour. In the USSR, on the other hand, agriculture is run along socialist lines. All the collective farmers are equal participants in the artel. But they do not all work the same number of hours, of course; the elderly folk, youngsters, and women having large families work limited hours, to the extent of their possibilities. Apart from farming operations, the collective and State farms do a great deal of building work, and have subsidiary establishments as well as welfare and children's institutions. For these reasons, Soviet agriculture will inevitably employ more people than in the USA, even when the labour expenditure per unit of output in the USSR drops below the American standard.

Farm Employment

On the basis of comparable data, agricultural employment in the USSR and the USA will appear as follows (the figures apply to 1958 for the USA and 1959 for the USSR):

	USSR	USA	Excess of USSR over USA
During the peak season (in millions)	38	14	2.71 times
On an average annual basis (in millions)	33	12	2.75 times

Thus, during the period of maximum employment, and on an average yearly basis, 2.7 times as many persons worked in farming in the USSR as in the USA. The total agricultural output of the USSR in 1959 was some 20 per cent below that of the USA in 1958. Hence, labour productivity in Soviet agriculture is about one-third of the US level. If we calculate the total yearly inputs of labour in man-hours in Soviet farming (including the subsidiary personal plots) for the range of operations comparable to those performed on US farms, we will again find a difference of some 2.8 times in favour of the USA. Hence, labour productivity in Soviet agriculture, on a man-hour basis, in 1958, was about one-third of the US level, i.e., we arrive at the same figure as before.

Natural and climatic conditions have an enormous influence on labour productivity in agriculture. As already noted, the Soviet Union, as a whole, has much less favourable conditions than the USA,[3] and it takes a much greater expenditure of effort on the average to produce a unit of output in the USSR than in the USA. It would therefore be more to the point to compare labour inputs not between the USSR as a whole and the USA as a whole, but by separate regions with more or less identical natural and climatic conditions. Thus, in grain crops the regions most closely resembling the USA are the Ukrainian SSR (the Steppe areas), the North Caucasus, Kazakhstan, and Western Siberia. In these regions, the labour inputs per centner of grain on collective farms in 1956-58 were lower than the average for the USSR as a whole: in the North Caucasus—2.1 times, in Western Siberia —2.4 times, in Kazakhstan—3.2 times.

The differences in agricultural labour productivity between the USSR and the USA is decisively influenced by the differing levels of mechanisation and electrification of agriculture in the two countries. Livestock breeding and some branches of crop production in the USSR are less mechanised than in the USA. In 1958, the USA had 5,180,000 tractors (including orchard and garden tractors), and the USSR only 1,001,000, or 1,750,000 in terms of 15 hp units; the number of grain-harvesting combines in the two countries was 1.1 million and 0.5 million,

and of trucks—2.9 million and 0.7 million respectively.[3] True, on Soviet farms the machinery is used more intensively than on the capitalist farms of USA, and the average output per tractor hp, foot of combine width and truck tonnage is higher.

Soviet Advantages

The advantages of large-scale socialist agriculture enable the USSR to complete the all-round and integrated mechanisation of all farm operations with a smaller number of tractors, combines, and other machines per 100 hectares than are used in the USA.

In recent years, many of the more efficient State and collective farms have substantially reduced labour inputs per unit of output. The measures taken to secure a sharp expansion in agriculture on the basis of party and Government decisions, have created opportunities for a rapid growth of agricultural labour productivity. Thus, while the big US farms require one man-hour to produce a centner of grain (exclusive of processing time), some of the State farms in 1956-1959 required less than one man-hour to produce a centner of grain.

In 1956-1959, it took 0.5 man-hour (including processing time) to produce a centner of grain at the Kirov State Grain Farm, Akmelinsk Region, 0.54 man-hour at the Gigant State Farm, Rostov Region, 0.8 man-hour at the Stavropolskii State Farm (Stavropol Territory), and at the Kropotkinskii State Farm (Krasnodar Territory), and so on. There are quite a few State farms in Kazakhstan and Western Siberia where production per man has in recent years exceeded 1,000 centners which is considerably more than on the big grain farms of the Central North-West in the USA.

In livestock breeding, we must apply the economical methods used by big US farms to maintain productive stock if production costs per centner of output are to be reduced further. We are referring to the loose housing system for dairy cattle and pigs, the use of automatic feeders, etc. The Peremoga State Farm (Zaporozhye Region), the Piatigorskii State Farm (Stavropol Territory), and the Provalskii State Farm (Lugansk Region) have adopted the loose housing system for cows, required 3.5 man-hours in 1958 to produce a centner of milk, 20 per cent less than on the big US farms. On the mechanised dairy farms, where one milkmaid tends 35 to 50 cows, it does not take more than two hours to produce a centner of milk. On a number of pigfattening State farms employing modern methods of tending pigs, less labour is required to gain a centner of increased weight than in the USA.

Our collective and State farms have great opportunities for rapidly increasing labour productivity in the near future. This is especially true of livestock breeding, where we are considerably behind the USA in labour productivity.

REFERENCES

1. **Statistical Abstract of USA,** 1960, p. 615.
2. See the article by A Pavlov and V Sobakinskigh "A Comparison of Soviet and US Levels of Agricultural Output," **Vestnik Statistiki,** 1961, No. 1
3. See the Statistical Year Book **Narodnoe khoziaistvo SSSR v 1959 godu,** p. 416; the magazine **Mirovaia Ekonomika i Mezhdunarodnye Otnosheniia,** 1959, No. 9, pp. 41-45

ROY D LAIRD

University of Kansas

Soviet Goals for 1965 and Problems of Agriculture

Russia is attempting to learn the lessons of US farming experience. Her present Seven-Year Plan, ending 1965, aims at approaching US economic output in all sectors. Though the achievements of recent years appear to have been considerable, in view of the greater attention paid to the improvement of agriculture than to any other economic objective, "the needs of the population are not yet satisfied." Although the total area under cultivation in Russia is not much greater than in the USA, 43 per cent (90 million) of the population are employed in agriculture as compared with 10 per cent (20 million) in the USA. Analysing the situation as it obtains today, the author refers to the views of Western and Soviet analysts, and states that the achievement of 1965 goals would seem "most unlikely."

IN VIEW OF the impressive rate of Soviet economic growth during the past three decades, it seems likely that the Soviet leaders may make good their promise "to catch up with and surpass" the United States' level of production. Although estimates vary, most analysts agree that, in recent decades, the rate of Soviet industrial growth has been two to three times as rapid as that of the USA. The present Seven-Year Plan, ending in 1965, aims at approaching American economic output in all sectors. Even in the troubled area of agriculture, the achievements of recent years appear to have been considerable.

Table I, prepared by the Soviet analyst A Shlikhter, gives Soviet agricultural advances over 1953, Soviet projections for 1965, and a comparison with levels of output in USA. These figures do not reveal that most of the four per cent "average" increase in agriculture has come

about since 1954—"largely," as Shlikhter recognises, because some 100,000,000 acres were newly ploughed in the virgin lands campaign.

Shortly before death Stalin admitted that, unless corrected, the backwardness of agriculture "will hamper the continued growth of the productive forces of our country more and more as time goes on."[1] Acutely conscious of this problem, Khrushchev devoted more attention to improvements in agriculture than to any other economic objective. However—impressive though his list of innovations is—Khrushchev refused to adopt any scheme that would fundamentally alter the Stalinist collective system, or abandon the priority given to industrial growth.

In spite of the recent gains in total agricultural output, the needs of a population of some 210,000,000, increasing by nearly 4,000,000 a year, are not yet satisfied. The widening gap between industrial and agricultural growth has made ever sharper demands on agriculture. As Khrushchev acknowledged late in 1958, "A definite lack of correspondence developed between the development of industry and agriculture, and between the actual needs for grain and other products by the government and their real levels of production. This divergence carried the possibility of serious consequences. It could have inhibited further rise in socialist industry, and improvement in the living standards of working people." Suggesting that the problem belonged to the past, Khrushchev nevertheless went on to say that "overcoming the lag in agriculture, and the need for a sharp upsurge therein, was not only of internal, but of international significance."[2]

TABLE I

	USSR			USA
	1953	1958	1965	1958
Gross Grain harvest (mil. tons)	82.5	139.5	164.0-180.3	179.8*
Including:				
Wheat (mil. tons)	—	75.4	—	39.8
Raw cotton (mil. tons)	3.5	4.4	5.7-6.1	Appr 7.0
Meat and lard (slaughter weight; mil. tons)	5.8	7.9	16.0	16.4
Milk (mil. tons)	36.5	57.8	100.0-105.0	56.8
Butter (thous. tons)	497.0	770.0	1150.0	687.0
Wool (thous. tons)	235.0	321.0	548.0	134.0
Eggs (bil. units)	16.1	23.5	37.0	64.0

* Harvests of wheat, corn, barley, and sorghum for 1958. The 1958 grain harvest far exceeded the usual harvest. In 1957, the harvest came to 158,200,000 tons, including 25,900,000 tons of wheat.

Many Western economists assert that the problems of Soviet agriculture arise chiefly from the lack of economic incentive for kolkhozniki (the peasant members of the collective farms). It is true that much of the recent increase in agricultural investment has gone to the kolkhozniki. It is asserted that their real incomes advanced 60 per cent between 1952 and 1958;[3] but the 1952 level was so low that the increase still does not provide adequate incentives.[4] By 1965 a further rise of 40 per cent is anticipated. However, the economic burden of purchasing the machinery of the Machine Tractor Station, in the absence of further rise in agricultural prices, makes such a further increase in incomes unlikely.

"Plight" of Kolkhozy

The majority of our collective farms have the necessary means for buying

those agricultural machines needed by them, as may be seen from the following figures. The income of all collective farms from State deliveries and sale of products to the State amounted in 1956 to 81.3 billion roubles (in 1955 it amounted to 60.7 billion roubles), and, with the inclusion of receipts from the sale of products at kolkhoz markets, to 94.6 billion roubles.

Soviet officials will surely continue to point to the "millionaire" farms, arguing that the plight of the less fortunate kolkhozy is due to inefficiencies for which the kolkhoz administrations are largely responsible.

In the past, the MTS monopoly of the agricultural machinery was considered an essential "lever" for maintaining economic control over the farms and political control over the peasants. Now that the party is fully entrenched on the farms, the financial drain of the MTS on the State Treasury is no longer thought justified. Administrative reorganisation, improved controls, and increased efficiency rather than raised incentives, remain, as before, the chief means for expanding Soviet agricultural output under the Seven-Year Plan,[5] and the priority given to industry continues in force.

Shlikhter points out that although the total area under cultivation in the USSR is not much greater than in the USA, "43 per cent of the population," or some 90 million, in the Soviet Union are engaged in agriculture as compared with 10 per cent, or less than 20 million, in the USA.[6] If the efficiency of Soviet agricultural labour could be doubled, as the 1965 goal envisages, some 20 million workers could be transferred to industry—assuming that about one-half of the farm population are in the category of "able-bodied kolkhozniki." How serious labour inefficiency in Soviet agriculture is was indicated by figures for 1956-57 that Khrushchev cited in his December 1958 address (Table II).

TABLE II

	Labour (hours) per centner of output			Percentage by which USSR exceeds USA	
	US farms	State farms	Collective farms	State farms	Collective farms
Grain	1.0	1.8	7.3	80	630
Potatoes	1.0	4.2	5.1	320	410
Sugar beets	0.5	2.1	3.1	320	520
Raw cotton	16.8	29.8	42.8	60	130
Milk	4.7	9.9	14.7	110	210
Added weight, cattle	7.9	52.0	112.0	560	1320
Added weight, pigs	6.3	43.0	103.0	580	1530

Increased Yields

Though its achievement is doubtful the planned increase in the production of commercial fertilisers by 1965 (31,000,000 tons) would rival USA levels, and could have a significant effect on yields.[7] However, increased yields depend not only on fertile soil, but also on labour and abundant moisture, whereas the plans reveal an attempt to reduce labour drastically, ignoring the costly business of expanding the area under irrigation. Indeed, without sufficient moisture the addition of fertiliser often can do more harm than good. Although the Soviets have attempted to learn the lessons of American farming experience, in failing to stress the expansion of irrigation they have missed one of the most important of such lessons. In recent years large additional areas of the USA have been put under irrigation. For example, irrigation has transformed much of Central Nebraska, where natural conditions are roughly comparable to large sections of agricultural Russia, into an important corn-growing area; and Khrushchev's favourite subject in agriculture was America's corn

and corn-hog production. However, it may be that the Soviets are slighting irrigation for what are to them sufficient reasons: the high cost of installing irrigation systems and the fact that irrigation is a most labour-expensive agricultural practice.

Now that the possibilities to expand the cultivated area are very largely exhausted, the Soviet analysts recognise that future advances should depend chiefly on increase in yields and mechanisation. However, evidently they do not realise that mechanisation does not itself guarantee increased yields except in a few cases —e.g., when machines are used in additional applications of fertiliser or the expansion of irrigation. As the experience of the American truck farmer or the Russian peasant working his private plot shows, higher yields depend more on labour intensification than on mechanisation. As Shlikhter correctly points out, although the USA leads the world in the efficiency of agricultural labour in yields, it lags far behind other areas where more intensive cultivation is employed—e.g., Japan and Denmark, where grain yields per acre are nearly double than those in America.[8] Extensive agricultural mechanisation, coupled with specialisation in single crops, has produced greater total output in areas where tillable land is abundant and labour scarce, but not in areas where all available land is already under cultivation. The American farmer has found greater profits in investing in machinery, specialised crops, and large farms, rather than in diversified farming that requires expensive manpower; but, as shown by the example of other nations, this has been at the cost of maximised yields.[9]

Machine cultivation of corn is good but no machine has been invented that will keep a field as clean of weeds as can a man with a hoe. Mechanical sowing saves labour, but no machine is as efficient as a Japanese farmer who goes over every inch of his land, planting each gap by hand. The Soviet leaders desire increases both in yields, which would feed the people better, and in labour efficiency, which would enable workers to be transferred into industry, but since either could only be maximised at the expense of the other, they have had to choose, and have chosen, the latter, as before.

Crucial Question

Some increases in yields will probably be realised during the next few years, but in the light of the means to be employed, the achievement of the 1965 goals would seem most unlikely. If surpassing the American economy in overall output is, as the Soviets have plausibly concluded, "ultimately" dependent on a major improvement in the efficiency of agricultural labour, the most crucial question concerning the future of the Soviet economy lies here.

It does not at all seem likely that the

... When early experiments in equalised peasant income removed all work incentive, the effects were disastrous. Soviet leaders felt compelled to adopt a new device : an extreme piece-work scheme ...

large amount of fat on the carcass of kolkhoz labour can be trimmed to anything like Western proportions. However, the reasons are not primarily economic—a point missed by Soviet analysts and by many Western economists as well. The bloated labour requirements of the kolkhoz are chiefly a result of the administrative system, and only secondarily of inadequate incentives. This point was vividly illustrated several years ago in a comparative study of the employment of labour in combining and threshing crews in Nebraska and the USSR. The study demonstrated that, using comparable machines, a combining crew regarded as exemplary by the Soviets required 10 workers for every one employed in an average Nebraskan crew. A similar comparison of threshing crews yielded a ratio of 14:1.[10] Khrushchev's 1958 comparisons indicate that in spite of organisational changes partially intended to save labour, little or no improvement in labour efficiency has been achieved. According to Khrushchev's statistics, the total labour requirements for growing grain in the kolkhozy in 1958 (ploughing, sowing, cultivating, and harvesting) was 7.3 times greater than American requirements.[11] Since harvesting always requires the peak utilisation of labour, 10 to 14 times as many workers must still be required for this operation in the Soviet Union as in Nebraska.

Arguing that electrification (that is, mechanisation) of agriculture was the proper basis for socialising agricultural Russia, Lenin laid the foundation for a collectivised system that would fulfil both the theoretical and practical demands of the Soviet State. Stalin found that a planned totalitarian system required an additional element, the bureaucratisation of farming. Today, Soviet economists regard the administrative organisation of the country's agriculture as its key feature.

Thus when Shlikhter argues that Soviet agriculture requires fewer machines than are needed in the USA, the UK and France, he concludes that the "socio-economic" system of the USSR is less wasteful of machinery than the capitalist countries. However, he, like other Soviet writers, wisely avoids opening Pandora's Box through a discussion of the problem of labour efficiency.

Key Feature

When early experiments in equalised peasant income removed all work incentive, the effects were disastrous. Soviet leaders felt compelled to adopt a new device: an extreme piece-work scheme. A peasant's income came to depend upon the number of "labour-days" (units actually based on work done and not on time at all) earned. Today, each collective has classified literally thousands of tasks, assigning them to one of nine "labour-day" categories. A peasant's work must be measured daily by an army of checkers employed by the farm. Everything must be recorded by a staff of book-keepers in the peasant's work book and in the kolkhoz accounts. In addition, the collective has an administrative and technical staff charged with the task of guiding and supervising the actual work.

As a result of Khrushchev's reforms, each collective now contains also a party unit that is entrusted with the political welfare of the farm and its members which, according to Soviet definition, includes the whole spectrum of human activity. District party and State officials are charged with keeping continual "day-to-day" checks upon the work of the farms in order to ensure proper fulfilment of the State plan. Each collective has so-called "inspection commissions," consisting of peasants not on the administrative staffs who are charged with keeping a check on the kolkhoz administration. These and numerous other non-productive tasks, like guarding

the kolkhoz produce against peasant stealing, occupy a multitude of able-bodied workers and hamper the efficiency of those directly engaged in production.

Although Khrushchev's post-1953 reforms have included several attempts to improve the system of remuneration, such as allowing the peasants to collect monthly advances on their earnings, rather than waiting until the end of the year, crucial problems remain. The ultimate value of a kolkhoznik's "labour-day" depends not only upon the whims of nature, but also upon the efficiency of several hundred fellow workers. The Soviet Press continually reports situations in which the value of one farm's "labour-day" is three or four times greater than that of a neighbouring farm. Under these circumstances a kolkhoznik can ill afford to leave his assigned field task to take care of a strayed or injured animal, or to take extra pains or precautions of any kind. Bureaucratic farming has yet to find a way to challenge him to make such efforts.

By 1965 "socialist competition" increased electrification, and more machinery are supposed to induce a 100 per cent increase in the efficiency of agricultural labour.[12] The past two decades, in which "socialist competition" has been tried, the number of tractors has doubled, and the kilowatts of power consumed on the farms have increased tenfold [13] —while the agricultural population has not grown appreciably—have brought no corresponding increase in efficiency, and there is no reason to expect the same methods suddenly to produce a different result. Unless and until the Stalinist agricultural system is recognised as the major flaw in the Soviet system, the lag in agriculture will increasingly retard the growth of the economy, and the possibility of achieving United States' levels of production will elude the Soviet leaders.

REFERENCES

1. STALIN, J, **Economic Problems of Socialism in the USSR** (Moscow: Foreign Languages Publishing House) 1952, p. 76.
2. **Pravda,** Dec. 16, 1958, pp. 1-7.
3. ZASLAVSKAYA, T, "Garantynaya denezhnaya oplata truda v kolkhozakh," **Voprosi ekonomik,** No. 2, 1959, p. 115.
4. According to Lazar Volin the greatly increased amount of cash distributed to the peasants in 1956, as compared to 1952 (the period in which the greatest increase occurred), only amounted to a total average income per peasant family of "a little more than $ 200 at a realistic rate of exchange." ("Reform in Agriculture," **Problems of Communism**, Vol. VIII, No. 1, Jan-Feb. 1959, p. 39.
5. A comprehensive study of the political role of the MTS is presented in a work by the present author and two colleagues. (Roy D Laird, Darwin E Sharp, and Ruth E Sturtevant: **The Rise and Fall of the MTS as an Instrument of Soviet Rule,** 1960.
6. **Ibid.**
7. **Ibid.**
8. **Ibid.** Of sixteen countries listed by Shlikhter only Argentina, Mexico, and Canada lag behind the USA in grain yields per acre.
9. This point was emphasised in a British evaluation of American agriculture when the author noted: "The American authorities fully realise that the economic advantages of specialisation and of the resultant high output per man may be outweighed by lower yields per acre and by long-term adverse effects of poor husbandry." (AN Duckham: **American Agriculture: Its Background and its Lessons**, London, 1952, p. 55.
10. NOVE, A and LAIRD, RD: "A Note on Labour Utilisation in the Kolkhoz,"

Soviet Studies, Vol. IV, No. 4, April, 1944, pp. 434-442.

11. **Fravda,** Dec. 16, 1958, pp. 1-7. According to the figures supplied in a discussion with Mr Seivek, chairman of the multi-millionaire Red Star Kolkhoz near Krasnodar (where labour efficiency is surely better than the national average), the collective has one able-bodied kolkhoznik for every 14 acres of land, calculated on the basis of those who are engaged solely in field work (each field brigade has 200-250 hands, and is responsible for 7,500 acres). The collective has one field hand for every 33 acres. The average Kansas or Nebraska farmer probably cultivates 10 times this area of land; other crops will, of course, require more intensive labour employment. On the Red Star the major crops were small grains (3,300 acres), corn (7,300 acres), sugar beets (7,780 acres), sunflowers (1,900 acres), vegetables (600 acres), annual and perennial grasses (8,400 acres), and gardens and vineyards (1,500 acres).
12. **Shlikhter, op. cit.**
13. **Ibid.**

'Crash Programme' to save food losses

The Central Food Technological Research Institute of Mysore has called for a 'crash programme' of scientific research to reduce losses—now estimated at 24 million tonnes each year—to foodstuffs during storage, handling, and transport.

The 'crash programme', proposed by the Institute as part of its 15-year perspective plan, involves an annual investment of Rs. 14 crores, as against Rs. 1 crore now spent on food technological research.

In defence of its proposal for increase in research investment, the Institute says that 24 million tonnes of food the country now loses is worth Rs. 140 crores, an amount that is equivalent to the total annual revenue of the Central Government.

The crash programme is proposed to be implemented by a complex of national institutes of food science and technology which are to carry out, on a much bigger scale, the research now done by the Mysore Institute's 13 departments.

The Institute warns: "It is absolutely essential for us to keep pace with modern development in the field of food science and technology; otherwise, the food shortages will continue to mount even if we achieve increased food production."

Productivity Methods in French Agriculture

There are about two million farms in France, covering 19 million hectares of arable land, which yield a wide range of products. This paper, presented at the Fifth APO Workshop Meeting of Directors of Productivity Centres, held at Tokyo in April 1965, surveys productivity schemes in the French agricultural sector. Because of dissimilarity in soil and climatic conditions, and differences in economic backgrounds, the techniques adopted by French agriculture are not applicable in their entirety to other countries. The French experience, however, is particularly valuable in the fields of production, management, and marketing, exemplifying what can be done with limited means.

IN 1963, agricultural productivity in France showed an annual average increase of 4.7 per cent per worker, which exceeded the rate in the other two major economic sectors, industry and commerce. The migration of workers in the last few years from agriculture into other sectors undoubtedly contributed to this increase, but it is not the whole explanation.

In this context, it is worth studying agricultural production figures in the last 15 years to try to see what has encouraged this development. In 1946, the active male agricultural population amounted to a little over 4 million, nearly 33 per cent of the total active male population. In 1962, the figures had fallen to 2.6 million or 20.5 per cent of active male population. A forecast of the French economy in 1985 shows that the active agricultural population at that period will represent no more than

11 per cent of the total active male population. If this percentage still exceeds that of certain highly industrialised countries, the fact must be attributed to the French agricultural potential (the highest in Western Europe).

The trend of French production in the last few years confirms the country's agricultural vocation. The average wheat yield per hectare, which was approximately 15 quintals before 1939, now stands at about 25 quintals. Maize, which hardly provided 15 quintals per hectare in its common form, now produces nearly 40 quintals with its hybrid varieties. At the same time, there has been a substantial increase in the yield from land under fodder crops owing to the use of new methods.

Trend in Mechanisation

The trend in animal husbandry has kept pace with the increase in feedingstuffs. The number of head of horned cattle rose from 15,342,000 in 1949 to 20,147,000 in 1963. In the same period dairy production increased from 133,000,000 hectolitres of milk to 245,000,000.

Without boring the reader with a tedious enumeration, two figures may be quoted, showing the trend in mechanisation. During the last 15 years, the number of tractors has increased from 120 thousand to a million, and milking machines from 40 thousand to 160 thousand.

The French agricultural industry has about 2,000,000 farms covering 19,000,000 hectares of arable land. These holdings are farmed under widely differing circumstances and yield a very wide range of products depending on a great diversity of soil conditions, climates, and structures. These factors serve to make the application of any advisory programme additionally difficult. However, the flexibility of the productivity schemes which have been so far put into effect has ensured a more rapid adaptation to new production, management, and marketing methods. It is worthwhile seeing how this has been done.

In the initial stage, productivity schemes have mainly concentrated on improving direct production factors. As a result of the popularisation of hybrid maize seed, and advice on its use, the area of land under maize and the yield from the crop have increased fourfold (nearly a million hectares as compared with 256,000; almost 40 quintals per hectare instead of 10).

Productivity may also be credited with a scheme which is less spectacular, but continues to prove increasingly important from a technical, economic, and human point of view: Centres d'Etudes Techniques Agricoles (CETA). These are voluntary groups of 10 or 15 farmers from the same locality who pool their experience. Meeting as regularly as possible, they compare their problems and try to find solutions by themselves, or in certain cases with the help of a technician.

At the present moment there are 1,200 CETAs in France. Compared with the size of the agricultural population, their number may well appear tiny. But it should be remembered that progress in agriculture spreads slowly but surely, and when a scheme has proved successful it hardly needs the help of an advocate to be generally adopted. The CETAs are an instrument of progress and popularisation: they are very widely used for experimental work.

Farm Machinery Pools

A further factor of progress are the CUMAs or 'Cooperatives d'Utilisation de Materiel Agricole' (Agricultural Machinery Pools), giving a certain number of farmers access to suitable equipment, which is

always in good working order, and does not involve them in heavy expenditure.

Mention might also be made of the various schemes in connexion with animal husbandry carried out with the co-operation of the Centre Nationale de Recherches Zootechniques:

——improvement in cattle-breeding methods particularly in mountainous areas,

——research on pigs and poultry,

——research to improve the bacteriological quality of milk.

Despite these schemes, which show that a productivity policy may well extend even to research, it must not be forgotten that preference should always be given, even in the initial stage, to action which is likely to have very wide repercussions.

It is precisely this type of action that the Service de la Productivite has endeavoured to encourage in the field of management and in the organisation of training in economics.

Management Methods

The modernisation of farming has brought about profound economic changes. The arrival of the tractor has put an end to the farmer's self-sufficiency. The need to buy fuel and keep the machinery in repair has made it necessary to have the ready money to meet this expenditure. Mechanisation also affects farm structure. Land consolidation becomes necessary to facilitate the use of agricultural machinery. The extra outlay entailed by the use of selected seed, a wider application of fertilisers, the adoption of animals with a higher performance, and the provision of pre-storage facilities to keep pace with increased production, call for a constant effort to maintain the farm's stability.

It becomes essential to keep accounts of all buying and selling operations. But these accounts must be properly recorded if the right conclusions are to be drawn from them.

Productivity action in this field has had a twofold objective: to promote training in elementary book-keeping among farmers and to encourage the work of organisations which conduct inter-farm comparisons in order to obtain a clear idea of the policy to be adopted in the case of farms which do not appear to be operating on economic lines.

These accountancy centres and management centres are far from covering the whole of French agriculture, but the exemplary value of the work they do is remarkable enough to warrant hopes that they will be further developed with spread of technical progress in agriculture.

The data available at management centres is most valuable in current research into the optimum economic size of farms. The Service de la Productivite has come to participate in this research owing to the consequences which predictable changes in the agricultural world threaten to have on the rural community.

The fact is that higher productivity in agriculture has released a considerable proportion of agricultural labour for other work and its social and vocational re-deployment may encounter difficulties due to the age or inadequate occupational skills of those concerned.

The passing of the self-sufficient farm has increased the importance of marketing. At the same time changes in the commercial field have led to the development of sales techniques involving standardisation and packaging.

This may offer agriculture an opportunity of raising the market value of its products. But farmers will have to learn these commercial practices and take account of consumer demand, and this is the objective of the Centre de Formation

des Assistants du Commerce (Centre for the Training of Staff in the Distributive Trades), the Centre de Formation des Cadres de la Cooperation du Betail et de la Viande (Centre for the Training of Managerial Staff for Animal and Meat Marketing Cooperatives) and the Centre Nationale de la Cooperation Agricole (National Agricultural Cooperative Centre).

Mention should also be made of the many schemes conducted by such bodies as the APEP (Association to Promote Agricultural Productivity) which does advisory work with the help of about 30 agricultural engineers, or the Institut de Formation des Cadres Paysans (Institute for the Training of Agricultural Supervisory Staff), which annually organises two three-month sessions at which 30 or 35 young officials from farmers' organisations are initiated into economic problems, e.g., administrative structures, planning, finance investment, national accounting, price policy, the Common Market, consumption, etc.

Many organisations, including the Federation Nationale des Syndicats d'Exploitants Agricoles (National Federation of Farmers' Union), the Centre Nationale des Jeunes Agriculteurs (National Centre for Young Farmers), and the agricultural branches of the Christian Union and Force Ouvrier foster productivity programmes providing training for their responsible officials, and training in economics and economic advisory work, while the labour unions organise the training of tractor drivers and tractor maintenance personnel.

Such is the picture which emerges from a rapid survey of productivity schemes in the French agricultural sector. The solutions adopted by French agriculture are not of course applicable in their entirety to other countries where soil and climatic conditions are dissimilar, and the economic background is also different, but they exemplify what can be done with limited means.

... Improving productivity does not primarily, and indeed does not often, involve the installation of considerable equipment. In the agricultural sector... productivity schemes may be devoted, in the first instance, to work which does not call for particularly skilled labour or large-scale equipment...

The agricultural productivity schemes carried out since 1949 by the Centre Francais de Productivite represent a total expenditure of 16 million francs, a million per year. This modest figure clearly shows that, although money is necessary in productivity to acquire certain equipment, pay for the help of technicians or specialists, and subsidise study missions, money is not the essential factor.

Improving productivity does not primarily, and indeed does not often, involve the installation of considerable equipment. In the agricultural sector which is our present field of study, productivity schemes may be devoted, in the

first instance, to work which does not call for particularly skilled labour or large-scale equipment. There is a whole range of small projects (repairing roads, clearing stones from fields, digging small irrigation channels, planting saplings), which can be put in hand, even in France, where in the areas least favoured by nature agriculture cannot show anything like the development it has achieved in our grain-producing plains.

Continuous Task

In these somewhat neglected villages, nothing is done any more, for people are afraid of getting into debt. And yet only a little effort is needed to rise above subsistence level to a point at which saving becomes possible—and hence also investment.

Let us quote, for example, the case of that Languedoc village where the young people were unwilling to stay any longer. One day a retired schoolmaster settled there. Many things were in a neglected state, particularly the roads which were practically unusable. Having agreed to serve as mayor, he first turned his attention to repairing the roads, but found the cost of using conventional methods too high. So he tried a cheaper procedure, using local materials and labour which was partly voluntary. To limit wear and tear on the roads, he persuaded farmers to replace the iron hoops on their cartwheels by tyres bought from second-hand motor supply stores. Gradually that village woke out of its lethargy, and began to develop and to hope. Mechanisation and cooperative farming methods followed.

To be sure, it is not always as simple as this to improve productivity, but in many countries there seems to be a possibility of giving the economy an initial impetus through the elementary projects we have mentioned. Once the economic machine has been set in motion, it gathers momentum, and progress can be achieved in all sectors.

As part of an employment policy, Tunisia carried out schemes of this kind while research was being done on pilot farms to determine optimum production conditions. These achievements, though at different levels, are part of an interlocking pattern. Helping the agricultural community to establish a basic infrastructure is to prepare it for the next stage: the popularisation of more modern production methods.

The benefits which may be expected from these small projects are considerable. The protection and restoration of the soil are prerequisites for an improvement in food resources, and at the same time they create possibilities of wider employment.

Productivity improvement is a continuous task. Each step forward means further research to fit the worker more effectively for his task and obtain a better yield from the farm. These initial projects which are quite feasible, because they are aimed at improving perfectly visible deficiencies (broken road surfaces, stony soil, the complete or almost complete failure to make use of animal droppings as fertiliser, etc.), help to make the rural population alive to the improvements in its productive resources, and thus create a climate conducive to future developments in productivity policy.

Read

PRODUCTIVITY

regularly

It's an NPC Publication

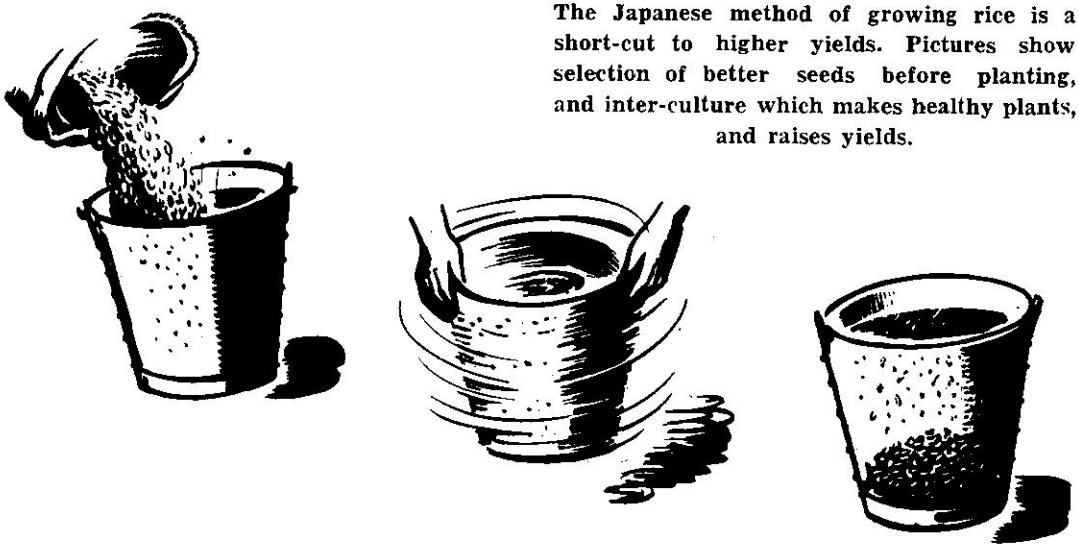
JAMES H BOULWARE

Agricultural Attache
American Embassy, New Delhi

Food Production: Some Lessons from Japan

Japan, which suffered heavily in World War II, and where everything was in short supply in 1946, became, within a matter of a decade and a half, the envy of most of its neighbouring nations. Food and consumer goods are abundant there today. As regards rice, we have in Japan and India a classic example of contrasting yields—yields in the former averaging well over 4,000 lb per acre, while in the latter it is just over 1,000 lb. Japan's agricultural productivity can well be "an ideal target for most nations." How she did this, with determination and perseverance, and how far an evaluation of its experience can be useful to us, form the theme of this paper.

IN SEPTEMBER 1964 I was delighted to learn of my assignment to India. In preparing for work here, I learned more of the food situation, and of India's efforts to meet the food problem. I learned that for three years, the production of grains and pulses had been almost static, at 80 million tons annually, while during the same period the population had increased about seven per cent. Consequently, when I arrived in India in December 1964, I was not surprised to find that India's food supply situation was critical. I was surprised that so many felt that the rapid population growth, shortages of fertilisers and other supplies, and low agricultural productivity made India's outlook extremely pessimistic. These pessimists felt that India could never afford the "huge" imports of food necessary to feed its growing population. They wondered whether India could ever raise its level of living, and especially nutrition. In short, could India increase its



The Japanese method of growing rice is a short-cut to higher yields. Pictures show selection of better seeds before planting, and inter-culture which makes healthy plants, and raises yields.

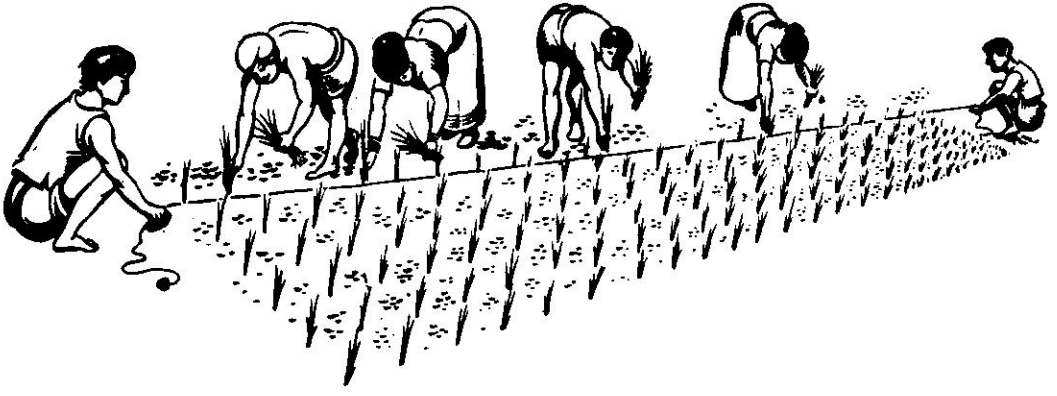
productivity more rapidly than its rise in population, and become an economically self-sufficient nation?

Many of these remarks and questions carried me back almost 20 years—to April 1946 when I arrived in Tokyo (Japan). At that time Japan's major cities and industries were in ruins as a result of the devastation of World War II. Virtually everything was scarce. The population, augmented by repatriation, and the inevitable surge that results from the return of members of an armed force to its homeland, was increasing more rapidly than it is in India today. Food was in extremely short supply. I know of only one person who was not convinced that Japan's future was bleak indeed.



To feed a population of 75 million, Japan had 15 million acres of arable land, or 0.2 acres per capita, as compared to about 0.7 acres in India. Resources to import food and other essentials were limited. One of my Japanese friends once said, somewhat in jest but with serious undertones that, "We have plenty of water, sulphur and people—everything else is in short supply."

When I left Japan in October 1950, things had greatly improved, but food was still a major problem. Many Japanese, and most Americans stationed in Japan, were still extremely pessimistic. They freely expressed the opinion that Japan could never become an economically viable nation. The thought furthest from our minds was that Japan would, in 10 years,

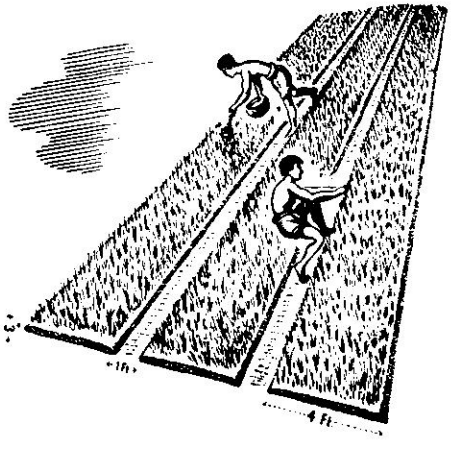


have a progressive, economically sound economy supporting a standard of living that would be the envy of most of its neighbouring nations. It was predicted that Japan would have over 100 million people by 1960. In our egotism, we even predicted that massive overseas assistance would be needed indefinitely.

Errors in those judgments of 1950 are too well known to recount. Japan has nearly stabilised its population, and the 100 million figure has not been reached still. Its economy is growing rapidly. Food and consumer goods are abundant. Its products are available in markets throughout the world. In agriculture, its productivity could well be an ideal target for most nations.

How did Japan do this? The simple answer is a rapid increase in agricultural and industrial productivity, but what made this possible? We are concerned here with agriculture, and will not discuss the industrial productivity, although it is, of course, of equal importance.

In 1950, a land reform programme was largely implemented. This provided virtually all of the six million Japanese



Paddy seedlings are planted in lines in the main field. The raised seed-bed is 4 ft wide and 3 inches above the ground level. Between the beds there is one-foot space. Manuring is an essential part of this method. RIGHT: The right and the wrong way of handling the seedlings while replanting.



farmers their land to own and operate as they chose, and to enjoy the benefits therefrom. The farmer benefited from free enterprise, and responded by doing his utmost to raise further an already high productivity. His success is illustrated by rice production, which rose from an average of about nine million tons in terms of brown rice in the late 1940s to 12 million in the early 1960s.

Food Distribution

The Japanese Government realised in 1950 that strict war and post-war food controls were not working, and could never be used to distribute equitably the basic foods used. It relaxed these controls gradually. By 1960, food distribution was, and continues largely, in the hands of the private trade, with the Government standing ready to purchase food grains to provide farmers a price that encourages maximum productivity.

The Japanese Government realised that ample supplies of farm inputs were absolutely essential to productivity. It recognised the absolute necessity for a rapid expansion of private investment if such inputs were to be produced in volume quickly and economically. It deliberately moved to create an investment climate that encouraged Japanese and foreign entrepreneurs to produce and market profitably fertilisers, pesticides, farm equipment, trucks, and many other requisites. It recognised that an absolute essential for the entrepreneur is an opportunity to earn a return on investment proportionate to the risk involved. In 1950, these risks were great, and some profits have been extremely large—to the benefit not only of the entrepreneur, but equally, if not to a greater extent, to Japanese labour and the country.

The ready availability of these farm inputs at reasonable prices as and when needed to Japanese farmers, as well as on world markets as exports from Japan, is testimony to the success of that policy. Research and farmer education had been an important part of the Japanese agricultural programme since early in this century. However, again the Japanese Government recognised certain shortcomings, including the isolation of its scientists from world research during the war years. It reorganised its extension services to ensure that farmers were aware of current research developments, and hastened to apply world developments to Japanese agriculture.

Japanese farmers, with Government assistance, reorganised the cooperative movement, and used cooperatives effectively to compete with private merchants.

Worthy of Emulation

Through the above and many other efforts, Japan has shown that, with determination and perseverance, a nation can overcome what would appear to be nearly insurmountable obstacles. The Japanese are practically 100 per cent literate, and have a history of industrial and agricultural research and development. However, Japan must import much of the coal, most of the iron ore and many other raw materials needed to produce farm inputs. Its soils generally are not inherently fertile. It has the industrial background necessary to produce fertilisers, pesticides, and machinery. However, such a background is less important for producing these products than it is for sophisticated goods such as transistors, computers, and electronic equipment.

Probably no one would suggest that the Japanese experience could or should be transferred without modification to India or any other country. Nevertheless, I am personally convinced that a careful evaluation of Japan's experience over the past 20 years could benefit many countries now endeavouring to raise the living standards of their people.

KS KAROL

Chinese Agriculture Has Big Margin for Expansion

Communist China may need yet another 20 years "to create a really modern agricultural system." The level of mechanisation is said to be "very low," and there is great variation in productivity per acre in parts of the same commune. The author, who recently spent 18 weeks in Mao's land, has (in an article on Maoism in the **New Statesman**) something to say on the reorganisation of the Chinese agricultural economy, how they regard it as the basic element in their economy, and the attention they are paying to it, so that the 120 million families now living off agriculture, may become a productive sector of the Chinese economy.

THE CHINESE tried to introduce full egalitarianism in their countryside in 1958, when they launched the communes in their most ambitious form: every member was to work as hard as possible, and receive everything he needed free in return. The system didn't work: there was not enough to supply both the towns and the shops and canteens of the people's communes. The experiment, moreover, coincided with a series of natural disasters. Some critics also held that the advanced communal system gave no incentive at all to the peasants.

So it was necessary to return to a more modest formula. The giant communes were divided into smaller units. The basic unit is a work-team, generally about the size of an average village. Each is paid according to its productivity, which, of course, depends on the soil and the climate. The present system of remuneration is rather similar to that in the

Soviet kilkhozes (collective farms). But there is one important difference: the commune is at the same time a productive cooperative and an administrative organ which the kilkhoze is not. Therefore, it has power to intervene to prevent too great a disparity between wages, and uses these powers to improve the condition of very large or deprived families.

An old myth, very widespread in the West, insists that Chinese peasants cultivate every scrap of land. You get this impression when travelling by train, but a close look at the people's communes gives a different picture. Chinese agriculture has a big margin for expansion. The productivity per acre in one commune where chemical fertilisers are used often surpasses that in other parts of the same commune by 3:1. And the idea of a 'pig farm' or 'chicken farm' is totally unknown. Almost everywhere, pigs are 'boarded out' with peasants who receive a certain number of 'work points' for the care and food they give them.

The level of mechanisation is visibly very low. Mr Wu Chen, Vice-minister of Agriculture, accepted some of my observations, but he emphasised the progress already achieved: "No one died of hunger here during the years of the worst natural disasters we have known in this country, and no one had to leave the worst-hit areas." According to him, China will need another 20 years to create a really modern agricultural system, capable of doubling its present yields. To reach this target, four fundamental elements must reach the land: electrification, mechanisation, irrigation, and plenty of chemical manure. "Everything is now mobilised to fulfil these conditions."

Poor Man's Menu

Tapioca is an important subsidiary food of the people of Kerala. It is known as a "poor man's menu." On a number of occasions it has helped withstand the acute food shortage in Kerala, particularly during and immediately after the last World War.

In India, Kerala is the major producer of tapioca, accounting for over 95 per cent of the total production. It is extensively cultivated in the erstwhile State of Travancore.

It is cultivated over an area of five acres, and in terms of percentage the area covered stands next only to paddy and coconut. The annual production is over 15 lakh tons.

Tapioca is one of the crops which find only a limited industrial use at present. But it can form a basic raw material for some important chemical industries. Primarily, tapioca is used for edible purposes. At the moment the only industry based on tapioca is a starch-manufacturing factory at Kundra. Besides, some small-scale units are also producing tapioca starch as a by-product of tapioca flour. However, there is enough scope for using tapioca as an excellent raw material for producing fermentation chemicals such as acetone, ethanol, and butanol. A small portion of raw tapioca is made into manioc meal and exported as pig and cattle feed to West Germany and Holland.

Towards the end of 1964 the Kerala Government banned the export of tapioca to any place outside the State.

WH SENIOR

Deputy Secretary
Dept of Agriculture & Fisheries
for Scotland, Edinburgh

Farm Management Revolution in Scotland

There is a world of difference between farming in India and Scotland, but the aim in both countries is increased productivity. Making a living from soil throws up problems, particularly of organisation and management, which are common to many parts of the world. A number of techniques, chiefly analysis of farm accounts, are in vogue in advising on individual farm business problems, and their adoption has brought, according to the author, quite astonishing benefits to individual farmers, and to agriculture as a whole, in Scotland. Indian readers may, therefore, find considerable interest in current developments in farm management in Scotland.

THE AIM in Scotland, as in India, is increased productivity, but the relationship between increased productivity and increased production in British agriculture has undergone a significant change in the past few years. During the war period (1939-1945), and for some years afterwards, the aim of greater efficiency in British farming was the maximum production of food for a country cut off from imports from abroad. British farmers responded vigorously to the incentives provided for greater output, but it was inevitable, in our primarily industrial country, that economic factors would, in due course, bring a change of emphasis. In the mid-1950s British farmers were told that the objective of production policy was the most that could be produced economically and efficiently in accordance with market requirements, increasing technical efficiency, and diminishing unit cost. The result has undoubtedly been to make British farming extremely costs-conscious. Profitability in

British farming is determined not only by scale of production, but also by efficiency in the organisation of production and in marketing. The farmer is a businessman, and it is now widely accepted that the time the farmer spends in his office is at least as vital as that he spends in his fields.

BPC's Slogan

In this change of attitude, an important role has been played by the British Productivity Council, whose Agriculture Committee recently launched a campaign called "Farmer, Know Your Costs!". This slogan is a useful pointer to the whole process: the typical Scottish farmer may well be running a wide group of enterprises on his single farm, perhaps including, e.g., dairy stock, pigs, cereals, and root crops. The economics of his farm may, therefore, be quite complex, but it still remains desirable that he should make sure, through costing, that each enterprise is contributing its fair share to the farm's profitability. Put in its simplest form, farm management means the choice of product and farming methods that will give the best return from any particular farm. But analysis of all the factors involved in such a choice is by no means a simple matter, and the trend in Scotland is for this work to be carried out by Agricultural Advisers, many of whom are specialised in economics. The Adviser cannot do everything, however; even if it were possible to provide enough Advisers to carry out the account work for every farm, no farmer wishes to hand over all his management responsibilities. Here again the slogan "Farmer, Know Your Costs!" is significant. It is for the farmer himself to assemble the accurate information which will allow for critical analysis of his farm's efficiency. Apart from that, BPC had in mind the obvious benefit to a central system of analysis if farmers adopt a uniform presentation of accounts. This facilitates the use of computing machinery for processing data.

Many farmers, of course, have long kept fairly detailed accounts, and for all a certain minimum has been necessary for taxation purposes. But recording for farm management aims to provide the basis not only for an accurate financial picture (revenue, expenditure, capital investment, profit) but also for, amongst other things, a measure of efficiency in the use of grass, forage, and feed. BPC's campaign is based on the encouragement of meetings of small groups of farmers to discuss costing methods, and to compare each other's methods and profitability. This has coincided with the production by the English National Farmers' Union of a standard form of record book which every farmer can use. A similar book is being produced in Scotland.

Clearly, Agricultural Advisory Services, in one form or another, have an important part to play in the development of farm management expertise.

Advisory Service

I have already mentioned the role of the "Adviser." In England and Wales, the National Agricultural Advisory Service, a part of the Ministry of Agriculture, are devoting a great deal of attention to farm management developments. I myself am concerned with Scottish affairs, and I should like to say something in more detail about the Scottish Advisory Service.

We, in Scotland, believe that there are disadvantages in having an Agricultural Advisory Service as part of the Government machine, and our Advisers are in the employment of three independent Agricultural Colleges, closely linked with neighbouring universities, and responsible both for the advisory service to farmers and for formal teaching for agricultural qualifications.

The advisory side of the colleges' work is divided between County Advisers, who are the men in the field in touch with the individual farmer; and Specialist Advisers stationed mostly at college headquarters. The Specialists carry out investigational work as well as informing the County Adviser of the latest research developments and acting as consultants on his more difficult cases.

... In all agricultural colleges, the aim is to help the farmer to judge his own farm business carefully, and in detail. This approach has indeed proved so popular that it has been difficult to provide for everyone wanting to join in ...

Two Types of Work

The colleges have been active in the field of farm management for 10 years or more. Their specialist staff for this work are situated in the College Agricultural Economics Departments, with, in addition, specialist staff engaged in studying improvements in the use of labour and machinery. Each college, therefore, has a team of skilled farm management men responsible for the development of new methods of farm business analysis; for training general advisers in farm management techniques and providing them with data; and for undertaking direct advisory work, in association with the county advisers, for farmers who come to the colleges with particularly difficult farm management problems.

The colleges see farm management work as being of two types. First there is the job of advising individual farmers about ways of increasing the profitability of their farm businesses: for this, personal contact with the individual farmer is essential. But growing in importance is the educational job of showing why business management is as important to farming as good husbandry, and how farmers can know more about their farms from the business angle. For this second job informal discussion groups are proving increasingly successful.

A number of techniques are used in advising on individual farm business problems, the main one being analysis of farm accounts to show how efficiently the farm is being run. What is its output per acre, what is its density of stocking of livestock, how productively does it use its labour force and its machinery, and so on? This is an examination of the whole farm business, which involves quite a lot of work especially if the information for it has to be dredged up from odd corners of the farmer's desk and memory; but it can give the clue to where the weaknesses lie —for example, in the choice of enterprises or in the use of particular items like feed or grassland or labour.

The next step is to plan a better organisation, and here the skilled adviser comes in using his wide experience to work out with pencil and paper what

changes might be made, and what effect they might have. He may well do this in terms of gross margins, a method of analysis which is widely used nowadays. This method depends basically on making a distinction between fixed and variable costs.

Fixed costs are those which are set by the farm itself, at least in the short or medium term, and will not vary with the level of output. Variable costs are those which are concerned with a particular enterprise, and would be materially affected if that enterprise were changed in importance. It will be seen that this enables individual enterprises to be judged, after their variable costs have been met, by the contribution they make to meeting the fixed costs of the farm and leaving something over as profit. This contribution is called the "gross margin" of the enterprise, and it is very much easier to work this out than to share all the fixed costs between enterprises. It will be seen too, that by sorting out separately those farm costs which can be changed by an alteration in the production pattern, this gross margin approach simplifies the business of budgeting the effect of possible changes in organisation.

Linear Programming

There are other more detailed ways which are not used so extensively at the moment, but which are under close investigation with a view to possible wider application. One of these is "Linear Programming" which involves the examination of all the possible ways in which a farm's resources can be used in order to discover the one way which will yield the highest profit. This becomes feasible with the use of an electronic computer into which is fed the gross margins of all the enterprises which are practised, or are practicable on the farm, together with information on the restrictions imposed upon the farm's work —by such things as the acreage, capital, labour, and buildings available, the crop rotation judged to be necessary, and the wishes of the farmer. The computer will then work out the effect of the possible combinations of the various enterprises within the limits imposed, starting with one feasible farm plan and then examining all possible modifications of that plan until it finally arrives at the best possible solution within the limits set. But in many cases such an approach may be over-elaborate. In many farm situations there are few restricting factors, and, in such circumstances, it is possible for the skilled adviser to list the enterprises in order of the gross margins that they produce, and then proceed by a series of budgets, each one improving on the previous one, to a solution which will not be so very different from that worked out by a computer.

For the situation where farm business analysis suggests that improvements are possible in a particular enterprise, or where the farmer is interested in finding out about his most important or most critical line of production, all the colleges either have in being, or are experimenting with, enterprise recording schemes. In the West of Scotland Agricultural College area, for instance, there is a spot feed check for dairy farmers, under which a farmer can choose a suitable day in the month, and fill up the details of his cow numbers, milk production, grazing, concentrates, and so on. From this the quantity and cost of feed per cow is calculated, and the computed results are returned to the County Adviser for discussion with the farmer. Another college has a farm management service in operation under which inputs and outputs for particular enterprises are recorded, and efficiency factors calculated for each enterprise month by month. The college economists add their comments and return the

figures via the County Adviser to the farmer.

In these and other similar systems, the aim is to help the farmer to judge his own farm business carefully, and in detail. This approach has indeed proved so popular that it has been difficult to provide for everyone wanting to join in.

This brings us back once again to the farmer himself. A group of skilled advisers is essential for the development of farm management. But the farmer himself must be alive to the benefits that he can gain from farm business analysis, and willing to cooperate by the provision of the necessary data. In the short term, great benefits can be achieved by the use of propaganda campaigns such as the one being run by BPC. But in the long term we must look to the education of our farmers, and here the colleges and other educational institutions are playing their part by providing classes and courses in farm management.

'Astonishing Benefits'

Already farm business analysis has brought quite astonishing benefits to individual farmers in this country, and of course to our agriculture as a whole. This development is by no means completed—indeed it is only within the last year or two that it has made significant headway among farmers.

My own expectation is that in the end of the day it will contribute as much to our agricultural industry as mechanisation has in the past. It is perhaps a pity that the days of "farming by instinct" are numbered for us, but increasing efficiency linked with higher educational standards can only result in improving the status of the farming community.

Do You Know...

Nearly 66 million draft animals and 40,000 tractors ("half of which are out of order") constitute the motive power in Indian agriculture. This works out to an installed power of about 0.25 hp per hectare, which is not even 1/4th of that available in advanced countries.

More than 10 million tons of food grains are wasted in this country every year. This is nearly twice the amount we hope to import annually over the next five years... Defective rice milling results in the yield of only 58 per cent of rice from paddy in contrast to 72 per cent abroad.

Since 1956 purchases under the PL–480 Agreement have cost us nearly Rs. 1,500 crores.

The United States of America which produce all their nation's food requirements, and also provide a big exportable surplus, with only eight per cent of their population employed in farming, possess only large-sized farms of 100 acres and above.

Seventy per cent of the total farm area in India consists of farms larger than 10 acres.

It was a simultaneous growth of industry and agriculture that had enabled Japan to increase its agricultural output by 45 per cent in the four decades from 1881 to 1920.

For every lakh tonnes of imported rice, India has to find Rs. 6 crores worth of foreign exchange.

DUPE OLATUNBOSUN

Dept of Agricultural Economics
Michigan State University

Incentives for Improving Nigerian Farm Productivity

This is a working paper prepared for a research project on incentives for improving productivity in Nigerian agriculture. The problem discussed is the use of monetary and non-monetary incentives as a means of improving productivity in agriculture. The objective is to find out what kinds of incentives can be used to increase productivity in agriculture in the developing nations of the world, with special emphasis on Nigeria.

IN the developing nations of the world where labour is abundant, and income per person is relatively low, the assumption is that applications of incentives will help towards increasing productivity in agriculture as well as in any other enterprise.

It is known even to a layman today that developing nations require capital and improvement in the application of agricultural technology to meet the expanding needs of their ever-growing population. It is not surprising that desire for capital and technological improvement as a means of improving productivity has blinded leaders of most under-developed countries to the vital role incentives can play in improving production. Another assumption is that if incentives are provided, and if the systems of values are favourable to obtain

the motivation and drive of the people a sense of national identity will develop, and this will give the people respect for themselves and confidence in their ability. Such conditions will cause them to work harder, and consequently meet the future more successfully.

It is my strong belief that the use of monetary incentives will have great significance, especially among the low income workers. To this group of people, the marginal utility of a rupee is comparatively higher than for the high income group. Hence the low income group value very highly additional increases of say 50 paise or more on top of their regular wage.

Diet and Health

The importance of such additional income cannot be over-emphasised when one remembers that most of the people in these developing countries live in abject poverty and are unable to meet the expenses of even the basic necessities of life, viz., food and clothing. If these people are encouraged to work by proper use of incentives, they will, through their own efforts, earn more money which will enable them to improve their diet, thus improving their health by adequate nutrition. With better health, there will be a general increase in productivity of labour—an indirect effect of incentives, and other factors. This will result in a higher output per man, an increase in the country's national income, a better balance of payment, increased purchasing power in the domestic market, and a better standard of living. This is a significant measure of economic progress.

The application of non-monetary incentives will have significance among the high income groups. These could be in the form of recognition, status, awards, praise, and such other factors which will provide motivation, and arouse the spirit of patriotism in the individuals. These will create in them a strong sense of contributing and belonging, which will make them willing to raise their contribution and quota to the progress of the community without expecting any monetary reward.

Incentives work best when the connexion between work done and incentive received is apparent. Thus the use of monetary incentives will be valuable among the daily-wage earners who form the bulk of labour in the developing countries. The immediate daily reward of their effort will serve as an impetus for them, and encourage others. In the studies carried out in Bihar, through the use of evaluation groups in August 1961, it was shown that a small financial inducement would stimulate both staff and students to assist in extension work*

I am highly optimistic that this project, if successful, will result in continuous improvement in management; and that the use of incentives may be another means of attacking the vicious circle of poverty in the developing nations.

Hypothesis: 1. That within the value system of a society, it is possible to find incentives, both monetary and non-monetary, which will be of considerable importance in improving productivity, especially in agriculture; 2. That since motives are internal while incentives are external, if motives and attitudes are understood, one will know the types of incentives to use.

Methodology of Field Research: This will be through the use of questionnaires—both with individuals and with groups of workers. This study will be carried out on a big plantation in

* Paper presented in Asian Studies Section of Michigan Academy of Science, Arts and Letters, at annual meeting at Western Michigan University, March 22, 1963.

Nigeria where adequate data can be collected. The plantation at Apoje, Western Nigeria, employs a heterogeneous collection of people from the various sections of the country. This should enable some tribal differences to be determined. The set up of the plantation is also such that both the monetary and non-monetary incentives can be applied. The villagers are very important in determining the economic pattern of the developing countries, hence any research should contain a significant percentage of this group of people in the sample.

Certain specific variables, which will determine the contents of the questionnaire, will be studied. Such variables include: (i) Religious background, (ii) Child-rearing practices, (iii) Whether grown up in the city or village, (iv) Education, (v) Sex, (vi) Jobs and experiences in the past, (vii) Income, (viii) Mobility —both residential and occupational, (ix) Future plans, (x) Whether optimistic or pessimistic about (ix) above, (xi) Orientation towards people, (xii) Age, and (xiii) Marital status.

It will be necessary to use control groups, and to find the determining variables that will help to show the value system of the society and the type of incentives to use. (This is the problem.) Both individual and group incentives will be considered. The strong attachment of individuals to group loyalty is important, for strong attachment to group may render the individualistic incentives ineffective.

It must be emphasised that this project is in its infancy, and what has been written is just a means of collecting ideas on how this very important project can best be carried out to achieve its objectives.

Growing Threat to Cultivable Land

About 15 million acres of originally fertile land has been rendered "unproductive" either due to the development of salinity or alkalinity of the soil, or rise in sub-soil water level, according to official estimates in Delhi.

Another five million acres in the coastal region are also reported to have become useless for cultivation owing to the tidal effect of the sea.

The problem of salinity and water-logging has assumed a very serious proportion already in parts of the Punjab and Uttar Pradesh, since the advent of canal irrigation. In Punjab, nearly 30 lakh acres of cultivable land has become saline, and are under various stages of deterioration. The annual loss of crop in the State is assessed around Rs. 34 crores. In UP the rate of deterioration is Rs. 50,000 crores per year, and about 30 lakh acres are lying waste because of saline and alkali soils.

GEORGE HOUSTON

Agricultural Situation in Eastern Europe

George Houston, who recently toured East European countries, describes in this article (reproduced from the **New Statesman**) the agricultural situation there. Food output has been lagging well behind their plans, he says, but the transition from the fragmented field system to cooperative farms "has at least solved the problem of size structure which bedevils agricultural policy-making in the West." Attention is drawn to the "weaknesses" in the system, but it is claimed that the "new policy" that is now being adopted, has already had an impact on agriculture.

AS THE PLANE flies east to Prague you notice the contrast between the fragmented field system of Western Europe and the large consolidated fields of cooperative farms in Bohemia. To a Scotsman accustomed to stone dykes enclosing herds of black, brown, and blue-grey cattle, fat lambs, and lean ewes, the absence of fences and grazing animals is an even more striking feature of the Czech countryside. When I did see socialist livestock, permanently housed in good buildings, their looks were better than their production records. The average milk yield, for example, is a little more than half that in Britain.

Yet, criticism of the weaknesses of agriculture in Eastern Europe has been so severe that a visitor is bound to be impressed by its positive features. The transition to cooperative farms has at least

solved the problem of size structure which bedevils agricultural policy-making in the West. Moreover, on the minority of good farms, small teams of competent, hard-working, young, scientific farmers are building up efficient enterprises that will soon rank among the best in Europe.

The greatest structural weakness of their agriculture is not so much the size of farms—though some are too big—as the age of the farm population. A cooperative of 1,500 acres is likely to have 300 members or more; half will be women and half will be over 50 years old.

One social reason for low labour productivity is that there are too many old people who have to be found jobs on the farms in order to enable them to earn a livelihood. Paradoxically, in 10 years or so, there could be a severe shortage of labour which further mechanisation will only partly offset. The young are leaving. Few come back after their military service.

The new policy to replace directives by economic measures has already had an impact on agriculture. Strict centralised control of the production plans of individual farms has been abandoned. In recent years, it has probably been most effective where it was not needed, and largely ignored where it could have helped. "When the regional plan came down to us in the local areas," one official said to me, "we always called in the most obstinate farm chairmen first. They were, of course, from the best farms. After we reached a compromise between what they wanted to do, and what was necessary for our local plan, we held discussions with the weaker farms. They always agreed immediately with what we suggested, although they did not succeed in carrying it out."

In Czechoslovakia, each farm can still be given planning directives for three products. The influence of Government on production can also be exercised, in practice, by varying the assistance given to farms according to their willingness to adopt an approved plan. But directives will soon give way to prices as the main means of influencing the level and pattern of agricultural production. The arguments concern the form and extent of the changes.

Allocation of Resources

A few major decisions have to be faced. Should the general level of agricultural prices be raised? Should the allocation of resources to farming (machinery, fertilisers, building materials) be determined by prices as well? To what extent should the State impose a differential land tax on the farms which have favourable natural conditions?

There is now a healthy scepticism about the possibility of discovering the correct solution to any of these problems. I listened to several different proposals on selecting appropriate guaranteed prices; one of these would introduce a system of regional prices, another would adopt long-run guaranteed 'floor' prices, but would allow supply and demand to determine any supplements above that level. In the near future, I believe, the level of farm prices will be raised, and the price structure changed throughout Eastern Europe. Increased investment, especially in livestock production, will also be necessary, but the method of allocating these new resources will present problems.

At a good farm I asked the manager why he did not spend more money on adopting modern techniques which he obviously knew about. "We have plenty of money," he said, "but we can't obtain the resources. They are allocated according to the plan." If the prices of tractors, fertilisers, and materials were raised, however, the better farms would be more

able to afford them than the poorer farms, and would acquire a larger share. It is also arguable that they would make better use of the new resources, and that farm production and efficiency would rise more rapidly.

The variability of farm incomes and efficiency is already wide in Eastern Europe, and the increasing use of the price-mechanism could increase it much more. Ideally, the State would like to cream off that part of high farm incomes which is the result of more favourable soil or climate; this requires a careful classification of farm regions, and such a survey is now being conducted or is in preparation in several countries. Income differences caused by better management are not to be removed under the new system; they will be used as an incentive to increase food production, for although labour productivity has gone up about five per cent a year following the decline in the agricultural population, food output has been lagging behind the plans.

More food will certainly be a popular policy in the towns, but when I asked a Prague taxi driver whom he thought was too highly paid in his country today, he said: "The tractor drivers on richer farms." A deliberate attempt to raise farm incomes may prove no more popular in Eastern Europe than agricultural subsidies in Britain. Czech feather-beds, as every tourist knows, can be too warm—and too easily displaced.

Harvesting: Symposium Urges Standardisation

The three-day symposium on Technology of Rice and Rice Products, organised by the Central Food Technological Research Institute in August, has suggested standardising harvesting, threshing, and drying of paddy for obtaining maximum yield in the milling of rice. In order to raise the efficiency of milling operations, the use of more modern machinery was essential.

Regarding quality standardisation of rice mills, the symposium felt there was need to undertake a systematic study for laying down more specific standards and setting up machinery for their enforcement. To protect consumers and millers, the symposium felt that it was essential to enforce improved techniques of par-boiling, if necessary, through legislation.

The symposium emphasised the urgency of developing rice bran industry, and recommended immediate studies to determine the minimum economic size unit for the extraction of rice-bran oil.

Regarding handling, storage, packaging, and marketing of rice, the symposium felt that there should be close collaboration between the CFTRI, the Grains Storage and Research Institute, the Central and State Warehousing Corporations, and the Food Corporation in research, extension, and application of techniques of rice storage.

PC BANSIL

FAO Agricultural Economist
Colombo

Intensification of Peasant Agriculture in Ceylon

Though capital for Ceylon's agricultural development, as well as any other industry, is scarce, there has been, compared with the 1952 base, an increase of 23 per cent in the acreage yields. Seventy-five per cent of the population is, directly or indirectly, engaged in agriculture, but PC Bansil says that, with the total cultivated land per head of population decreasing in the past 50 years, the only solution to the paddy problem lies in a further intensification of peasant agriculture. The author discusses this problem, and others like productivity of land, labour, and capital, and the institutional factors linked with agricultural productivity, and states that irrigation, fertilisers, and improved seeds can definitely be isolated as adding to land productivity in this order.

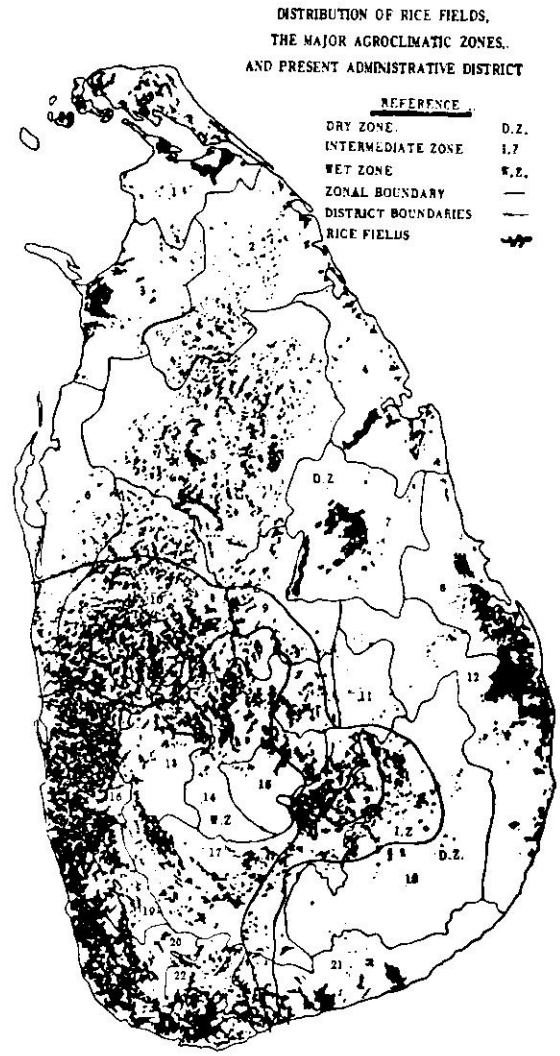
OF THE total geographical area of the Island of Ceylon—16.2 million acres—nearly one-third constitutes the Wet Zone, and the balance is Dry Zone. The present extent of cultivated area is about 3.8 million acres. The total area available for cultivation is roughly 6.5 million acres. Thus about 3 million acres is available for further exploitation.

Of 3.8 million acres of cultivated area, as much as 2.8 million acres lies in the Wet Zone where agriculture is devoted mainly to the growing of plantation crops —tea, rubber, coconut, papaw, cinnamon, pepper, and other spices. The total area cultivated in the Dry Zone is thus hardly a million acres. With the exception of the Jaffna peninsula, where the standard of cultivation is comparatively high, and a few scattered colonisation schemes with commercialised rice production, agriculture in the Dry Zone is generally of the subsistence type. Rice is cultivated in

the irrigable lowlands, while gingelly, gourds, cowpeas, grains, and chillies are grown on the unirrigable land according to the traditional chena system, yet surviving from the time of the Sinhalese Kings.

The total area of about three million acres available for cultivation lies in the Dry Zone. Since the development of this land is closely linked with the availability of irrigation water, the pace of agricultural development in this area is rather slow. The lack of a sufficient number of perennial rivers, and the failure to find subterranean water supplies, have restricted the development of irrigation almost entirely to the restoration of ancient irrigation schemes. Even with the maximum development of all the irrigation schemes, it is estimated that about 2.5 million acres will still remain unirrigable.

Table I gives an idea of the land* utilisation pattern in the country. In peasant agriculture, paddy is the most important crop accounting for about 1.2 million acres. With the exception of the main plantation crops—tea, rubber, and coconut—the area devoted to other crops is negligible. Since there is no scientific basis for the collection of agricultural data, except for paddy, we shall restrict our analysis to paddy alone. The distribution of paddy cultivation in the Island



* Ceylon is a pear-shaped Island in the Indian Ocean situated to the South-East of India. For agricultural purposes, Ceylon has been divided into two broad natural regions, based largely on the distribution of rainfall. The Wet Zone which has a mean annual rainfall of over 75" is bounded approximately by the Deduru Oya in the North, the Walawe Ganga in the South, the Sea on the West, and the Eastern foothills of the Central Massif in the East. Lands outside this area constitute the Dry Zone, which has a rainfall of less than 75", and is characterised by a pronounced draught during the S-W Monsoon from May to August. But for some small sections on the Western Coast, upward of Puttalam and the South Coast round about Hambantota, the average annual rainfall even in this region is between 50" and 75".

TABLE I

Land Utilisation Pattern in Ceylon—1962

	In Million acres
Geographical area	16.2
Total State forests	3.5
Roads, streams, tanks, buildings, etc. ..	1.3
Rocky and steep lands, and land over 500 ft., etc. ..	4.8
Available for future cultivation	2.9
Net cultivated area	3.8
Paddy	1.2
Tea	0.6
Rubber	0.7
Coconut	1.1
Other Highland crops, including chena	0.3

is given in the map on page 307.

Because of the lack of data again it would not be possible to go into a detailed analysis of productivity. Broadly, there are about a million families working on 1.2 million acres of paddy, which means roughly a cultivator family handling 1.2 acres. The total cropped area under paddy for both the reasons—Maha and Yala—in the Island today is 1.56 million acres, which gives an average of 1.56 acres as the cropped area under paddy per cultivator family.

Pressure on Land

The total number of families in the Island being two million, each cultivator family has to support an additional family. With the present rate of increase of population at 2.7 per cent, and little possibility of addition to the cropped area keeping pace with this galloping rate of population increase, pressure on land is increasing every day. Since the beginning of the century, population has increased fast from less than four million to over 10 million, and the cultivated area per head of population has declined from 0.63 to 0.37 acre. Between 1946 and 1962, while population increased by 56 per cent, the total extent of agricultural land increased only by a little more than nine per cent. This has resulted in increasing the pressure on land. While an acre of agricultural land supported 1.56 persons in 1946, this ratio went up to 2.24 in 1962. In so far as paddy is concerned, the total area under the crop—1.56 million acres—has to support today a population of nearly 10.6 millions for their staple food. At present just 0.14 acre of paddy land is available per head of population. Obviously, with the present yield of 38 bushels (one bushel=45 lb of paddy or 30 lb of rice) per acre, and the per capita consumption of a minimum of eight bushels, we need at least 0.25 acre per head at the present levels of productivity, if self-sufficiency is the objective. Even the total cultivated land per head of population is decreasing slowly over the last four to five decades. The only solution to the paddy problem of Ceylon thus lies in a further intensification of peasant agriculture.

Ceylon is one of those countries where people engaged in agriculture, directly or indirectly, constitute more than 75 per cent of the total population, and capital for the development of agriculture as well as any other industry is rather scarce.

A study of public sector investment in the development of agriculture during the last 5-6 years, would show that investment outside land development and irrigation for paddy is rather insignificant. Ceylon is no exception to the prevalence of the general phenomenon of peasant agriculture being subject to the exploitation of landlords. According to the 1953 Census, a little less than

half the area under paddy was cultivated by peasants who did not own the lands they cultivated. The results of the 1963 survey are not yet available, but the position might have deteriorated further because of the continued pressure on land. Paddy cultivators have often to pay exorbitant rents, and have no security of tenure.

Institutional Device

The Paddy Lands Act of 1959 attempted to solve these problems by granting security of tenure, and fixation of rents. It also made it obligatory on all tenant cultivators to cultivate their lands efficiently. Cultivation Committees, with representatives of tenants and landlords, etc., were instituted as bodies incorporated in law for the implementation of the provisions of the Act. They were, in addition, intended to serve as an institutional device to impart the advantages of large-scale cultivation and planning to small fragmented individual holdings.

Largely due to legal difficulties, the implementation of the Act became rather difficult. As many as 25,000 tenants were evicted from paddy lands. The legal procedures to be followed before tenancies could be restored were so dilatory that not more than 4,000 out of them could be given protection.

It is true that the implementation of the Paddy Lands Act has been weak, but through recent amendments to the Act, attempts are being made to remove the existing lacuna in the legislation. It can be reasonably expected that the set-up of the Cultivation Committees and the education of the cultivator in the course will go a long way in improving the condition of the cultivator so as to give him sufficient security from exploitation by landlords.

To enable the cultivators to take to improved methods of cultivation, enough cooperative credit facilities have been provided under the Credit Scheme which was introduced in 1963-64.

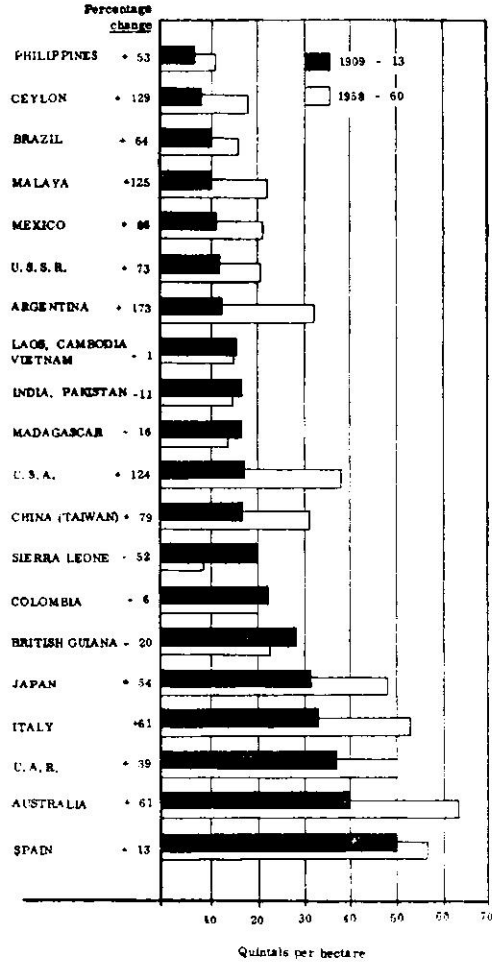
The entire share value of Rs. 50 can be paid in instalments of Rs. 5 per harvest. Over-due loans are to be reviewed and written off, if they are due to factors beyond the control of the Society. Every effort is to be made to make the societies credit-worthy. The total amount of credit admissible to a cultivator is enough for him to resort to all the improved methods of cultivation. One share entitles the farmer to credit at the rate of Rs. 175 per acre cultivated by him up to a maximum of Rs. 500 for the first season, while with two shares credit may go up to a maximum of Rs. 1,000. If a particular piece of land is cultivated twice, the maximum credit limits are further raised to Rs. 750 and Rs. 1,500 respectively.

Apart from ensuring the farmers with adequate credit for production purposes, the new scheme also provides a marketing advance to farmers about one month before the harvest is due, in order to insulate them from the operations of traders and middlemen who are particularly active at this time. The limit for such advances payable to a single cultivator is fixed at Rs. 200 or 20 per cent of the value of the crop which the farmer expects to sell to the GPS (Guaranteed Price Scheme) from his current harvest, or 20 per cent of the value of the paddy which he actually sold to the GPS during the previous harvest, whichever is less.

Guaranteed Prices

Ceylon is one of those countries where quite an efficient GPS for paddy is in operation for more than a decade. Every cultivator is eligible to sell off his produce to the Government through the Cooperative organisation at Rs. 12 per

Average Rice Yields (1909-13 & 1958-60)*



bushel (about 30 lb of rice). Along with this GPS, each citizen of the country, including the cultivator, is also entitled to two measures of rice per head per week at 25 cents a measure (2 lb) for his consumption. In other words, while the producer is paid roughly at the rate of Re. one per measure for the rice produced by him at his farm, and his cost of production is nearly half that, his consumption requirements are supplied at 25 cents a measure.

Besides, there are other incentives offered through the Fertiliser Subsidy and Crop Insurance Schemes which normally go a long way in helping the cultivator to resort to intensive methods of cultivation. The Ceylon Government has been subsidising the use of fertiliser for paddy for more than a decade. All paddy cultivators can get fertiliser at 50 per cent on cash purchase. Cooperative Societies can get it on credit at 33-1/3 per cent concession. There also exists a Crop Insurance Scheme for paddy. The area under insurance covers a total paddy acreage of 0.2 million acres in 16 districts, roughly 16 per cent of the total asweddumised paddy land in Ceylon. The target for 1965 is 3,00,000 acres. Commencing from the year 1963-64, the damage by wild elephants has also been included as an additional cause of loss against which insurance protection is offered.

Ceylon has at present an average yield of about 38 bushels of paddy per acre equivalent to roughly 1,040 lb per acre. Crop-cutting experiments were started in 1952, and the yield data before that period are not very reliable. Compared with 1952 as base, there has been an increase of 23 per cent in the acre yields from 30.9 bushels in 1952.

Compared with some of the selected countries in the world, and analysed over a longer period of about 50 years, it will be found that the average yield of rice in Ceylon has gone up by 129 per cent, and that it is quite comparable to some other countries in the region. The graph shows that Ceylon is already well on its way to catch up with the present yields in Malaya.

Whether or not this is due to higher prices offered to the cultivator, it is difficult to say, more so because the scheme

*Source: The State of Food and Agriculture, FAO, 1963.

of guaranteed prices at the prevailing rates was introduced about 10 years back. Table II, however, throws an interesting sidelight on this aspect of the problem. While Ceylon pays more or less the highest price (with the exception of Japan) per ton of rice, the average yields here are still low as compared to Malaya, the Philippines, Korea, and China (Taiwan). One may all the same observe from a study of the table that while it may be good to provide incentive prices to the cultivator, it is not necessary that productivity of land will have a direct relation with such prices. Land productivity is normally co-related to the application of the improved methods of cultivation and the availability of various input factors to the cultivator at reasonable prices as well as at the time required, it has to be noted that even a statement of this nature may be difficult to substantiate in a country like Ceylon where agricultural data are not very reliable.

Table II

Price, Yield and Income per hectare of paddy in selected Asian Countries

Country	Paddy price per ton 1957 (in Rs.)	Yield/hectare (average 1957-59) (100 kg)	Gross income per hectare (in Rs.)
Japan	704*	46	3237
China (Taiwan)	286	30	857
Korea Republic	381	29	1095
Ceylon	576**	17	1000
Malaya	386**	21	809
Philippines	557	12	666
Pakistan	300***	14	428
Thailand	219	14	305
India	214	13	276
Viet-Nam Republic	190	13	248
Burma	143**	16	228

*Paddy equivalent of farm price for husked rice

**Minimum guaranteed price

***Government procurement price—1957-58

SOURCE: The World Rice Economy, Volume II—Trends & Forces (30, Commodity Bulletin Series, No. 36, p. 24 FAO).

While irrigated area under paddy increased by 62 per cent during the period under discussion, and fertiliser consumption by more than 800 per cent, the productivity of paddy has hardly gone up by about 23 per cent. Table III (page 310a) supplies the necessary data in this respect both with regard to the actual quantities consumed as well as an index with 1952 as base. Consumption of fertilisers for paddy alone during the last 3-4 years has been going up by about 9,000 tons every year. With a steady increase in fertiliser consumption, acre yields have, however, shown some sort of stickiness. During 1960, Ceylon had an average yield of 36.3 bushels per acre, and it has gone up to only 37.9 bushels per acre in 1963.

A study of the last 10 years for the whole of the Island would indicate that has increased only by 28 per cent, in the harvested area, paddy production has increased by 70 per cent. In spite of this increase in the production of paddy during 1952-63, the per capita production has increased only by 28 per cent, which, in other words, means that the existing increases of production are just enough to meet the natural increase of population alone. This has resulted in

an actual increase in the import of rice during the period under discussion from 4,39,000 tons in 1952 to 5,15,000 tons in 1962, although collections under the guaranteed price have also increased 18 times during this period.

The analysis can be further taken down to the district level. The yield varies considerably from 52.4 bushels per acre in Moneragala (Wet Zone) to 29.6 bushels in Galle (Dry Zone). The highest yields to be found in the Moneragala and Pollonnaruwa districts, represent the recently colonised areas having the ideal conditions for growing paddy. The soils are rich, and the size of the holdings is much above the average in the Island, and controlled irrigation is available for practically the whole of the paddy area. The second best group of Nuwara Eliya and Badulla districts have practically the whole of the paddy area below 1½-acre size groups, but that irrigation facilities are available to a large extent. These districts are in a position to maintain a high level of productivity. The same pattern is not maintained in Puttalam-Chilaw where 80 per cent of the paddy area is irrigated and nearly 78 per cent of the area falls below the 1½-acre size group. Yields in this district fall much below the average in the country. The average cultivator in this district has not taken to improved methods of cultivation, hence the extension services of the Department of Agriculture have got to be strengthened so as to educate the cutivator to attain higher levels of productivity which should otherwise be possible. The same would be the fate of a district like Anuradhapura, or even Hambantota, where ideal conditions exist by way of full irrigation facilities for the whole of the paddy area.

... In certain parts of Ceylon, a major portion of the plant food is consumed by the weeds—salvinia in particular. Unless some economic methods of controlling weeds are evolved, and adopted by cultivators, it would be rather difficult to raise the levels of productivity in the Island ...

It is not possible to make any categorical statement about the importance of one or the other factors leading to higher levels of production. Irrigation, fertilisers (including organic manures), and improved seeds can definitely be isolated as adding to land productivity in this order, but under conditions of Ceylon agriculture weedicides would also seem to be very important because it has been observed that, in certain parts of the country, a major portion of the plant food is consumed by the weeds —salvinia in particular. Unless some economic methods of controlling weeds are evolved, and adopted by cultivators, it would be rather difficult to raise the levels of productivity in the Island. With the various incentive schemes already in operation, facilities provided by nature, and an improved extension service, Ceylon should be well on its way to achieve much higher and higher levels of productivity.



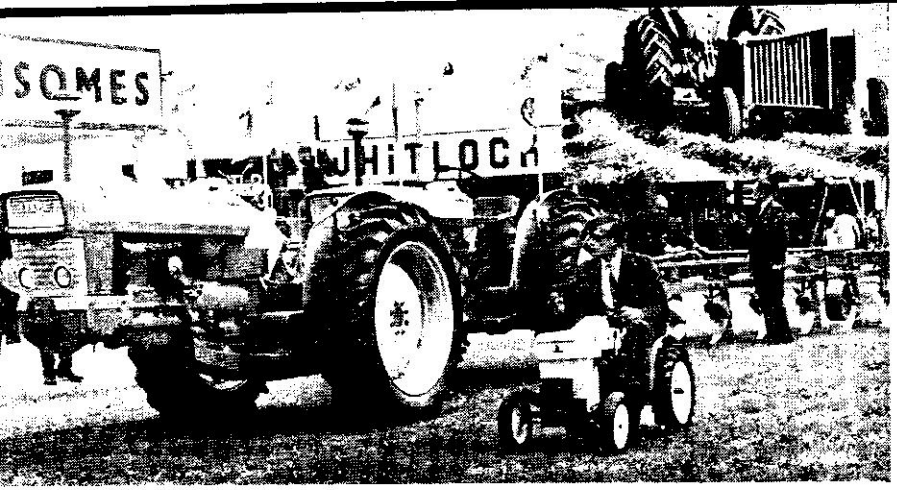




NEW HORIZONS
IN FARMING:

In Japan, USA, UK & France

Japan is the model of productivity in Asia, and has improved her agricultural production tremendously in the last quarter of a century (See article —pp. 289–292). On this page are (Top) beautifully cultivated terraces which are among Japan's familiar landscape patterns. Only 16 per cent of the land is arable, and terracing of hillsides is a must in Japan; (Centre): growth of paddy seedlings is enhanced by Vinyl sheets. These sheets are widely used to protect the growth and strengthen the young seedlings during the early spring planting season Japan produces about 4,000 lb of rice per acre (Bottom): Motor-driven hand driller being used in a Japanese field Though Japanese farms are small in size, mechanisation is becoming widespread as small-size equipment is being developed.







The agricultural industry in Britain is one of the most highly mechanised in the world. Photos on this page show:

TOP: A tractor for every job on display at the recent Royal Agricultural Show at Stoneleigh, England. The tiny Trojan Toraktor Mark 4 tractor embodies, in miniature, all the working principles of a full-size tractor, and is contrasted with one of the giants of the show—a Doe 130 4-wheel drive tractor.

CENTRE: A new self-propelled combine harvester, which can be supplied for either a 10-foot or 12-foot cut, is being introduced by a British Company. The engine is mounted on the chassis to give extra stability, and to allow the combine to operate on hillsides with safety.

BOTTOM: Checking the height of new wheat varieties against established crops at a farm attached to the National Institute of Agricultural Botany, Cambridge.

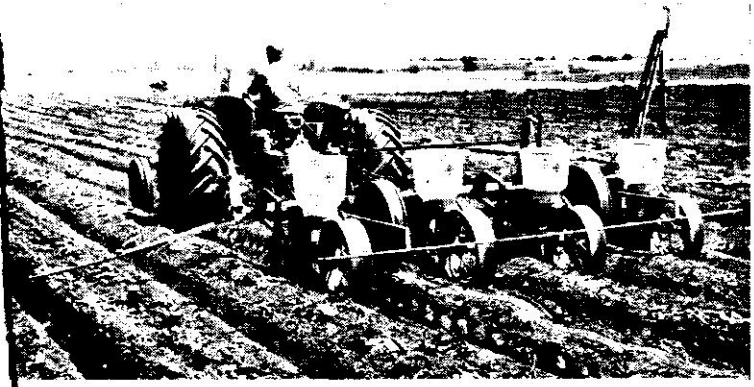


Improved technology based on research has resulted in major productivity gains in US agriculture, particularly during the past four decades.

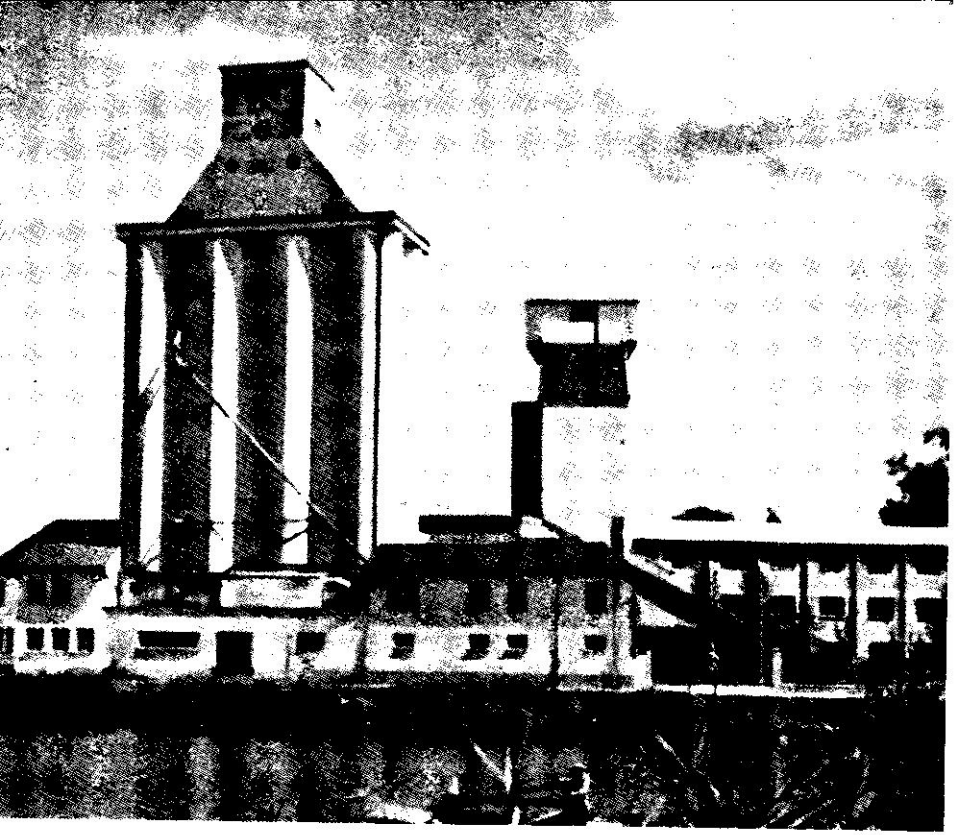
LEFT: Dikes which follow land contour in a California rice field. The land is precisely graded to assure good drainage.



lere is an area in the emi-arid west of USA, vith some unirrigated and in the foreground. On the far side of the anal, however, irrigated rchards, green pastures, nd crop-lands extend lmost as far as the eye can see.



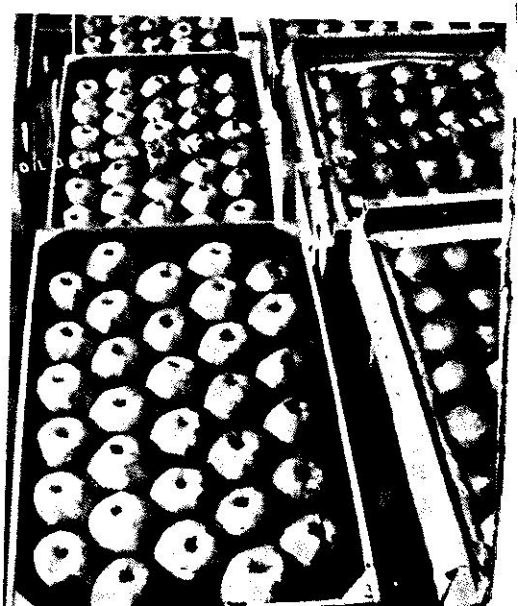
LEFT: A new machine which save as much as 40 per cent of cost pe hectare in planting corn in the track left by a tractor that has pulled plough, without any previous diskin and harrowing.



The Centre d'Etude Techniques Agricole (CETA), of France has a role in agricul ture not unlike that o research department in industry. They ar bodies, each compri sing a limited num ber of farmers—usual ly 15 to 20—wishing to get together to dis cuss in common such problems as arise on their farms, and to apply the best solu tions to these pro blems. The first CETA was created in 1945 and there are now over 1,200 of them in France. Originally directed exclusively towards production techniques, they are directed now towards the study of market ing problems, etc. (See article, pp. 284-288)

Only quality satisfies. Only quality pays. The quantity of French fruit production and the advantages (freshness and taste) which distinguish it make it possible for the fruit preserving industry to carry on a consistant manufacture both as regards quality and rhythm.

More Pictures on pp. 413-416 and 465-472



AP JAIN

Governor of Kerala

Planning of Agricultural Production Programmes

An immediate rise in our agricultural production is essential in the context of the present emergency. Unless the gap between supply and demand is speedily reduced, there will be serious repercussions on the growth of the nation's economy. AP Jain, who was Union Minister for Food and Agiculture, draws attention here to defects in the planning programmes for increasing food production, the several unforeseen factors which affect output, and asserts that "if India has to meet the challenge of her growing demands for agricultural production, she must develop an organised and integrated system of agricultural research, education and extension, with knowledge of new information flowing like a stream."

AGRICULTURE has about it many imponderables, unforeseen factors which affect its output. The farmer may take all precautions—prepare the soil tilth, make correct seed selection, sow and irrigate in time—but a strong wind may flatten the crop, a spell of drought or unusual rain reduce the yield, or heavy frost may destroy the crop. Farm produce is never secure, unless the crop reaches the barn. The best of farmers in that land of advanced science and technology—the USA—told me that weather could make a 20 per cent difference in crop yields, either way.

During my tenure as Minister for Food and Agriculture, the Third Plan was under preparation and the Ministry had fixed a production target of 110 million tons of food grains at the end of the Plan, i.e., in 1965-66. The increase in population was rated at 10 million per year, and the per capita daily requirements of cereals and pulses at 15 and 3 ounces respectively. The consumption

requirements of food grains, cereals, and pulses came to 88 million tons for food, and 12.6 million tons for seed, feed, and losses. The target provided a safety margin of 9.4 million tons for nature's vagaries.

A major assumption for increasing food grain production in the Third Plan was the use of chemical fertilisers, as Indian soils had been exploited for thousands of years without replenishment of crop nutrients and tracer elements. The Ministry of Food and Agriculture had put the requirements of chemical fertilisers at 15,00,000 tons of nitrogen, 7,50,000 tons of phosphate, and 2,00,000 tons of potash.

Production Target

The Ford Foundation Team composed of top agricultural experts (Indian and foreign) completely endorsed the target of production, and the requirements of fertilisers. In fact, it commented: "We view these targets as **the very minimum** if the food goals are to be reached. The amounts that could be used to advantage, and that it would pay cultivators to use with other good practices, would be of the order of twice the Committee's (Food and Agriculture Ministry's) targets for nitrogen, four times for phosphorus, and seven times for potassium."

There has been a rhythmic tragedy in India's agricultural production policy. When food becomes difficult, both the politicians and administrators shout, but no sooner the situation eases they develop a sense of self-complacency. In 1958-59 food grain production shot up by 13.7 million tons compared to the previous year, and by the last year of the Second Plan it went up by another four million tons. There was a significant rise in food grains import from 3.2 million tons in 1958 to 5.1 million tons in 1960.

This increase in supplies led to a feeling of smugness, and the Planning Commission reduced the Third Plan target of food grains to 100 million tons, thereby removing the safety margin. Concurrently, fertiliser targets were reduced to 10,00,000 tons of nitrogen, 4,00,000 tons of phosphorus, and 2,00,000 tons of potash. When it came to actual availability, the facts were still worse. According to the mid-term appraisal of the Third Plan, India would, by the end of the Plan, indigenously produce only 5,00,000 tons of nitrogen against the target of 8,00,000 tons. In the third year of the Plan, only 31.3 per cent of nitrogen, and 27.3 per cent of phosphorus of the additional quantities projected for the Plan were made available. Potassic fertilisers are not produced in India, and we depend for their availability on imports. In the prevailing tight balance of payments position, it is doubtful if the potassium targets would be achieved. Commercial crops—tea, coffee, sugarcane, potato, and the like—have an economic advantage over food grains in the consumption of fertilisers. They consume the bulk of our fertilisers, and the brunt of shortfalls falls on food grains.

The same story of failure in fulfilment of targets of irrigation, soil conservation, improved seeds, and plant protection repeated itself. Plant protection was planned to cover, by the end of the Third Plan, an additional area of 34 million acres, but the achievement in the first three years was only six million acres or 17.6 per cent.

Farm Implements

I am heading a team of the Planning Commission to make a study of agricultural implements, and two years' work has led us to the conclusion that very little has been done by way of research, manufacture, and propagation of improved implements. The garden tractor and power tiller have yet to come out of the assembly line. As against a target of 20,000 medium-size tractors at

... Research is the life-breath of all progress. However, agricultural research in India continues to be sluggish. It lacks dynamism...

the end of the Third Plan, India is now producing less than 5,000. A large number of tractors of odd sizes and makes imported lately from rupee-payment countries are lying idle for want of replacement of parts.

The Ford Foundation team was of the opinion that price stabilisation was a condition necessary for increasing food grain production. There had been too many, and excessive, rises and falls in the prices, which provided fertile ground for speculative activities of traders, but worked to the detriment of producers. The team recommended that a guaranteed minimum price be announced, in advance of the sowing season, and purchase depots set up within bullock-cart reach of the farmer. After a lapse of six years, minimum purchase prices for food grains have been announced, but they are not pre-sowing nor are there arrangements for purchase from the farmer.

Land reforms, no doubt, have great significance in the context of India's land distribution. But despite Parliament's amendment of the Constitution giving blanket protection to a large number of laws dealing with ceilings, the State Governments have not completed their programme of enforcing ceiling limits, and the uncertainty continues. Commenting on the tenurial system of three IADP districts of Tanjore, West Godavari, and Shahabad an American surveyor, Mr Wolf Ladejinsky, writes:

> "The land records do not contain any information about tenants. Ejection of tenants has taken place in the past, and the landlords still continue to change tenants from plot to plot to defeat the tenancy laws. The few tenants who have been allowed to continue over a fairly long period feel insecure. Thus, a large number of cultivators hold no title to the leased lands, pay extortionate rents, and are never certain of their status. They are left with little to subsist on and much less to invest.'

The VLW refuses to make a production plan for tenant-farmers, unless the the land owner agrees to it, and the cooperative would not advance him a loan unless the land owner countersigns the loan application.

Research is the life-breath of all modern progress. However, agricultural research in India continues to be sluggish. It lacks dynamism. The Commodity Committee's efforts are dispersed, and incoherent. Whatever be the achievements of research, they do not reach the farmer. Between the scientists and the extension workers there exists a gap. If India has to meet the challenge of her growing demands for agricultural production, she must develop an organised and integrated system of agricultural research, education and extension, with knowledge of new information flowing like a stream.

As time passes, I am becoming increasingly convinced of the imperative need to separate the Departments of Food and Agriculture at Delhi. I get added strength from the recent thinking to bring Community Development and Cooperation under the same umbrella

with Agriculture. The Minister for Food is the most harassed and worried of all Cabinet Ministers. He is too much under fire on the food front, when his undivided attention is needed for the fulfilment of the agricultural programme. It is, therefore, desirable, in the national interest, to bifurcate the activities of the present Ministry of Food and Agriculture into two ministries, one for Food and another for Agriculture, Community Development and Cooperation.

Food is far too important to be lightly treated, or with smugness. Our imports of food grains have already reached dangerous dimensions, and any further increase may mean a breakdown. It is wrong to blame solely nature as, since the dawn of history, nature has been giving unfailing warnings that Indian agriculture has a cycle of good years, bad years, and indifferent years. If we ignore that warning, and eliminate the safety margin, as we did at the time of formulating the Third Plan, the responsibility is ours. Nor can the farmer or anyone else be blamed for the performance failures. The cyclic order has repeated itself, and after three consecutive years of stagnant food crops we had the bumper year of 1964-65 with an estimated 86 million or 88 million tons of food grains. The next year may also be good; but it would be unfortunate if we become complacent again, as at the time of formulating the Third Plan.

Unesco Aid for Farm Education

The United Nations Educational Scientific and Cultural Organisation (UNESCO) has agreed, in principle, to extend assistance for improving agricultural education in India in 1967-68.

To help in formulating requirements of assistance, which would cover the agricultural universities and agricultural secondary schools, an Agricultural Science Education Adviser would be deputed to India by this world organisation.

UNESCO would from now relate its science programmes to the needs of development of member-countries especially in the Asian and African regions. The organisation was in touch with various governments to know their agricultural and industrial development programmes.

Let's understand Problems of Farmers

Have we a good understanding of the problems of farmers in India? Speaking on this subject at the symposium on Technology of Rice and Rice Products, organised by the Central Food Technological Research Institute at Mysore, Mr TA Pai, Chairman, Food Corporation of India, said that unless there was a change in the attitude of the nation towards farmers, and an understanding of their problems, there would not be any substantial change in the present food situation.

He said: "There is not any national consciousness as regards the magnitude of our food problems, but the present food crisis has awakened the nation to the necessity of increasing the production of food grains to make more food available to the people..."

WILBUR B WOOD

Group Leader
Punjab Agricultural University

Development of Human Resource—Key to Productivity

A plea for emphasis on the development of human resource, both in mind and skills, has been made in this paper by Wilbur B Wood who characterises it as the key to productivity not only in agriculture, but in all the industries. This, naturally, calls for a large increased investment in people. He refers to the benefits of having strong, healthy agriculture, the role of agricultural universities in the training of new skills in management, and welcomes the stress currently being given by these institutions on the development of research for the development of new technology.

A FOREIGN agriculturist arriving in India quickly realises the enormity of the problems adversely affecting the production of food and fibre. It is quite evident, both to foreign and Indian specialists, that if the nation is to increase agricultural production sufficiently to meet its recognised needs, solutions to the many problems must be found.

Of the four conventional factors of production, viz., labour, land, capital, and management, surely India is blessed with an abundance of the first, and relative to many other developing nations, an abundance of the second with an excellent climate for crop growth. The land potential, subject to the limitations imposed by land reform policies, irrigation and drainage is much greater than in the vast majority of nations.

Population is increasing at the rate of 2.2 per cent yearly or, in absolute terms,

a net addition of approximately 10,000,000 persons yearly. Consequently the area of cropland per person is diminishing at an alarming rate. This factor alone is recognised by many as the major problem of India.

Numerous other recognised problems, such as low yields per acre, inadequate supplies of inputs, and poor communication systems, all appear enormous when compared to the desired quantity or efficiency level necessary to obtain a satisfactory standard of living for the masses of India. Comparisons with other countries are often made to emphasise the contrast in yields and industrial output.

Contrasting Yield

A classic example of contrasting yields is shown in the case of rice yields in Japan and India. Yields in Japan average well over 4,000 lb of rice per acre. India's production of similar rice is just over 1,000 lb per acre. Similar situations exist in the production of food and feed grains in several other countries as compared with India's output.

Actually such comparisons are unnecessary. Within India, one finds many cases of outstanding yields, and high rates of industrial output in selected industries. When an attempt is made to explain why these few case situations are not commonplace, instead of exceptional, two factors are always found as the major restrictions. These are the last two of our conventional four factors, capital and management. Management of labour, supported by mechanisation, is credited as the positive factor in affecting increased efficiency in the use of available labour. There is great opportunity in this area in India. Capital is noticeably a scarce factor in Indian agricultural production. The per capita income of the agricultural worker is low. Costs of input items are rising steadily. High rates of population growth impede the rise in per capita income. Both affect adversely the availability of capital for agricultural production. The economy must advance at a rate equal to the population growth to maintain existing per capita incomes. If India cannot exceed this, then gains in per capita income will be meagre and it will continue to be very difficult to provide adequate capital for investment in agricultural production.

Capital can be, and is being imported in large sums. Capital formation within the country is also evident, but the addition of capital alone is not sufficient to solve the problem. Capital can yield a high rate of return in terms of product only if used efficiently. To use it efficiently requires the development and use of tremendous amounts of technology new to India. This situation makes it mandatory that great emphasis be placed upon the development of the human resource both in mind and skills. No one has any doubts concerning the potential of the human mind in India. That this mind is equal to that of any other country has been amply demonstrated by thousands of persons from this nation. The major problem then becomes to create a proper environment in which this human resource can realise its potential. In addition, this environment must be created on a larger scale than was ever dreamed of in other nations.

Many of us see the development of the human resource as the key to productivity not only in agriculture, but in all the industries. This calls for a large, increased investment in people. Indian leadership is to be congratulated for the emphasis currently being placed on the development of research at the agricultural universities for the development of new technology. In this programme, researchers cooperate with cultivator-motivators in an effort to find breakthroughs in production. This cooperation with cultivators

provides a two-way communication between the researcher and the cultivator that aids in pinpointing major restrictions in inputs for agricultural production. In addition, this cooperation naturally causes research to be problem-oriented and directly related to current agricultural production problems.

Since 1955, seven States (Punjab, Uttar Pradesh, Mysore, Rajasthan, Madhya Pradesh, Orissa, and Andhra Pradesh) have recognised that education and research in agriculture are essential for agricultural progress, and have created agricultural universities within their States. Punjab, for example, has developed during that time an imposing institution with a highly trained staff consisting of 60 Ph.Ds. out of a total staff of over 500. They instruct more than a thousand undergraduate and postgraduate students on the campus, conduct a carefully planned, and properly financed, agricultural research programme in two central and 24 outlying experimental farms, and an extension educational programme reaching into each block of the Punjab State.

Cultivators send their sons to the campus to obtain training in scientific agriculture, and come to the campus themselves for short courses on their special farming enterprises, and on other occasions participate in extension meetings held by the University in their neighbouring or home villages. In fact, agriculturists from many countries where agriculture has reached much higher levels of production see this as a step in the right direction. It is imperative that the man on the land, as well as the man in the street, have every benefit possible from research and education. These individuals are responsible eventually for economic production. Unless they have the benefit of what knowledge is available to assist them in their job, they will fall short of production goals, regardless of who sets the figure—government, the simple law of supply and demand, or the worker himself.

> ...Basic education is required for the adoption of improved practices on land... Neglect of education for the 10-year-old is virtually a sentence to existence as an unskilled labourer for the remainder of his life...

This is why Indian leadership is now considering it so vital that every individual should know how to read and write; and why it is important that we develop such communication media as radio and television. The citizenry of any nation, and ultimately the nation itself, is better off if it has free access to truth. The more newspapers, magazines, books, radio programmes, motion pictures, exhibitions, and other media there are engaged in presenting responsible information to the public, the more quickly it is possible to disseminate useful information about production methods and other progressive ideas to the people. But there is no particular benefit from the discovery or development of new knowledge unless the person or institution responsible really communicates that knowledge to others.

The development and diffusion of

new knowledge about farm technology is credited with about one half of the fivefold increase in agricultural production in the United States since 1870. Significantly, 1870 marked the beginning of the American Land Grant Institution, a programme designed to "teach agriculture and the related arts" to cultivators, sons of the labouring class, and others.

The need to improve the literacy rate in India is recognised in an ever-increasing manner. A member of the first Planning Commission recently remarked:

> "When we developed the First Plan we said our first task was to increase production. We considered education for all of school age to be one of the firsts, and said we would give the needed attention to such education at a later date. Now we know how wrong we were. We cannot materially increase production without first improving the literacy of our people. Education from the early age through higher education in agriculture is essential in increasing farm production."

Basic education is required for the adoption of improved practices on land. Changes in attitudes towards existing practices, creation of desires for improvements in working conditions and within the home, decision-making for successful operation of cooperatives, and for intelligent participation in the social and political life of the community, are all essential for the continued growth and development of a nation. Neglect of education for the 10-year-old is virtually a sentence to existence as an unskilled labourer for the remainder of his life.

Production Economy

Our production economy cannot grow if it rests on the shoulders of the underprivileged, uneducated, and inept. Ignorance is the husband of poverty. Their marriage breeds hunger, want, disease, fear, unrest, and chaos. Conversely, an enlightened citizenry does promote reason, responsibility, industry, growth, progress, abundance, peace, stability. India today has many well-educated and highly skilled people actually, but in terms of percentage of population, or in relation to the need for such persons, their number is pitifully low.

Historically, every nation with a strong, healthy agriculture, has enjoyed relatively good economic health in other respects also. As United States economists pointed out in a publication entitled **How the United States Improved its Agriculture:**

> "An abundant supply of agricultural products has contributed greatly to economic growth in the USA. Throughout American history, agricultural output has increased more rapidly than population. The overall productivity in agriculture has gone up rapidly, doubling in the last century. Real costs per unit of agricultural output decreased by one half.
>
> "Rising productivity in agriculture has contributed to the economic development of non-agricultural sectors in several ways. It has supplied increasing amounts of food and other farm products at relatively low costs. It has freed workers for employment in non-farm industries, served as a source of capital for non-farm industries, and earned foreign exchange that helped finance imports of scarce capital goods. Also (and this is extremely important to the support of a developing industrial economy), it has provided a major market for industrial goods and services."

The increasing use of tractors, trucks, automobiles, electricity and electrical equipment, and other power equipment; the wide variety of field implements; the greater use of fertilisers, pesticides, and other agricultural chemicals; and a multitude of other technological advances

have created a tremendous demand for the products of industry.

The adoption of new technology in agricultural production will necessitate drastic changes, and call for training of new skills in management. This is the point at which the agricultural university stands ready to support a developing economy. It can train men and women for more productive work on the land, in the laboratory, or in industry and business.

Manpower Needs

As the economy grows, more and more of our businesses and industries will gear production and distribution to the needs of agriculture. They will need men and women who understand agriculture, and can speak the cultivators' language, as the saying goes, to manage the agriculture-related aspects of their business.

Public service benefits, too, from the increasing number of knowledgeable and responsible individuals coming into the market for employment from universities which train youth in practical economics, for instance. As improved methods, adoption of technological advances, and other progressive factors give strengthening support to agriculture, production will increase, and manpower needs for agricultural production will decrease. The young men who will no longer be needed to produce food and fibre for the nation will become available for work in industry and commerce. At the same time, education will equip more and more of our rural youth for responsible positions of leadership in community affairs. From this, it is only one step to leadership in public affairs of broader scope. Thus, both the State and nation benefit from an enlightened generation.

Just as the stability and growth of the general economy depends upon a strong agriculture, stability in agriculture depends upon an enlightened rural citizenry. Faithful and industrious application of knowledge gained through research and education will in the field of agriculture yield dividends which will multiply the growth rate of the economy.

Only 10 per cent of farmers use fertilisers

Not more than ten per cent of India's farmers use fertilisers. Our per capita consumption of 0.9 kg is the lowest in the world as against 17 kg in Japan, 41 kg in West Germany, 40 kg in the Netherlands, and a world average of 12.2 kg.

We have no doubt gradually increased the amount we have used per hectare. In 1960-61 we used 1.7 kg per hectare, 2.25 kg in 1961-62, and 2.71 kg in 1962-63. But, compared to our needs and capacity, this rate of increase is negligible. The national Plan aims to raise it to 4.08 kg by 1965-66 and 8 kg by 1970-71.

MS RANDHAWA

Special Secretary
Ministry of Food & Agriculture

India's Programmes for More Food Production

Among the many problems confronting agricultural output are low yields per acre, inadequate supplies of inputs, and poor communication systems. Capital is noticeably a scarce factor, and costs of input items are rising steadily. MS Randhawa refers to several programmes to boost production, which have been operating with varying degrees of success, and points out some major defects in their planning—for instance, the resources, inadequate as they are, have been dispersed on too many heads of schemes over too wide an area. A number of suggestions on farm planning, supplies and storage, improved implements, use of fertilisers, plant protection, efficient water use, etc., have been made, and these, if implemented, are bound to lead to increased output.

AN IMPORTANT development during the last four years in planning agricultural programmes has been the adoption of the "Package" concept—the use in agriculture of inter-related factors, physical, technological, social and institutional, in strategic combinations which are likely to produce an impact on agricultural production in selected areas most responsive to such production efforts. The programme involves not only making available to the cultivators the means of production, such as improved seeds, fertilisers, pesticides, improved implements and advice as to how to use them to best advantage, but also developing facilities so that the required credit is made easily available to them.

To make this possible, considerable increases in resources for providing the needed services and extension aid in the selected areas have been made. Also, new concepts and approaches in regard

to the way in which the administrative machinery should operate have been developed. Lack of effective coordination between the various departments and agencies concerned with agricultural production, at various levels, has been one of the weakest links in the chain of administrative arrangements.

In the areas selected for the Package Programme, commonly known as the Intensive Agricultural District Programme, efforts have been made to secure proper coordination through the formation of Coordination Committees at State and district levels. In these committees, all interests, official and non-official, connected with agricultural production, are represented. In general, one district in each State is covered by this programme. In these districts there has been a substantial strengthening of the staffing pattern which provides the Project Officer-incharge of the technical aspects of the programme at the district level, with an adequate staff of Subject Matter Specialists at the district and block levels. The number of village level workers has also been doubled. Since the programme attempts to reach all farmers through cooperatives and the other local agencies, like the panchayats, a considerable amount of educational effort to strengthen the cooperatives and revitalise them, wherever they were weak, have been found necessary.

Powers for Officials

For effective use of institutional measures, and to ensure speedy action, a review of the existing powers of functionaries at various levels was done. As a result, changes have been made in respect of delegation of powers, administrative and financial, so that officers at different levels are given more freedom of action without frequent references to higher authorities becoming necessary for securing sanctions to operate funds, and take decision in respect of operational needs of the programme. The overall responsibility of the scheme in the district has been placed on the shoulders of the District Magistrate or the Deputy Commissioner-in-charge of the district. His powers have been increased suitably.

In addition to the package districts, in which a total of about 300 blocks has been brought under the programme, a number of districts have been selected for intensification of agricultural programmes in respect of the crops for which particular districts are important. Thus 75 districts covering 646 blocks have been selected for intensive cultivation of paddy, 53 districts with 351 blocks have been selected for millets, and 20 districts with about 200 blocks have been taken up in the predominant wheat-growing States for intensive cultivation of wheat. This agricultural programme is now in operation in 148 districts selected for intensive cultivation of paddy, millets, and wheat.

With the starting of the programme it soon became apparent that for its success an essential pre-requisite was an intensive training of staff in order to improve their knowledge and working efficiency. Periodical training programmes have been organised at central, regional, district, and block levels. These programmes not only attempt to reorient the staff in the concepts, methodology, procedures and techniques of intensive agriculture development, but also include training on performance of particular jobs, so that the staff improves in skill as well as confidence in handling the problems of the cultivators. Besides the training of the professional staff, training of farmers is also considered important, and is being organised at suitable centres in each district.

Farm planning was found to be an extremely useful approach for developing the production programme based upon intimate personal contacts between the village level workers and the individual

farmer. This needs a close examination of the enterprise and resource situation of individual farmers, and discussions between them and the extension staff which are aimed at preparing farm plans for individual farmers. For the participating farmer it is an educative experience. Besides he is provided with an estimate of the production requirements in respect of seed, fertilisers, pesticides, etc. Thus the farmers are enabled to take decisions.

With rise in demand for supplies required for production. It was found that the existing distribution arrangements for seeds, fertilisers, etc., were far from satisfactory. In certain areas this has resulted in the offtake being very poor, as compared to the demand for these items of production. The problem is likely to get more magnified in subsequent years when the total quantities to be handled would be several times more than what they are today. One factor which can help improve the distribution of production requisites is the availability of adequate storage facilities within convenient distances in rural areas. Therefore, a high priority is being given to the construction of storage godowns at various levels, and funds are being made available to State Governments under the Special Development Programmes over and above the State plan ceilings.

Role of Fertilisers

Fertilisers play a vital role in boosting food production. They give profitable returns to the growers on their investments. With the increase in the extension efforts in the selected areas, the demand for fertilisers will show a rapid rise. It becomes all the more necessary, therefore, that the number of godowns should be sufficiently large and well distributed to serve farmers' needs. The tendency for the construction of rural godowns in a haphazard manner has given place to a methodical programme based upon advance planning, with due regard to construction at rail heads and mandi levels of larger godowns, so that they can feed the other godowns with the stocks which they will handle. Sufficient attention was not paid in the past to the designing of storage structures. Blueprints have now been prepared for different types of godowns so designed as to take into account supplies such as fertilisers, pesticides, and improved implements which are to be stocked, their quantities, and the period for which they have to be kept.

In order that improved agricultural implements be demonstrated and popularised in the selected districts, it was decided to establish workshops for designing and testing implements which are an improvement over those in use in respective areas. The first of these workshops has just been completed, and it has started the work of demonstration and popularisation of those implements which had already been tested and found suitable.

Even when all other factors like good seed, improved implements, irrigation, etc., have been provided, the level of production from a certain area is not likely to go up substantially unless the productive capacity of the soil is high. In most parts of India, the yield levels are very low because the land has been overcropped for centuries, and the soils are depleted of plant nutrients necessary for satisfactory growth of crops. The amount of manure which is added every year is hardly sufficient to meet 1/10 of the requirements of high sustained yields. In spite of efforts to increase manure production from the cattle shed and the compost yard, and in spite of the emphasis given to the practice of green manuring, the total amount of plant nutrients so added to the soil remains only a small fraction of the needs for high production.

A programme of rapid build-up of soil productivity through a large increase

in the addition of organic residues in the soil, along with providing the needed plant nutrients directly to the crop, is necessary. Fortunately, this is possible with the fertilisers which can greatly help in providing the increase in the organic residue which our soils need besides directly feeding the crops. In order, however, that the fertilisers are able to do this in an adequate manner, it is necessary to increase their consumption manifold as compared to their present consumption. This consumption is only about 2.7 kg of plant nutrients per hectare when in some of the countries which have high levels of production, such as West Germany, Holland, Belgium, and Japan the amount of plant nutrients added in the form of fertilisers every year is 200 kg to 300 kg. With the large area under irrigation, and an equally large area with good rainfall, there is every reason to suppose that the use of fertilisers in India can be stepped up many times

Looking After Livestock

In the context of the need to increase agricultural production, adequate attention has to be focussed on the improvement of the health of farm animals.

Writing on this subject, THE STATESMAN's Farming Correspondent says :

"... Cows are now expected to produce much more milk than they did a few years ago, and large poultry farms exist in confined spaces and on deep litter. All this necessitates better management and feeding. It must not be overlooked that this increased productivity increases the strain upon the well-being of animals and further separates them from nature.

Greater care is therefore required in their supervision, feeding, and hygiene. A greater responsibility is imposed upon owners who must be able to recognise and describe the first signs of ill-health, and on the veterinary services which have to advise the farmer on both prevention and cures.

To achieve a good standard of health among our livestock is, however, not an easy matter. It requires a full understanding of the techniques of feeding, breeding, management and disease control, as well as a proper coordination between all of them.

Although India's economy rests mainly on rural production, the veterinary services throughout the country have not been able to carry out all that has so far been expected of them. Many important projects to improve farm animal health and productivity, and to upgrade and breed better strains of grain, more resistant to disease, have consequently been affected."

more than at present with substantial increases in the yield of crops, providing food and fibre for the nation.

The possibilities offered by fertiliser use have, unfortunately, not yet been sufficiently brought home to a large majority of farmers who still do not know the use of fertilisers. Even where they know that fertilisers help in increasing the yields of crops, they do not have enough information on the magnitude of the return which they can get from the use of fertilisers, nor have they developed sufficient confidence that investment on fertilisers (which would usually involve their buying the fertilisers on credit) will give very attractive returns.

Fertility of Fields

In many cases, though the farmer is aware of the profits from the use of fertiliser, and is anxious to use them, either the non-availability of fertilisers near at hand, or the inability on his part to get the required credit in sufficient volume in time, or both the reasons have prevented his making use of the opportunities offered by fertilisers. The solution to this problem lies in a rapid development of supply lines through departmental or institutional agencies or through private dealers. This is what is being done in the intensive agricultural areas. In the areas selected, priority has been given to developing the supplies through cooperatives although other agencies are not being ruled out, especially where the cooperatives have not been found to be sufficiently strong to handle the supplies needed for the production programmes.

Recommendations on application of fertiliser have been made on the basis of results of simple field trials conducted on the farms of cultivators. These recommendations have only a general application. Because the level of fertility of different fields may vary, it becomes necessary to base the recommendations on fertiliser application keeping in view fertility levels of particular fields and the deficiencies of particular plant nutrients in the fields in question. Therefore, a programme of soil-testing has been taken up. Soil samples from the fields of individual cultivators are collected for analysis in a number of soil-testing laboratories which have been set up in different parts of India. At present there are 29 such laboratories, each having a capacity of testing 10,000 to 20,000 soil samples in a year. Based on the soil test results and correlation studies between crop responses and fertiliser application on the basis of soil tests, it is expected that it would be possible to prepare soil fertility maps for each block, and ultimately for each village, in intensive agricultural areas.

Investments on raising production from fields often fail to give expected returns on account of damage to crops from pests and diseases. With higher intensity of cropping, and greater use of fertilisers, the incidence of pests and diseases is likely to increase. Plant protection measures have, therefore, to be greatly expanded in area as well as intensity, so that the efforts made at higher production are able to bring maximum results. The factors which are important in this connexion are provision of adequate amounts of plant protection chemicals (pesticides) and equipment for spraying or dusting them, use of chemicals to control weeds, and setting up of agencies to undertake areawise prophylactic measures. In addition, one important measure is to protect stored grains against storage pests.

Another programme which needs much attention of the farmers as well as of the extension workers and the executive authorities is proper water management. This includes not only efficient and timely use of available water

in accordance with the soil characteristics and crop requirements, but also saving the crop from the damage caused in large areas by waterlogging and floods. Efficient use of water involves construction of irrigation channels to ensure proper distribution of water, with minimum loss from seepage, levelling of land, and construction of bunds, and demonstration of the different steps necessary for proper land preparation and water use according to depth of soil, and methods and types of irrigation. Emphasis is being laid on the construction of wells and tubewells in compact areas, and coordinating the construction programme with the availability of power.

The burden of ensuring farmers with adequate and timely supplies of credit, and other production requisites at reasonable rates, rests primarily on the cooperative institutions. At present they are suffering from several weaknesses such as shortage of godown accommodation, absence of link between marketing and credit, restrictive conditions governing the eligibility of grant of loans, lack of sufficient representation of the weaker sections of the community, and absence of well-organised cooperative units as the core of the cooperative movement.

... The farmers are independent individuals who do not relish the idea of other persons, whether they are farmers or not, making decisions for them. They decide for themselves what they will do on a particular field, and how ...

'Disturbing Feature'

Steps have been taken to simplify the procedures for disbursement of loans, liberalise the limits up to which production loans can be granted, and distribute loans mostly in kind and in instalments according to the agricultural operations. Still there is much to be done in this field. The majority of farm families are not yet covered by cooperative institutions, with the result that they are not in a position to avail of the credit facilities offered by them. Another disturbing feature, which has been responsible for the denial of credit to farmers by cooperatives, is the high percentage of overdues which has been showing a rising trend. In order to arrange an equitable return to the farmer, and facilitate timely recovery of the loans advanced, a phased programme of developing cooperative marketing has also to be pushed through with speed.

The first step towards the adoption of improved practices by farmers is the creation in them of the awareness of these practices. This has to be done through suitable information aids among which are simple visual media. In the IADP districts an Information Unit had been established as a part of the extension set-up in each district. This unit is charged with the work of producing the needed information material like films, flannelgraphs, flash-card, slide-stories, teaching charts and hoardings for wide dissemination of the package of practices. In the past, the educational process, which has

been the weakest link in the whole programme, has not received the attention which it deserved. More effective even than films, slides and charts are demonstrations of improved practices on the fields of the farmers themselves in educating the farmers about the scope and benefits of these practices. For conducting effective demonstrations which would be purposeful requires a considerable effort and time of the extension workers who have to get down to work with the demonstrating farmers in the field. Such demonstrations have been found to be among the best means of motivating the farmers to move from traditional to improved farming practices.

Extension Work

In the intensive agricultural areas, package of recommendations on crops is being made by experts on the basis of the latest research findings. In this process, the gaps in our knowledge are coming to the surface. Therefore, organisational arrangements have to be developed to establish contacts between workers at research centres and extension workers, so that research is properly tuned to the needs of the farmers more easily, and in respect of specific problems which they face. Research and extension, when properly linked, help each other through a continuous give and take of knowledge, and provide live interest in day-to-day problems which give new hope to agricultural production programmes, and new meaning to agricultural research.

With the best efforts made in order to develop facilities in respect of the physical requirements of the programme, as well as of the educational and research needs of the farmers, the programme will only progress if supported by local leadership and active involvement of local people in the planning and implementation of the programmes. In a large measure, the involvement of the farmers has to be made individually, because they are independent individuals who do not relish the idea of other persons, whether they are farmers or not, making decisions for them. They decide for themselves what they will do on a particular field, and how. No two farmers are alike, and, therefore, their reactions to new ideas may be different. Therefore, the task of the extension worker engaged in developing a programme of agricultural production becomes all the more complex and arduous.

In order that the programme gathers momentum, and becomes a mass movement, it is necessary that all agencies of the Government as well as of the people play a substantial part. The official staff will not be sufficiently large, even when considerably strengthened, to motivate the 60 million farmers who determine what the production levels of the country will be, which means that participation of local institutions is vital. The programmes are, therefore, placing considerable emphasis on participation and involvement of local agencies through the identification and development of local leadership.

If you wish to keep in touch with productivity trends in industry and agriculture

Read

NPC Information

(Published every month)

Annual Subscription Rs 3

in the service of

Agriculture

FACTAMFOS
(Ammonium Phosphate 16:20)

ULTRAFOS
(Finely ground
mineral phosphate)

AMMONIUM SULPHATE

SUPERPHOSPHATE

NPK FERTILISER MIXTURES

•

in the service of

Industry

ANHYDROUS AMMONIA

SULPHURIC ACID

SULPHUR DIOXIDE

AMMONIUM CHLORIDE

FACT
first in the field!

THE FERTILISERS AND CHEMICALS
TRAVANCORE LIMITED
Regd. Office: Eloor, Udyogamandal P. O Kerala State

CRITERION-FT-511

BUILDING TODAY FOR A BRIGHTER TOMORROW...



A dynamic industrial combine backed by over two decades of pioneering experience, KAMANIS keep industry abreast of technological progress—through diversification... through constant research and development.

INDIAN RUBBER REGENERATING COMPANY LIMITED
Top-grade reclaim rubber for any product that uses rubber.

KAMANI TUBES PRIVATE LIMITED
Copper and brass extruded and drawn rods, sections and tubes for a wide range of industrial applications.

KAMANI METALLIC OXIDES PRIVATE LIMITED
Zinc oxide, litharge and red lead for paints, rubber, rayon, ceramics, batteries, lead chromate and pharmaceuticals.

KAMANI ENGINEERING CORPORATION LIMITED
Transmission towers, sub-station structures and electrification equipment that carry vitally needed electricity all over the country.

KAMANI METALS & ALLOYS LIMITED
Brass, copper, phosphor bronze in the form of sheets, strips and coils that go into the manufacture of a variety of industrial components.

JAIPUR METALS & ELECTRICALS LIMITED
House service meters, and A.C.S.R., all-aluminium, cadmium copper and hand drawn bare copper conductors for overhead transmission.

SHBI-KB-90

IK

Symbol of Industrial Vitality

KAMANI CHAMBERS, NICOL ROAD, BALLARD ESTATE, BOMBAY 1 BR

Scientific packaging must keep pace with the planned growth of consumer goods industries

Each of the products listed below needs scientific packaging for its preservation and distribution. And so, as their production grows from Plan to Plan, it is essential that the consumer packaging industry keep pace.

The packaging industry like any other, must grow by its own efforts. By utilising its resources to maximum advantage. By undertaking ceaseless research and imaginative development. By keeping constantly in touch with the mainstream of international packaging know-how.

And while the packaging industry is doing and will do all these things, it must be assured of one thing—adequate supplies of the basic raw materials it needs to keep production moving and growing.

Especially supplies of tinplate—the primary consumer packaging medium. Until such time as the expanding local production of tinplate meets the packaging industry's requirements fully, this essential metal will have to be imported.

Without adequate tinplate the growth of the packaging industry will be seriously hindered—much of the fruits of planning go waste.

PRODUCTION TARGETS FOR SELECTED INDUSTRIES

(Third & Fourth Plans)

Industry	Unit	1965-66	1970-71
FOOD PRODUCTS			
1. Biscuits	'000 tonnes	40	75
2. Confectionery	"	25	50
3. Vanaspati	"	450	550
4. Fruits & Vegetables (Preserved)	"	75	150
NON-FOOD PRODUCTS			
1. Lubricating Oils	"	100	800
2. Paints & Varnishes	"	120	200
3. Cosmetics	Rs. million	150	250
4. Arc Welding Electrodes	mill. meters	274	550
5. Soap	'000 tonnes	220	320
6. Drugs & Pharmaceuticals	Rs. million	1750	3000

EXPORT TARGETS

(Third & Fourth Plans)

Commodities	1965-66 +		1970-71	
	Quantity '000 tonnes	Value Rs. Crores	Quantity '000 tonnes	Value Rs. Crores
FOOD PRODUCTS				
1. Fish & Fish preparations	23.90	9.02	89.90	33.80
2. Fruits & Vegetables	121*	30.73	193*	49.00
3. Cashew, Kernels & Nuts	63.48	24.52	83.61	32.40
4. Vegetable Oils	137.9	18.80	249.8	34.00
NON-FOOD PRODUCTS				
1. Medical & Pharmaceutical Products	246*	2.46	1000*	10.00
2. Soaps & Cleansing Preparations	200*	0.84	714*	3.00

* Represents index with base 1961-62: 100. + Revised

Source: *Notes on Perspective of Development—India: 1960-61 to 1975-76.* New Delhi, Perspective Planning Division, Planning Commission.

MB

METAL BOX

protective packaging

IWTMB 2633A

OF INTEREST TO SMALL SAVERS

EFFECTIVE 1st APRIL 1965

POST OFFICE SAVINGS BANK

Increase in rate of interest

- 4% Tax-free interest on lowest monthly balances
- Deposits and withdrawals without limits
- Cheque facilities available
- Can be operated by adults and children

CUMULATIVE TIME DEPOSIT ACCOUNTS

Tax-free Maturity bonus

- For deposit of Rs. 10 per month, in addition to the present maturity value
  Rs. 15 for a 5-year account
  Rs. 50 for a 10-year account
  Rs. 100 for a 15-year account
  for new accounts opened and for old accounts with outstanding terms of 5 years or 10 years to maturity
- Proportionate bonuses for other amounts of monthly deposits
- Deposits into these accounts will qualify for deduction from income for tax purposes

NATIONAL SAVINGS CERTIFICATES (FIRST ISSUE)

- Interest subject to tax
- In denominations of Rs. 10, Rs. 100, and Rs. 1,000
- Maturing after 10 years at Rs. 18, Rs. 180 and Rs. 1,800 issued to individuals only.

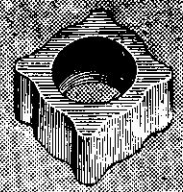
These certificates will be on sale from 1st June 1965. But, purchasers of 12-year N.D.Cs. from 1st April 1965 will be entitled to convert them into the new certificates until 31st December 1965.

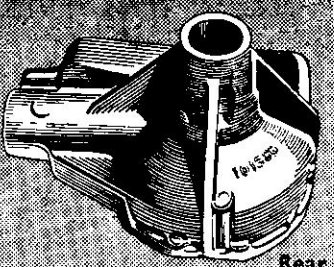


NATIONAL SAVINGS ORGANIZATION
MINISTRY OF FINANCE, GOVERNMENT OF INDIA

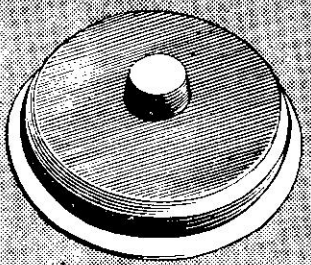
DA 64/739

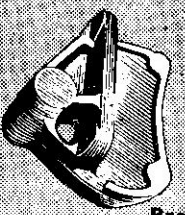
S. G. IRON AUTOMOBILE COMPONENTS

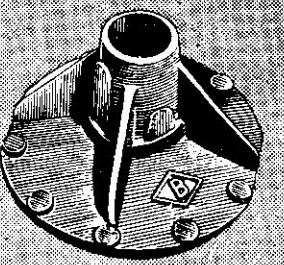

Bracket Pedal Pivot

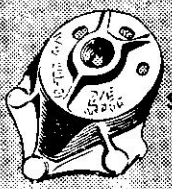

Rear Axle Casing

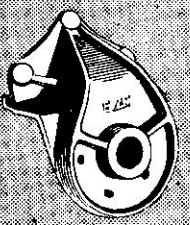

Speedometer Housing

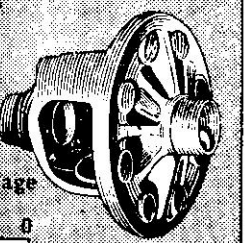

Rear Brake Drum

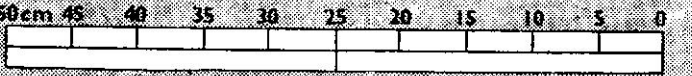

Propeller Shaft
Centre Bearing Housing


Rear Axle Cover


Steering Box
Bkt L.H.


Steering Box
Bkt R.H.


Differential Cage



THE THINGS WE MAKE...

ROLLING STOCK & COMPONENTS • POINTS & CROSSINGS • STRUCTURAL STEELWORK • PRESSED STEEL TANKS • STEEL, SPHEROIDAL GRAPHITE & GREY IRON CASTINGS • MACHINE PARTS, COMPONENTS & GEARS • FORGINGS, STAMPINGS & PRESSINGS • SLUICE VALVES & TWIST DRILLS • CRANES & PULLEY BLOCKS

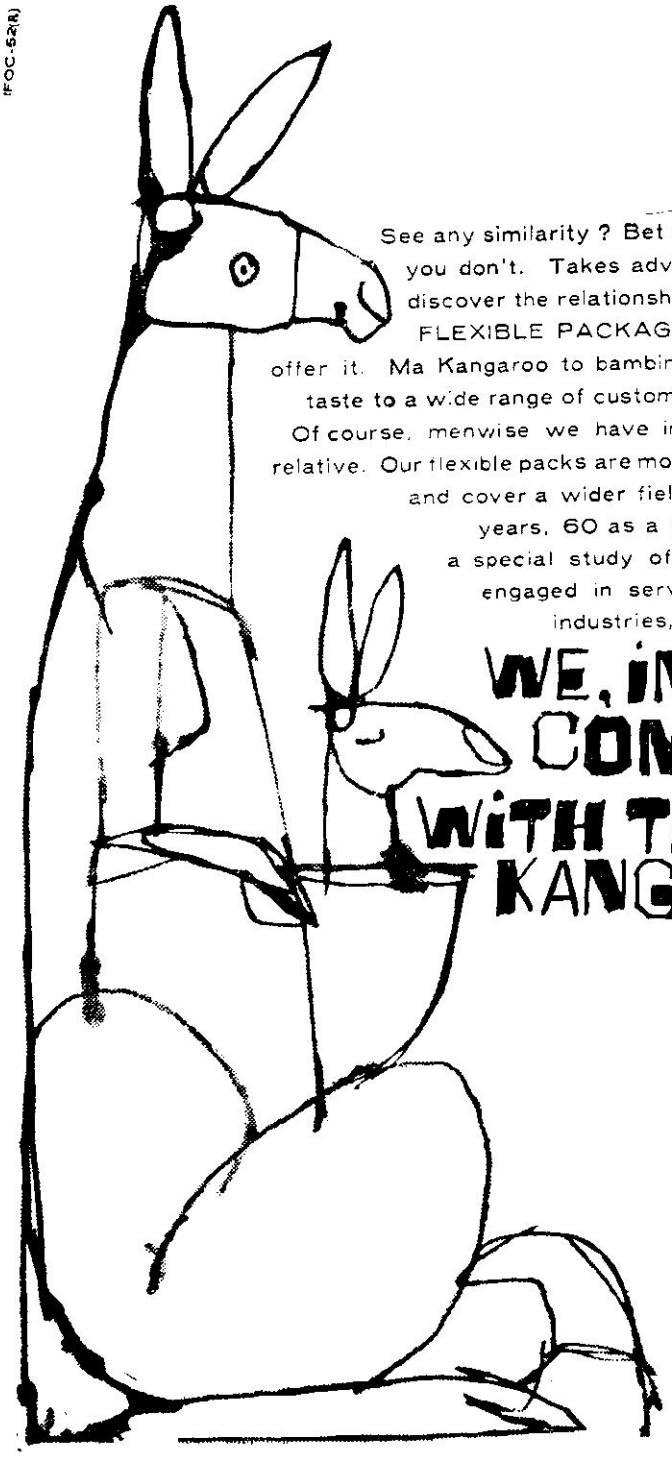
BURN & CO. LTD.

HOWRAH WORKS

Managing Agents : MARTIN BURN LIMITED
MARTIN BURN HOUSE, 12 Mission Row, Calcutta 1
Branches : NEW DELHI BOMBAY KANPUR PATNA
Agents in South India : The South Indian Export Co. Ltd., Madras 1

BHIC-45

IFOC-52(R)



See any similarity ? Bet a pumpkin to a pedigree poodle you don't. Takes advertising genius to do that— discover the relationship, we mean. But there it is— FLEXIBLE PACKAGING SERVICE. Both of us offer it. Ma Kangaroo to bambina; we with a more catholic taste to a wide range of customers, industrial and other sorts. Of course, menwise we have improved upon our paunchy relative. Our flexible packs are more protective, more decorative and cover a wider field of application. Over the years, 60 as a matter of fact, we have made a special study of the subject and are today engaged in servicing the needs of many industries, including pharmaceuticals, cosmetics and confectionery.

WE, IN COMMON WITH THE KANGAROO

India Foils Limited

(Incorporated in Great Britain)

CALCUTTA BOMBAY
MADRAS NEW DELHI

WAGE WAR ON ADULTERATION

A ROAD IS NOT THE ONLY PLACE WHERE YOU CAN DRIVE A JEEP.

DRIVE IT OFF THE ROAD. RUN IT THROUGH IMPOSSIBLE TERRAIN. ON A CART TRACK. UPHILL. DOWN A ROCKY SLOPE. THROUGH SLUSH AND MUD. VIRTUALLY ANYWHERE. YOU WILL BE ASTOUNDED BY ITS STRENGTH AND VERSATILITY! POWERFUL, MANOEUVRABLE, THE WORLD'S BIGGEST LITTLE VEHICLE IS UNBEATABLE IN PERFORMANCE AND ECONOMY. IT HAS A 72 BRAKE HORSE POWER ENGINE. A 4 WHEEL DRIVE...CAN BE EASILY ADAPTED TO MANY USES.

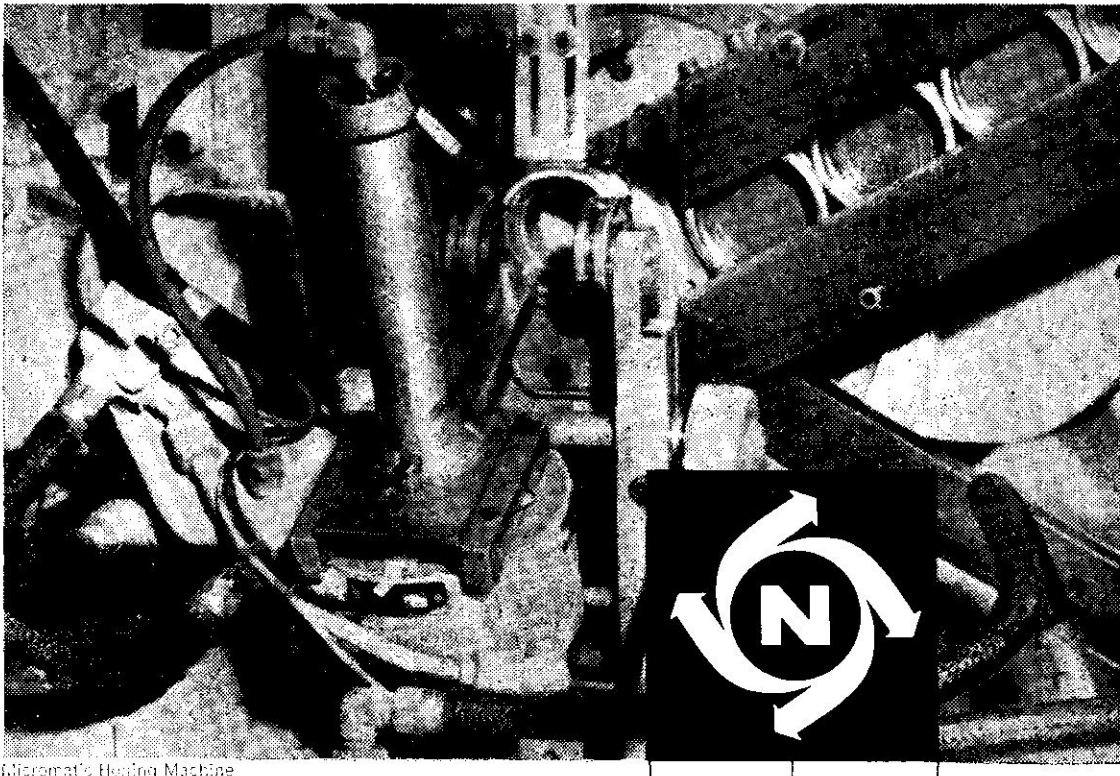


THE JEEP UNIVERSAL IS THE MOST DEPENDABLE VEHICLE YOU CAN OWN

MAHINDRA & MAHINDRA LTD.
BOMBAY • CALCUTTA • DELHI • MADRAS

Authorised dealers

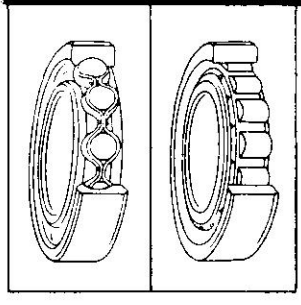
AUTOMOTIVE MANUFACTURERS PVT. LTD., Secunderabad • BHOPAL MOTORS PVT. LTD., Bhopal • CAMA MOTORS PVT. LTD., Ahmedabad • CENTRAL AUTOMOBILES, Raipur (M.P.) • GARAPATI GARAGE (1959) Vijayawada • GHATAGE & PATIL, Kolhapur • HIRAKUD MOTORS, Sambalpur • INDIA GARAGE, Bangalore • INDIA GARAGE, Madras • JADWET TRADING CO., Port Blair (Andaman & Nicobar Islands) JAMMU & KASHMIR MOTOR CORP., Jammu-Tawi (Kashmir State) • LAWLY SEN & CO., Patna • METRO MOTORS, Bombay METRO MOTORS (KATHIAWAR) PVT. LTD., Rajkot • NARAIN AUTOMOBILES, Lucknow • NARBHERAM & CO. PVT. LTD., Jamshedpur • PATNAIK & CO. PVT. LTD., Cuttack PROVINCIAL AUTOMOBILE CO. PVT. LTD., Nagpur • SANGHI BROS., (INDORE) PVT. LTD., Indore SANGHI MOTORS, New Delhi (Branch: Chandigarh) • SILVER JUBILEE MOTORS PVT. LTD., Poona • T.V. SUNDRAM IYENGAR & SONS PVT. LTD., Madurai • TASHI COMMERCIAL CORPORATION, Phuntsoling (Bhutan) • TENZING & TENZING, Sikkim • UNITED MOTORS OF RAJASTHAN, Jaipur VISHNOO V. KAMAT TARCAR, Cidade De Goa, Goa • WALFORD TRANSPORT LTD., Calcutta (Branches: Dibrugarh & Siliguri)



Micromat's Honing Machine

NORMA

puts
silence
in speed



Domestic and industrial fans, electric and diesel motors, scooter and motor car wheels—and a hundred-and-one other things that rotate—depend on ball and roller bearings for smooth and quiet operation.

The finest ball bearing steel, a microfinished raceway geometry of the rings, perfected by the latest Micromatic honing machine and balls with a highly finished surface, together go to make NORMA bearings extremely quiet in operation. Soon, a hundred different types of NORMA ball and roller bearings will be produced.

Backed by 50 years of American technical experience, every NORMA bearing has three prerequisites to perfection

1. **DIMENSIONAL CONSISTENCY** brought about by ultra-precision manufacture;
2. **MINIMUM AXIAL PLAY** ensured by exhaustive tests and checks;
3. **SMOOTH, QUIET RUNNING** due to highly finished ball and raceway surfaces and exact matching of balls and rings.

PRECISION BEARINGS INDIA LIMITED

REGISTERED OFFICE: Wavell House, 15, Graham Road, Ballard Estate, Bombay 1. FACTORY: Jhambuwa, Post Makarpura, Baroda. SALES REPRESENTATIVES: For Eastern, Northern and Southern India: THE EAST ASIATIC COMPANY (INDIA) PRIVATE LIMITED For Western and Central India: UNIVERSAL BEARING COMPANY PRIVATE LIMITED.

NORMA keeps the wheel moving

PBI 1521C

PS SHARMA

Research Officer
Registrar General's Office

Relative Variations in Productivity

Can agricultural productivity be increased even with the worker-area ratio remaining more or less unchanged? This and a number of other connected questions are discussed here by PS Sharma who says that the level of variations in the productivity per worker and per acre between States roughly indicates the broad divergence existing between the minimum and maximum productivity levels. This he considers a hopeful sign for further potential increases in agricultural productivity and production.

AN ASPECT relevant to the supply projection for food grains relates to the variations in the productivity per acre, and productivity per worker, with the change in labour strength per unit area. On this basis, it is possible to study whether higher or lower labour strength per unit of cultivated area (or higher or lower acreage per worker) is relevant to the level of agricultural productivity. In other words, it is possible that agricultural productivity can be increased even with the worker-area ratio remaining more or less unchanged. The validity of such a study depends upon that implicit assumption. Such a study can be undertaken on a scientific basis of cultivated land being more or less standardised, as also of the labour in terms of technical skill, efficiency, etc.

Since this sort of adjusted data for cultivated area and agricultural workers are not available, this study has been made for various States by considering the total cultivated area and the total

production of forecast crops[1] in relation to total agricultural labour, consisting of cultivators and agricultural labourers. Plantation crops have been excluded both from area as well as production so as to make the statistics comparable to the agricultural workers of 1961 Census in which plantation workers had been separately identified from non-plantation agricultural workers.

It is realised that the gross production of forecast crops cannot be arrived at by just adding up the physical production figures for various crops. There are, broadly speaking, two approaches to arrive at the gross value of production. One might be termed as 'Income Approach' under which the harvest prices as prevalent in different States for various crops may be utilised. This approach obviously cannot give a correct assessment of the actual variations in productivity per worker and per acre, covering as it does the variations due to fluctuations in prices and physical yields.[2]

Physical Approach

The other approach might be termed as the physical approach under which the production of various crops can be combined on the basis of inter-crop relationship, taking one of the crops as the standard crop. This approach can perhaps better assess the relative variations in productivity per worker and per acre, and has been used here. For our purpose, wheat has been taken to be the standard crop, and weights for various forecast crops have been developed by the price relatives in relation to average annual harvest wheat prices.

On this basis, the total production for each of the forecast crops has been combined so as to assess the gross production in terms of wheat. This has been attempted for each of the various States. In order to iron out the seasonal fluctuations in area and production of forecast crops, the average for the three years ended with 1955-56 and 1958-59 has been worked out, and these averages for area and production of forecast crops have been related to the agricultural workers as estimated for the years 1953-54 and 1957-58 on the basis of the variations observed during 1951-61. On the basis of the above procedure, the productivity per worker and per acre has been worked out, and the results are given in Table I, from which it is observed that the productivity per worker (in terms of wheat) is high in relation to the all-India average in the States of Andhra Pradesh, Assam, Madras, Punjab, Uttar Pradesh, and West Bengal. The States which are below the average all-India level are Bihar, Maharashtra-Gujarat, Kerala, Madhya Pradesh, Mysore, Orissa, and Rajasthan. If we look to the productivity per acre (in terms of wheat) in the various States in relation to the all-India average, it will be seen that more or less the same States which have higher productivity per worker in relation to the all-India average have also recorded higher productivity per acre, with the exception of Kerala, with almost double the level of productivity per acre in relation to the all-India average, although the productivity per worker in Kerala was lower than the all-India average.

The table also shows that at the all-India level, the productivity per worker shows a slight decline. This pattern of decrease has been observed in most of the States with the exception of Kerala, Punjab, and Rajasthan. In productivity per acre, Kerala, Madhya Pradesh, Punjab, Madras, Andhra Pradesh, Bihar, and Maharashtra-Gujarat have shown increases.

If we look at the level of variations with respect to the pressure of agricultural worker per 100 acres of area under forecast crops, and the variations in

TABLE I

Productivity per Worker and per Acre in different States

State	Agricultural workers per 100 acres of area under forecast crops		Productivity per worker * (in terms of wheat)		Productivity per acre* (in terms of wheat)	
	1953-56	1956-59	1953-56 (tons)	1956-59 (tons)	1953-56 (tons)	1956-59 (tons)
Andhra Pradesh	34	40	0.77	0.70	0.27	0.28
Assam	55	59	0.83	0.74	0.45	0.44
Bihar	54	58	0.45	0.43	0.24	0.25
Bombay	27	28	0.62	0.60	0.16	0.17
Kerala	90	88	0.55	0.58	0.49	0.51
Madhya Pradesh	28	30	0.67	0.66	0.19	0.20
Madras	44	51	0.86	0.79	0.38	0.41
Mysore	25	30	0.70	0.61	0.18	0.18
Orissa	38	42	0.64	0.53	0.24	0.23
Punjab	23	21	1.26	1.46	0.29	0.31
Rajasthan	26	24	0.56	0.61	0.14	0.14
Uttar Pradesh	39	39	0.72	0.72	0.28	0.28
West Bengal	36	40	1.25	1.06	0.45	0.42
All-India excluding Union Territories	34	36	0.72	0.69	0.24	0.25
Coefficient of variations	44.06	41.48	31.58	35.04	35.29	38.44

* Excludes plantation crops.

productivity per worker and acre it is observed that the coefficient of variations has gone down from 44 per cent to 42 per cent in between States in the case of agricultural workers. However, the coefficient of variations with regard to productivity per worker and per acre has increased from 32 per cent and 35 per cent respectively in 1953-56 to 35 per cent and 38 per cent in 1956-59. The level of variations in the productivity per worker and per acre between States can, perhaps, roughly indicate the broad divergence which exists between the minimum and maximum productivity levels, and this is a hopeful sign for further potential increases in agricultural productivity and production. Infact if we attempt to see the relationship between the pressure of agricultural workers per unit of cultivated area in relation to the productivity per worker and per acre, it is observed, on the basis of correlation coefficients, that in 1953-56 the pressure of agricultural workers and the productivity per worker were inversely related to the extent of (–) 0.32, and in 1956-59 to the extent of (–) 0.35. This does not indicate any significant correlation between the pressure of agricultural workers and the productivity of agricultural workers. However, this indicates the broad trend indicated by the inverse relationship. A study of the relation between the pressure of

agricultural workers and productivity per acre shows a high positive correlation (0.7) at both the points of time under study.

The relationship between the pressure of workers per acre and the food grains productivity per worker has been more closely studied for the States of Andhra Pradesh, Madras, Mysore and Uttar Pradesh on the basis of the 1961 Census data by size class of holdings. The results are combined in Table II.

... In Madras, because of the high level of irrigation and intensive cropping, there is relatively more utilisation of workers, and per worker productivity has shown a rising trend during 1952-55, and the reafter it has declined with the increase in the load of workers ...

Load of Workers

It may be stated in clarification of the methodology that the food grain workers have been estimated on the basis of the relationship between the crop patterns and the strength of the agricultural workers. Such a relationship has

TABLE II

Food Grains Productivity per worker in selected States by size of holding (in rural areas)

Size of Holding	Uttar Pradesh		Andhra Pradesh		Madras		Mysore	
	No. of food grains workers per acre	Food grains productivity per worker (tons)	No. of food grains workers per acre	Food grains productivity per worker (tons)	No. of food grains workers per acre	Food grains productivity per worker (tons)	No. of food grains workers per acre	Food grains productivity per worker (tons)
Less than 1 acre	2.56	0.12	3.06	0.15	2.92	0.17	2.72	0.13
1.0—2.4	0.88	0.35	1.19	0.38	1.47	0.33	1.06	0.34
2.5—4.9	0.46	0.65	0.62	0.72	0.99	0.50	0.56	0.63
5.0—7.4	0.33	0.81	0.45	0.75	0.40	1.12	0.42	0.64
7.5—9.9	0.24	1.10	0.34	1.00	0.64	0.70	0.31	0.87
10.0—12.4	0.22	1.19	0.28	1.02	0.60	0.59	0.26	0.78
12.5—14.9	0.19	1.38	0.23	1.18	0.52	0.68	0.23	0.82
15.0—29.9	0.16	1.82	0.20	1.23	0.47	0.76	0.17	1.08
30.0—49.9	0.11	2.22	0.14	1.56	0.29	1.24	0.11	1.69
50 +	0.07	3.59	0.08	2.87	0.14	2.49	0.05	3.47
Unspecified	0.27	1.00	0.34	0.98	0.27	1.67	0.29	0.93
All sizes	0.37	0.73	0.35	0.84	0.72	0.61	0.25	0.86

been studied for over 200 districts of India, and, on the basis of these results, it has been found that the ratio between the food grain and non-food grain workers works out to 75 : 25 in Andhra Pradesh, 70 : 30 in Madras, 60 : 40 in Mysore, and 85 : 15 in Uttar Pradesh. On the basis of these proportions, the total agricultural workers have been deflated, and a statistical estimate of food grain workers has been arrived at so as to relate them to the area under food grains and the total production of food grains, already estimated by size classes of holdings.[4] The correlation coefficient between the number of food grain workers per acre and food grains productivity per worker works out as follows :

	Correlation Coefficient
Andhra Pradesh	(—) 0.64
Madras	(—) 0.63
Mysore	(—) 0.54
Uttar Pradesh	(—) 0.59

This shows that even within the States, an inverse relationship has been observed between the pressure of agricultural workers and their productivity. This conclusion further corroborates the tendency observed on the basis of inter-State analysis. This does not, however, mean that there is any linear or proportionate relationship between the variations in the pressure of workers and the productivity per worker. This only shows that a relatively higher pressure of agricultural workers is having its impact on the productivity per worker.

Qualitative Results

The results regarding the relationship between the pressure of agricultural workers per acre and gross productivity per worker and per acre, arrived at on the basis of cross-sectional data, have also been worked out on the basis of time series data for the years 1951-52 through 1960-61 for one State each from North India (Punjab), South India (Madras), and for Central India (Madhya Pradesh) as also at All-India level, and the results are contained in Table III, (See Page 346).

It may be emphasised that the results based on the time series data should be considered only as qualitative, based as they are on incomparable data due to changes in coverage and method of estimation.

Table III shows that the pressure of agricultural workers per unit of cultivated area, as also the gross productivity per worker and per acre, differ from State to State. Thus in Madras, there is a variation from 39 to 58 workers per 100 acres, as against 27 to 31 in Madhya Pradesh, and 21 to 27 in the Punjab. It appears that the broad norm of workers per unit of cultivated area for the Punjab and Madhya Pradesh has got stabilised roundabout 20-22 and 28-30 per 100 acres respectively so far as crop production is concerned. In the case of Madras, the load of workers has varied from 39 in 1951-52 to 58 in 1960-61. It is probable that in some of the Southern States, like Madras, the higher pressure of agricultural workers might be due to a liberal definition of agricultural workers in the 1961 Census. But the fact to be noted is that in Madras, even with a relatively higher pressure of workers, both the gross productivity per worker (67-80 wheat tons per 100 workers*) and per acre (30-46 wheat tons per 100 acres) are relatively high. These figures for the Punjab and Madhya Pradesh work out between 98 and 164 and 53 and 75 wheat tons per 100 workers, and between 26 and 36 and 16 and 23 wheat tons per 100 acres respectively.

If we study the impact of pressure

* This is lower than the Punjab figure. —**Editor**

TABLE III

Pressure of Agricultural Workers per acre of Area under Forecast Crops and Gross Productivity per Agricultural Worker and per acre, in selected States from 1951-52 to 1960-61

Year	Pressure of agricultural workers per acre of area under forecast crops				Gross productivity per agricultural worker (tons) (in terms of wheat)				Gross productivity per acre (tons) (in terms of wheat)			
	All-India	Punjab	Madras	Madhya Pradesh	All-India	Punjab	Madras	Madhya Pradesh	All-India	Punjab	Madras	Madhya Pradesh
1951-52	0.34	0.27	0.39	0.28	0.65	0.98	0.79	0.58	0.22	0.26	0.31	0.17
1952-53	0.34	0.27	0.44	0.27	0.67	1.15	0.67	0.63	0.23	0.30	0.29	0.17
1953-54	0.33	0.25	0.42	0.28	0.75	1.24	0.86	0.66	0.25	0.31	0.36	0.18
1954-55	0.34	0.25	0.43	0.28	0.73	1.30	0.89	0.67	0.25	0.29	0.38	0.19
1955-56	0.34	0.21	0.46	0.28	0.71	1.25	0.84	0.68	0.24	0.27	0.39	0.19
1956-57	0.35	0.22	0.49	0.29	0.73	1.41	0.83	0.74	0.25	0.31	0.40	0.21
1957-58	0.36	0.22	0.53	0.31	0.66	1.40	0.81	0.53	0.24	0.31	0.42	0.16*
1958-59	0.36	0.21	0.54	0.30	0.75	1.62	0.76	0.75	0.27	0.34	0.41	0.23
1959-60	0.37	0.22	0.56	0.30	0.72	1.46	0.78	0.73	0.26	0.32	0.44	0.22
1960-61	0.38	0.22	0.58	0.31	0.77	1.64	0.79	0.74	0.29	0.36	0.46	0.23
Percentage variation in 1959-61 over 1952-54	+9.89	(−)17.70	+34.39	+9.61	+8.22	+40.18	+1.30	+18.72	+17.15	+17.24	+36.47	+30.81

* This reduction occurred due to a significant decline in rice production in 1957-58.

of agricultural workers on productivity per worker and per acre, it is observed, on the basis of correlation coefficients, that there is no fixed input-output relationship. In fact, the optimum norm for workers, input and output per worker and per acre, appear to differ from State to State. This is but natural in a country like India where so much heterogeneity prevails with regard to the socio-economic conditions, structural and institutional factors, level of inputs like fertilisers, improved seeds, and technology.

However, it may be stated, on the basis of Table IV, that, broadly speaking, as the pressure of workers per acre tends to increase beyond the optimum level, the productivity per acre is likely to decline, other factors remaining constant**. The cases of the Punjab and Madras are, however, exceptions to this. In the Punjab, the load of workers per acre has declined during 1952-56, and thereafter has got stabilised, but the per worker gross productivity has shown a steady rising trend. In Madras, because of the high level of irrigation and intensive cropping, there is relatively more utilisation of workers, and per worker productivity has shown a rising trend during 1952-55, and thereafter it has declined

** This is a pure tautology; assuming the optimum, the decline will occur either way—**Editor**

TABLE IV

Correlation Coefficient between Agricultural Workers per Acre & Gross Productivity per Worker

State	Year	Observation	Correlation coefficient	Remarks
Andhra Pradesh	1960-61	10 (between size classes of holdings)	(—) 0.64*	Food grain workers per acre and food grains productivity per worker
Madras	-do-	-do-	(—) 0.63*	
Mysore	-do-	-do-	(—) 0.54	
Uttar Pradesh	-do-	-do-	(—) 0.59*	
All-India	Cross-sectional Data	14 States 1953-56	(—) 0.30	
		14 States 1956-59	(—) 0.35	
Punjab	1951-52—1960-61	10 years	(+) 0.71**	
Madras	-do-	-do-	(+) 0.67**	
Madhya Pradesh	-do-	-do-	(+) 0.45	
All-India	Time series	10 years 1951-61	(+) 0.43	

Correlation Coefficient Between Agricultural Workers Per Acre and Gross Productivity Per Acre

Punjab	Time series	1951-61	(+) 0.50
Madras	-do-	-do-	(+) 0.25
Madhya Pradesh	-do-	-do-	(+) 0.33
All-India (excluding Union Territories)	Cross-sectional	1953-56	(+) 0.70*
-do-	-do-	1956-59	(+) 0.74**
-do-	Time series	1951-61	(+) 0.79**

* Significant at 5 per cent level
** Significant at 1 per cent level

with the increase in the pressure of workers.

Coming to the relationship between the per acre worker and per acre productivity, it may be stated that the two variables seem to be moving in the positive direction. Theoretically speaking, an increase in the strength of workers per acre will increase the productivity per acre so long as the optimum level has not been reached. However, from the operational point of view, this relationship might be explained by the fact that due to higher per acre productivity, it is possible to sustain a higher load of workers. Further, various agricultural operations, like sowing and harvesting, are seasonal in nature, and as these operations are of limited duration, the availability of labour in time might affect the per acre productivity. This argument is particularly relevant to those parts of India where the rainy season is very short. As Prof Colin Clark has pointed out:

> "... any plans for the permanent diversion of this rural labour surplus come up against the fact that it is not available throughout the year. It is true that the better distributed the rainfall, the better distributed also is the demand for labour; but even where the rainfall is uniform, there are still peak demands. In some parts of India, where the rainy season is very short, this peaks the demand for labour in a most alarming manner. Instead of being an embarrassing surplus,

labour suddenly becomes the critical factor in production. As Mr Pirie has pointed out, if any able-bodied man or woman is incapacitated by illness during this period, the loss of production may be very serious (though the critical period is rarely as short as the five weeks which he suggests). Experience in some European countries, such as Italy and Greece, shows that the cultivation of fruits and the keeping of livestock spread the demand for labour, more evenly over the year. These countries too, however, have a problem of labour shortage at the peak period."[5]

It may be relevant to state that the total value of human and bullock labour inputs in relation to total inputs per acre in food crops varies from about 50 per cent in the Punjab, Madhya Pradesh, and Madras to about 70 per cent in Uttar Pradesh on the basis of the results of Farm Management Studies conducted by the Ministry of Food & Agriculture. Any variation, therefore, in labour inputs is likely to have its impact on the productivity per worker and per acre.

REFERENCES

1. The forecast crops are: rice, jowar, bajra, maize, ragi, small millets, wheat, barley, gram, tur, other pulses, potatoes, sugarcane, ginger (dry), pepper (black), chillies (dry), tobacco, groundnut, castorseed, sesamum, rapeseed and mustard, linseed, cotton, jute mesta, sannhemp.

2. "Agricultural Production vis-a-vis Productivity of Agricultural Workers during 1956-59," by PS Sharma. Annual Number, **Agricultural Situation in India**—August 1961.

3. The weights for crops are: wheat (1.00), rice (1.09), jowar (0.62), bajra (0.63), maize (0.67), ragi (0.66), small millets (0.60), barley (0.72), gram (0.82), tur (0.82), other pulses (0.76), potatoes (0.62), ginger (1.76), dry chillies (3.90), tobacco (4.71), sugarcane (0.92), groundnut (0.92), castorseed (0.94), sesamum (1.55), rapeseed and mustard (1.38), linseed (1.29), cotton (4.18), jute (1.60), mesta (0.88), black pepper (6.83).

4. See for reference "Estimation of Marketable Surplus by size class of Holding" Annual Number, **Agricultural Situation in India**—August 1964.

5. Colin Clark: "Future Source of Food Supply—Economic Problems" in **Journal of the Royal Statistical Society**—Series A (General)—Part 3, 1962, page 435.

Inputs to Treble Crops Yield Available

Scientific ingredients necessary for trebling the present average yields of rice, wheat, maize, and other cereals are now available in India, according to Dr MS Swaminathan, of the Indian Agricultural Research Institute.

Addressing a meeting at Cambridge University, early in August, he said that in rice and wheat the dwarf varieties, which were capable of utilising solar and chemical energy very efficiently, had yielded more than six tons per hectare. Use of atomic radiation had helped correct defects of crop varieties introduced from other countries.

Dr Swaminathan said that to step up yields there was need for supply of all necessary inputs particularly seeds and fertilisers. The pace of progress in the overall production would ultimately depend upon the extent of the availability of these inputs.

PARESHNATH CHATTERJEE

Formerly of the Department of Business Management Delhi University

Indifferent Behaviour of Agricultural Productivity

In the context of economic growth, Indian agriculture has so far been a 'pull' factor, rendering part of the rate of growth in the other sectors nugatory. The author, who analyses the indifferent behaviour of agricultural productivity since 1950-51, mentions a number of methods and measures to be adopted for lifting agriculture from the morass of under-development that has continued even during the era under planning. He welcomes NPC's entry into the field of agricultural productivity, and, among other things, suggests that it should encourage the establishment of farming companies and agro-industries, and introduce countrywide programmes of farm education.

THE share of agriculture in national income by industrial origin was 48.1 per cent in 1948-49 from which it has come down to 44 per cent in 1962-63, in terms of current prices. The relatively greater rate of growth in the sectors of industries and services has accounted for this decline in the part of agriculture in the national economy. However, it continues to be the major single contributor to national income. As far as it goes, it is a healthy sign that the relative share of agriculture is declining. However, this is not all, for the potential for agricultural build-up in this country has been relatively unexplored, in spite of the fact that, during the period under planning, agriculture received considerable emphasis in terms of proportionate outlay and resource inputs. Despite this, the rate of growth in the agricultural sector has been rather low. Thus there is a strong case for adequate

and concerted attention for creating a climate of efficiency in this vital sector of the national economy.

Critics of Indian economic policy are not slow in pointing out that in the sphere of agriculture, the fertility of the soil has desperately lagged behind the fecundity of official slogans. Maybe, this is an exaggeration, but it can hardly be gainsaid that agriculture has remained a sad victim of overlapping jurisdictions of the Centre and the States and within each of different Ministries, Departments, or agencies. The impressive figures of fertiliser production, irrigation projects, and land reforms have failed to evoke the desirable response from those who matter. Needless to stress much requires to be done to enliven this sector.

The dominant characteristic of Indian agriculture is said to be the predominance of food grains production over non-food grains production. However, there has been a marked tendency since 1950-51 of increasing acreage under non-food grains in relation to food grains, and expansion in food grains production, though considerable in itself, has not been as much as to cope with the increased requirements of food in conditions of higher 'income elasticity of demand' and growth of population. The recent rise in food grains prices would appear irreconcilable to many, if it is taken into account that food grains production was only 80 million tons in 1960-61 and about 90 million tons in 1964-65.

Loopholes in Distribution

Supplies have been continuously further augmented largely through the charity of Uncle Sam (PL-480) at an average level of 4.5 million tons per year, with the peak level of 7 million tons last year. While thus the total availability of food grains increased beyond doubt, there were loopholes in the distribution system and prices rose with reference to regional scarcities.

As for non-food grains, however, production has increased at a much higher and more consistent rate than food grains, and taking 1949-50 as the base, production of non-food grains was over 50 per cent higher than in 1963-64.

Tables II and III show the official indices of area and production of food grains, non-food grains, and all commodities, taking 1949-50 as 100. It will be seen that in the case of food grains, the expansion in area has been

TABLE I

INDEX OF PRODUCTIVITY

	Food Grains	Non-Food Grains	All Commodities
1950-51	92.4	95.6	95.7
1951-52	93.0	91.1	95.9
1952-53	98.0	89.3	96.9
1953-54	108.1	90.3	102.8
1954-55	105.2	94.9	104.2
1955-56	103.0	91.7	101.6
1956-57	107.4	97.8	107.2
1957-58	98.6	95.8	101.0
1958-59	112.5	102.0	111.8
1959-60	109.1	97.1	108.0
1960-61	118.3	106.3	117.9
1961-62	117.8	102.2	116.5
1962-63	111.0	101.5	112.0
1963-64	115.0	102.8	115.0

TABLE II

INDEX OF AREA

	Food Grains	Non-Food Grains	All Commodities
1950-51	97.9	110.8	99.9
1951-52	98.0	121.3	101.7
1952-53	103.2	116.2	105.3
1953-54	110.2	115.9	111.2
1954-55	109.3	127.4	111.3
1955-56	111.9	130.7	115.0
1956-57	112.5	134.4	116.0
1957-58	110.8	135.2	114.7
1958-59	116.1	136.6	119.4
1959-60	117.2	139.0	120.7
1960-61	114.6	139.2	118.5
1961-62	116.7	146.0	121.4
1962-63	117.5	148.8	122.5
1963-64	117.3	147.6	122.2

TABLE III

INDEX OF PRODUCTION

	Food Grains	Non-Food Grains	All Commodities
1950-51	90.5	105.9	95.6
1951-52	91.1	110.5	97.5
1952-53	101.1	103.8	102.0
1953-54	119.1	104.7	114.3
1954-55	115.0	120.9	117.0
1955-56	115.3	119.9	116.8
1956-57	120.8	131.5	124.3
1957-58	109.2	129.5	115.9
1958-59	130.6	139.4	133.5
1959-60	127.9	135.0	130.3
1960-61	135.6	147.9	139.7
1961-62	137.5	149.2	141.4
1962-63	130.4	151.0	137.2
1963-64	134.9	151.2	140.5

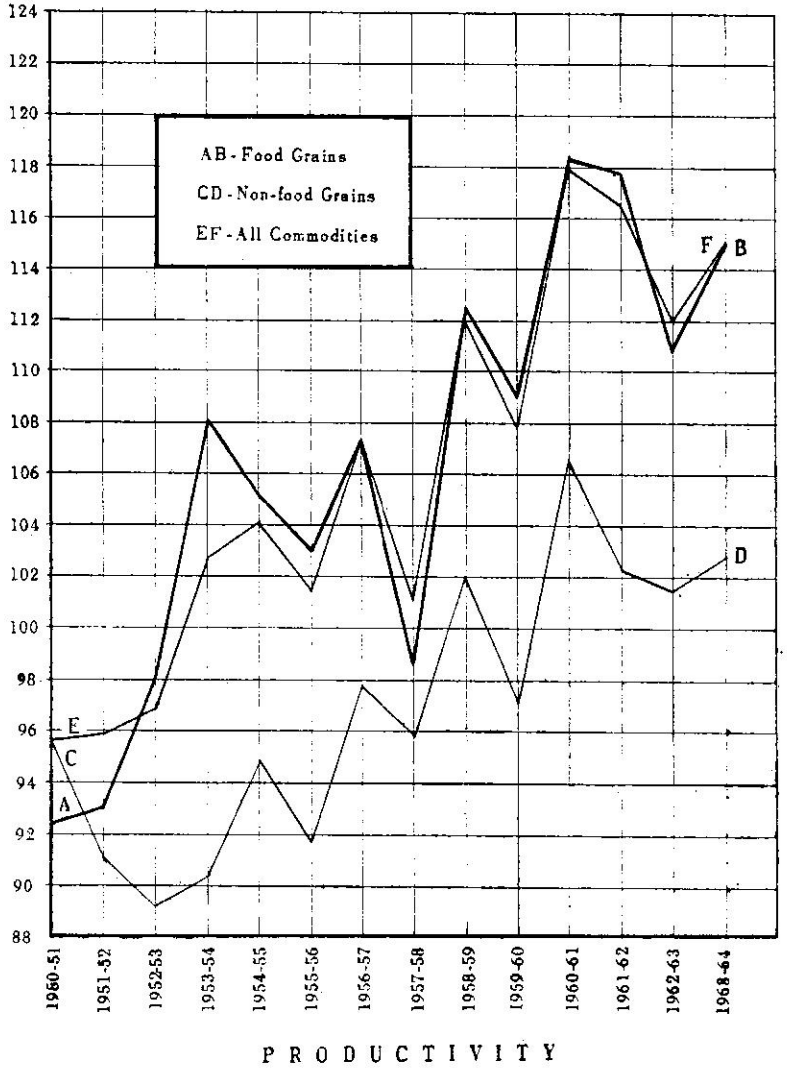
nearly 48 per cent. In terms of all commodities, the expansion has been over 22 per cent. It will thus be seen that a major part of the expansion in area under agriculture has been accounted for by non-food grains.

The official index of productivity (See Table I) indicates recurrent ups and downs in almost all cases: food grains, non-food grains, and all commodities. The index of productivity of food grains was as low as 92 in 1950-51 from which it gathered momentum up to 108 in 1953-54, declined to 103 in 1955-56, again rose to over 107 in 1956-57, to come down to nearly 99 in 1957-58, again rising to 113 in 1958-59, rising to 115 in 1963-64 via the peak year 1960-61, when it touched over 118. These movements have a pictorial quality in the frequency of the rise and fall from year to year. The graphs showing these movements are to be read together with the tables.

The same was the condition of non-food grains, though the index never

touched 100 before 1958-59, and was only 102.8 in 1963-64. During the peak year 1960-61, the index was only 106 as against 118.3 in the case of food grains. Thus, it can be said that the increase in the production of non-food grains was possible more through extension in the area, rather than through more efficient use of the available acreage under non-food grains. The productivity trend in this case is disconcerting and needs urgent attention.

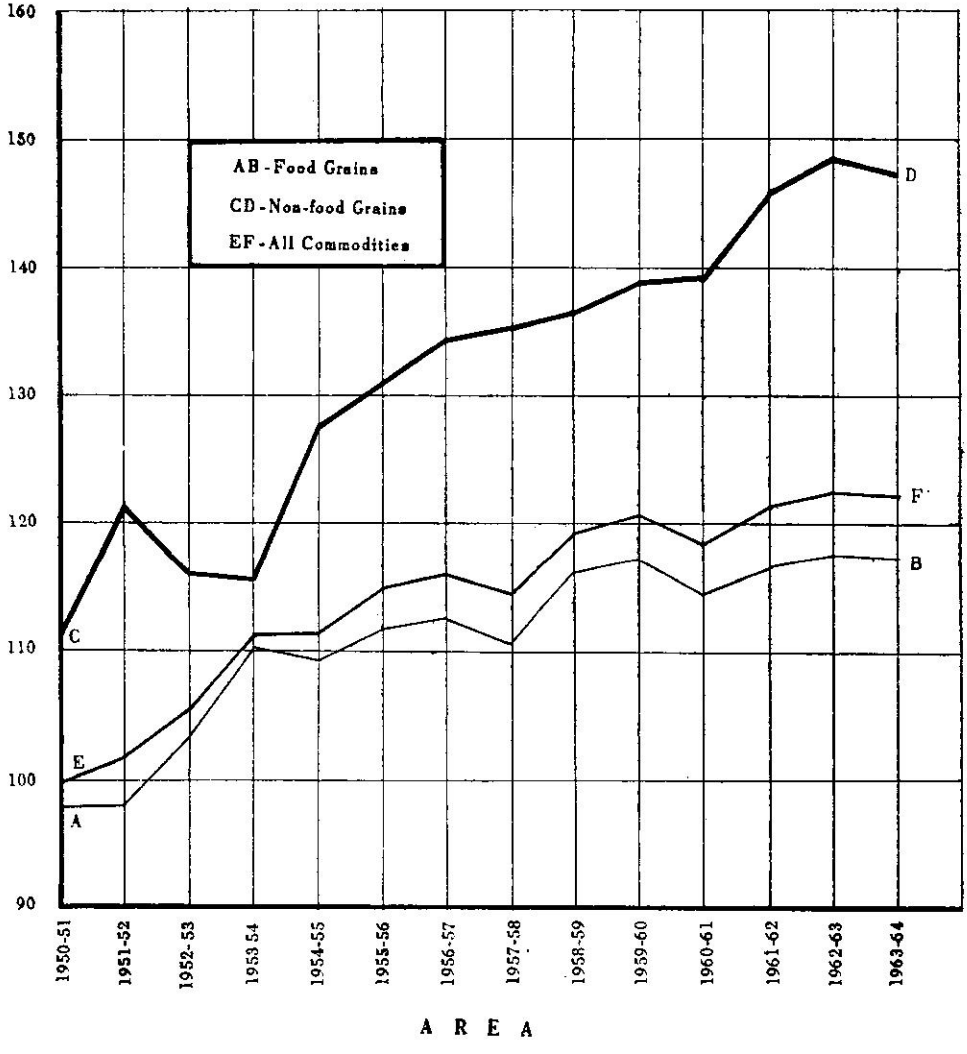
In a recent series of lectures at Patna, Dr KN Raj observed: "In India the bulk of the increase in production in the last decade has come from extension of area, and only a small proportion from increase in yields." Tables I, II and III, however,



show that this was not the case in regard to food grains. While expansion in area was over 17 per cent in 1963-64, the increase in output was by nearly 35 per cent: the improvement in productivity was of the order of 15 per cent. Dr Raj's statement, however, is true of non-food grains, as noted earlier.

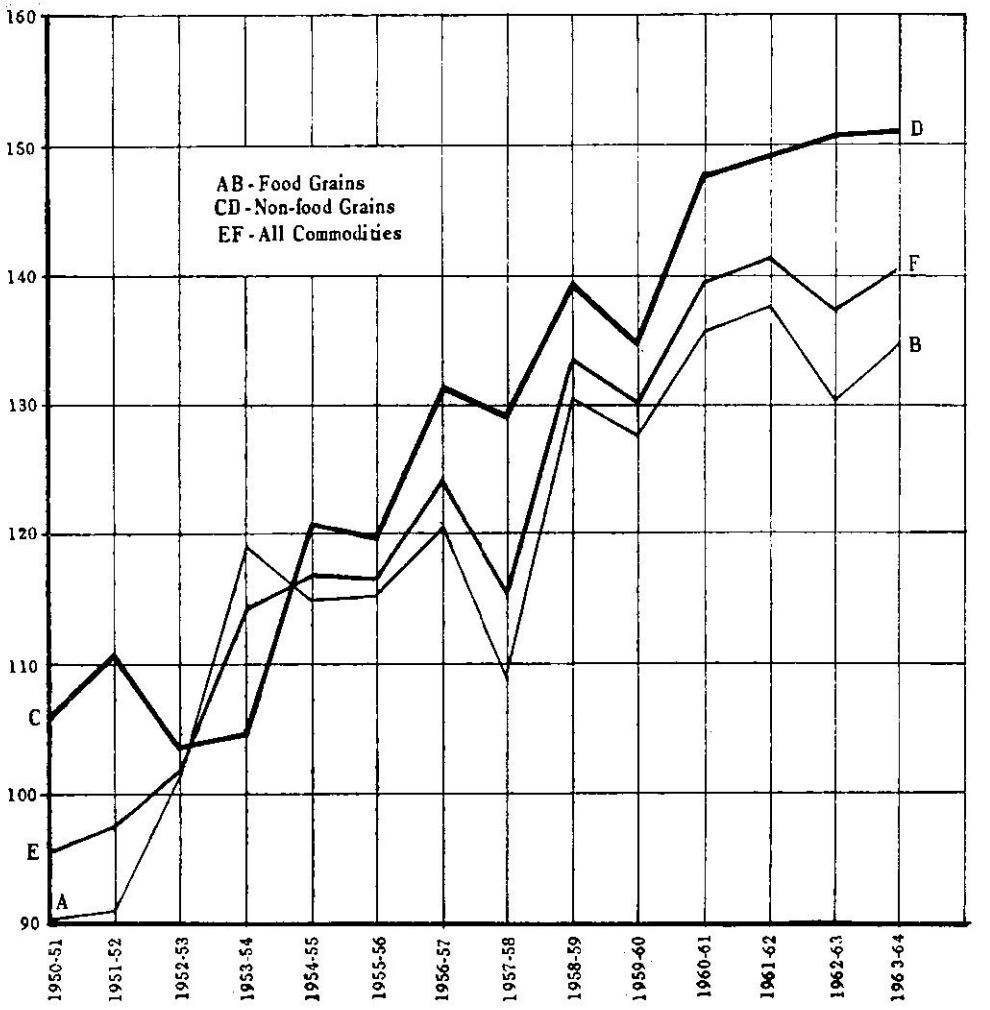
As regards commodities, the productivity trend has been more consistent with that of food grains, and since 1953-54, it did not look back below 100. The behaviour, however, has been erratic and the ups and downs have been as frequent as in the other cases.

The picture thus afforded is one that can hardly be said to have responded to any of the stimuli as provided under the



plans. There are variations in trends according to States and regions, to different crops, to size of holdings and types of organisation adopted in this sphere. This rather indifferent behaviour of agricultural productivity underlines several internal and external factors over many of which control could not be effective. For example, during the last decade, ravages of flood have caused heavy losses in several States.

During the period under planning, much emphasis has been put on agricultural research for improving yields. A research study by the ICAR with respect to fertiliser economies in paddy cultivation brought out some interesting facts which have good relevance to improvement



PRODUCTION

TABLE IV

Dose of Fertilisers (md. per acre)	Cost Rs.	Additional yield (md.)	Value of additional Produce Rs.	Net profit per acre Rs.
1¼ md. Ammonium Sulphate (20 lb. Nitrogen) ..	17	4.5	54	37
2½ md. Ammonium Sulphate (40 lb. Nitrogen) ..	34	6.6	79	45
1½ md. Superphosphate (20 lb. P_2O_5) ..	13	3.6	42	29
3 md. Superphosphate (40 lb. P_2O_5) ..	26	4.9	59	33
1¼ md. Ammonium Sulphate 1½ md. Superphosphate (20 lb. Nitrogen, 20 lb. P_2O_5) ..	30	6.6	79	49
2½ md. Ammonium Sulphate 1½ md. Superphosphate (40 lb. Nitrogen, 20 lb. P_2O_5) ...	47	7.9	95	48

in the cultivation of paddy. The study reveals, as shown in Table IV, that 1¼ maunds ammonium sulphate, 1½ maunds superphosphate (20 lb. nitrogen, 20 lb. P_2O_5) is the most profitable type of fertiliser combination for application, though not the highest yielding one; in every case given, there was additional yield and profit. The nature of response towards application of fertilisers, however, continues to be sluggish, to say the least, in spite of occasional subsidisation.

Economists have suggested that the application of fertilisers should be more concentrated on irrigated land for better results. However, considering the fact that only about 16 per cent of the total cultivated land is irrigated, the scope of fertiliser application becomes rather limited, if this strategy is adopted. As a strategy, this is not always workable. As Dr Raj put it, "the high rents in force in these areas operate as a serious disincentive for tenant-cultivators to apply inputs to the extent that would be otherwise worthwhile" (KN Raj, **Indian Economic Growth: Performance and Prospects, 1965**, p. 12).

Among the measures that the NPC may consider for adoption, mention may be made of the following:

1. Encouragement for the establishment of farming companies and agro-industries.
2. Introduction of countrywide programmes of farm education.
3. Charting soil types and responses to fertilisers with regard to different crops and different combinations and doses of fertilisers.
4. Inputation of the hours put in for agricultural operations and wages and salaries for farm labour, and supervision, including family labour.
5. Measurement of resource inputs and production.
6. Benefits, if any, of multiple cropping.
7. Irrigation water, water rates, manner of utilisation and output raised in terms of water inputs, and of combined water-fertiliser inputs.
8. Compilation of statistics of productivity on the basis of man-year or man-hour and individual, or combined resource inputs in constant measures.

T RAMAKRISHNA RAO

Agricultural Economics Research Centre, Madras University

Inter-District Variations in Madras State

Inter-district variations in the level of per capita income help to identify low income districts requiring special assistance. A study of variations in the levels of development, and with reference to potentialities, helps to identify under-developed regions needing developmental assistance. The present study seeks to identify the districts in Madras State which have attained higher levels of agricultural output per unit of area. It is the author's hope that the study of the unique cultural practices of districts showing output in excess of their potentialities will offer fruitful lessons for extension.

THERE are several alternative methods of measuring agricultural productivity. Productivity could be measured in terms of (i) output per unit of area, (ii) output per unit of labour, either man-hours, man-days, or man-years, and (iii) output in terms of all the inputs[1]. The choice among these three measures depends upon the factor of production, which needs to be economised. Where land is scarce in relation to labour, land needs to be economised, and the measure most suitable is output per unit of area. In adopting this measure, all other factors, excepting land, are considered costless; but in countries where land and capital are both scarce, an economy is to be observed in respect of the use of capital also. A better approach, would probably be to consider the output per acre, after deductions towards the use of capital inputs. This approach, though desirable, is rendered difficult, because of the absence of data regarding

TABLE I

Index of Productivity Variations—Cropwise

PRODUCTIVITY INDICES OF CROPS

District	Rice	Cholam	Ragi	Cumbu	Minor Cereals	Cotton	Groundnut	Pulses	Sugarcane
Chingleput	79.23	..	81.09	92.87	107.31	..	97.82	109.35	..
South Arcot	99.65	51.31	101.58	77.71	172.29	..	100.00	118.29	113.63
North Arcot	104.88	86.01	115.61	84.84	100.14	..	100.00	127.64	90.90
Salem	129.36	125.22	80.73	94.66	63.01	123.24	100.00	82.11	..
Coimbatore	132.27	94.02	111.19	112.72	64.56	135.21	100.00	82.11	122.73
Madurai	114.79	112.54	113.56	128.07	85.51	88.73	102.09	91.06	..
Tiruchirapalli	86.23	82.51	86.12	106.49	125.32	102.82	100.00	109.35	93.93
Thanjavur	101.41	..	..	..	137.27	..	104.27	82.11	..
Ramanatha-puram	65.26	107.73	100.11	99.67	109.28	76.06	100.00	109.35	..
Tirunelveli	122.36	138.05	125.40	92.35	60.48	73.24	104.27	109.35	..
Nilgiris	98.42	..	71.77	..	78.34	..	106.36	..	..

Note:—Index is not shown where acreage formed less than one per cent of the total area in the district.

capital inputs. The consensus among agricultural economists, is that it is convenient and operationally meaningful for purposes of comparing productivity in different regions if it is based on per acre productivity, while the variations in respect of other factor inputs might be viewed as possible causes of variations in productivity, and might be examined as such[2]. Hence, per acre output is chosen as a measure for studying variations in agricultural productivity.

The statistics of yields per acre have been taken from Season and Crop Reports of Madras State. The yields of rice, cholam, ragi, and cumbu are based on results of crop-cutting experiments conducted by the Department of Statistics, Madras. Hence data in respect of these crops are much more reliable than in respect of other crops. The triennium ended with 1959-60 is chosen for study to eliminate possible fluctuations owing to changing weather conditions.

The index of crop productivity is shown in Table I. The index of crop productivity of the ith crop in the dth district is defined by the relation

$$C_{id} = \frac{Y_{id}}{Y_{is}} X100$$

where Y_{id} = Yield per acre of the ith crop in the dth district, and Y_{is} = Yield per acre of the ith crop for the State as a whole, for the triennium ended 1959-60. In other words, the weighted yield per acre of the State for the triennium ended 1959-60 is taken as the base to work out the index of variations. Indices are not shown in respect of crops, the acreage of which forms one per cent or less of the total area in the district. The newly formed Kanyakumari

District is not included. We posed two questions :

1) What are the crops in respect of which variations are quite significant, so that extension could be fruitful?

2) Which are the districts that record maximum output per unit of area?

Of the nine crops studied, groundnut shows the least variation. Of others, the range of variation is as follows:

Crop	Maximum Index	Minimum Index
Rice ..	132.27	65.26
Cholam ..	125.22	51.31
Ragi ..	125.40	80.73
Cumbu ..	128.07	77.71
Minor Cereals ..	172.21	60.48
Cotton ..	135.21	76.06
Pulses ..	127.64	82.11
Sugarcane ..	122.73	90.90

The variation is quite significant in respect of all these crops, suggesting the possibilities of increased overall production by translating the practices of districts with high yields to those with low yields. We may now identify the districts with possibly better cultivating practices, and also those with inferior cultivating practices.

Crop	DISTRICTS First Rank	Second Rank	DISTRICTS Last But One	Last
Rice	Coimbatore	Salem	Chingleput	Ramanathapuram
Cholam	Tirunelveli	Salem	Tiruchirapalli	South Arcot
Ragi	Tirunelveli	Madurai	Chingleput	Salem
Cumbu	Madurai	Coimbatore	North Arcot	South Arcot
Minor Cereals	South Arcot	Thanjavur	Coimbatore	Salem
Cotton	Coimbatore	Salem	Ramanathapuram	Tirunelveli
Pulses	North Arcot	South Arcot	Coimbatore	Salem
Sugarcane	Coimbatore	South Arcot	Tiruchirapalli	North Arcot

No single district is found to be unique in respect of all the crops. Coimbatore is found to be the best in rice, cotton and sugarcane, but the percentage of area under rice is comparatively very small in Coimbatore. In respect of cotton and sugarcane, the percentage compares favourably with other districts. Tirunelveli is the best in cholam, but the percentage of area under this is quite low compared to the predominantly cholam-growing areas like Coimbatore, Madurai, and Tiruchirapalli. Hence Salem should be a better example than Tirunelveli. Tirunelveli is good at ragi also, but even here the percentage of area is quite small. Madurai records the first rank in respect of Cumbu, but the percentage of area is much smaller, when compared to Coimbatore. In respect of minor cereals, South Arcot is outstanding: here the percentage of area is quite large. North Arcot is good at pulses: the percentage of area under this just exceeds the State average. In general, Tiruchirapalli, Ramanathapuram, and Chingleput are found to be districts with low yields.

Several alternative methods are possible in evolving a composite productivity index. Kendall devised a method of ranking co-efficients. Stamp applied this method for determining the agricultural efficiency of several countries. The same method is adopted by Suprey and Deshpandey in their study of "Inter-district variations in agricultural efficiency in Maharashtra State";[3] but conversion of proportionate acreage to ranks is quite unnecessary, and makes the composite index unreasonably insensitive.[4] Hence the method adopted here is to weight the index of each crop with the triennial

average of the proportional area in the same district.[5] Thus composite crop productivity index (per gross cropped acre), $C_d(^i)$ is defined by the relation,

$$C_d^{(i)} = \sum_1^n C_{id} \; W_{id}$$

$$\text{where} \quad W_{id} = \frac{a_{id}}{\sum_1^n a_{id}}$$

proportionate area under the ith crop in the dth district in the gross cropped area of that district such that $\sum_1^n W_{id} = 1$, and n is the total number of crops in the district. This index is further weighted by the intensity of cropping in the district, such that the composite crop productivity index can be related to the sown acre. $C_d(^s)$, the composite crop productivity index (per sown acre), for the dth district is defined as

$$C_d(^s) = C_d(^i) \times I_d$$

where I_d = Intensity of cropping in the dth district

$$= \frac{\text{Total gross cropped area}}{\text{Total net sown area}}$$

This index weighted by intensity is again weighted by crop rating system so as to arrive at a final measure of productivity. Composite productivity index (gross value per sown acre) is defined for the dth district by

$$V_d = C_d(^s) \times R_d$$

where R_d = Crop rating index for the dth district defined as

$$R_d = \frac{\sum_a id \; g^{is} / \sum_d id}{\sum A_i \; g^{is} / \sum A_i}$$

where g^{is} = gross value per acre of the ith crop for the State as a whole (i.e. at average yield for State, and at State harvest price) and

a^{id} = gross cropped area under i^{th} crop in d^{th} district,

and A_i = gross cropped area under i^{th} crop for the State as a whole.

R_d is the ratio of total gross value per acre of the dth district to the total gross value per acre for the State at State yields and prices. Thus each district is rated by its cropping pattern keeping the yields and prices constant, higher weights being given to more productive crops as defined by higher gross value per acre.

The derived figure gives us the weighted index for the State as well as the districts. An index of variation (presented below) has been worked out.

Index of Crop-rating System

District	Index of crop-rating system
Chingleput ..	133.22
South Arcot ..	111.69
North Arcot ..	113.89
Salem ..	73.26
Coimbatore ..	82.87
Madurai ..	92.25
Tiruchirapalli ..	92.71
Thanjavur ..	140.16
Ramanathapuram ..	90.51
Tirunelveli ..	88.77
Nilgiris ...	96.41

This shows that the predominantly rice growing districts like Thanjavur, Chingleput, South Arcot, and North Arcot recorded much higher crop-rating than other districts, because of larger weightage.

The composite productivity indices are shown in Table II. A significant thing to be noted is that the inter-district variations are large only when the productivity is weighted by the crop-rating system;

high crop-rating may not be due to better efficiency, but due to better natural resource endowment, since the variations in index weighted by crop-rating systems without relating it to natural resource endowment will not be much helpful in drawing policy conclusions. In considering the composite indices, figures against the Nilgiris district need to be ignored, since the crops in question form only a small percentage of the total cropped area. Between the two indices—the index weighted by acreage under each crop and the index further weighted by intensity—the latter should be considered to present a better picture of variations, for productivity should be judged not only by the yield of crop per unit of area, but also by the number of crops raised on the same unit of area. Examining this index, if we exclude Ramanathapuram, which is found to be particularly low, the variation ranges from 91.78 in Tiruchirapalli to 110.61 in Coimbatore. Relating the range of composite index to the range of variations for individual crops, it is found that the former is much smaller. This confirms the previous observation that districts with high indices under each crop, broadly speaking, record low percentage of area under such crops. It suggests that the possibility of translating such practices on a wider scale are not very great, and the achievements in overall output by translating the practices of districts with high yields to others cannot be very significant. Major advances could be made only through general improvement of practices of cultivation in all the districts.

TABLE II

Index of variations of Composite Productivity

District	Crop Productivity Indices Weighted by proportionate acreage under each crop		Weighted by Indensity		Weighted by crop-rating system	
	Index	Rank	Index	Rank	Index	Rank
Chingleput ..	81.77	11	93.45	7	124.49	2
South Arcot ..	101.09	6	107.03	2	119.54	4
North Arcot ..	102.76	3	105.35	4	119.98	3
Salem ..	97.27	7	93.18	8	68.26	11
Coimbatore ..	107.07	1	110.67	1	91.71	6
Madurai ...	105.77	2	100.44	6	92.66	5
Tiruchirapalli ..	96.65	8	91.78	9	85.09	8
Thanjavur ..	101.65	5	106.77	3	149.65	1
Ramanathapuram	87.18	9	78.39	10	70.95	10
Tirunelveli ..	102.73	4	102.73	5	91.19	7
Nilgiris ..	86.53	10	74.89	11	72.20	9

Suitability of Soils

Potential productivity is sought to be measured by considering natural endowments, availability of labour, and capital availability. PS Sharma[6] attempted an overall ranking of potential productivity for different regions of India by examining six factors: 1. Soils, 2. Rainfall, 3. Cultivated area as percentage of geographical area, 4. Net area irrigated as percentage of net area sown, 5. Agricultural workers per 100 acres cultivated, and 6. Population density per square mile. Sharma derived an overall ranking by giving equal weights to each of these factors.

In a subsequent paper[7] published in the **Indian Journal of Agricultural Economics**, he gave weights to some of the factors and worked out the composite resource index for districts in India, but related these indices to productivity index worked out on the basis of rice and wheat only. A similar procedure is attempted here, in constructing the potential, productivity index. P_d defined by $P_d = \sum L_j Z_j$,

where L_i are the potentiality indices listed below, and Z_i the associated weights. The factors denoting potentiality are:

1. Rainfall
2. Soil fertility
3. Percentage of cultivated to cultivable area
4. Percentage of area irrigated to net sown area
5. Workers per sown acre
6. Livestock per sown acre
7. Ploughs per sown acre
8. Pumping-sets and oil-engines per sown acre.

Figures relating to rainfall have been obtained from Season and Crop Reports for the triennium. The index of variations is worked out, taking the State average as the base. Excepting in the Nilgiris, the rainfall varied between 27" in Coimbatore district and 41" in Thanjavur district.

Since we had no access to data relating to soil fertility rating of each district, we took land revenue per acre of ryotwari area as a measure of soil fertility. Thanjavur was unique.

The percentage of cultivated to cultivable area would throw more light on the suitability of soils for cultivation. The total cultivable area includes cultivated area, current fallows, old fallows, and cultivable waste. The percentage of area irrigated refers to percentage in the total sown area. Figures relating to this also are got from the Season and Crop Reports of Madras State. The total number of workers in each district engaged in agricultural labour have been obtained from the 1961 Census. Female workers are not considered, because of the possibility of variability of investigation bias. Workers per sown acre are got by dividing the total number of workers by the total sown area of the district. The number of livestock, ploughs, pumping-sets, and oil-engines of the district are got from 1961 Census of Livestock and Implements as recorded in the Season and Crop Reports of Madras State. All these are expressed in terms of per unit of sown area. In the case of all the factors, the variations are worked out by taking the State as the base. The composite index of variations of potential productivity is derived by adopting the same weights as given by PS Sharma, in the case of rainfall, soil fertility, percentage of area irrigated, and workers per sown acre. For all others, a weight of one is given.

The composite index of potential productivity shows that potentialities vary largely among districts. Not considering the Nilgiris, the potential productivity varies from 153.14 in Thanjavur to 76.71 in Tirunelveli. The index of Thanjavur is high, largely because of its outstanding position in respect of soil fertility, rainfall, percentage of cultivated to cultivable and percentage of area irrigated. Chingleput, which comes next in potential productivity, reports high indices in respect of rainfall, percentage of area irrigated, male workers per sown

Disincentive

The Indian farmer, who is probably the world's poorest, has to pay the highest price for his fertilisers. Such a high price naturally acts as a disincentive to more farmers using more fertilisers. Every attempt should be made to reduce the cost of production. But still the price cannot be brought down low enough to induce greater sale. Other countries like the United Kingdom, West Germany, the UAR, Ceylon, Thailand, etc., have adopted the measure of providing Government subsidy to the farmer.

TABLE III

Index of Variations of Potential Productivity

District	Rainfall	Soil Fertility	Percentage of cultivated to cultivable	Percentage of area irrigated	Workers per sown acre	Livestock*	Ploughs	Pump-sets and Oil Engines	Total weighted index of variations
Chingleput	108.89	99.36	92.86	170.51	130.00	143.60	130.19	206.25	135.37
South Arcot	95.35	131.41	107.94	115.90	135.00	126.40	138.05	137.50	122.32
North Arcot	84.51	77.56	106.28	96.92	125.00	124.20	125.53	210.42	111.02
Salem	85.55	55.77	104.42	46.15	102.50	109.20	121.75	104.17	82.31
Coimbatore	73.17	63.46	102.91	82.31	67.50	80.70	72.85	165.62	84.63
Madurai	81.82	89.10	104.70	84.62	95.00	95.60	97.67	80.21	90.16
Tiruchirapalli	76.65	107.69	98.94	69.74	95.00	101.30	108.86	48.96	87.84
Thanjavur	11.69	285.26	119.97	215.38	105.00	99.00	89.77	13.54	153.14
Ramanatha-puram	80.26	93.59	85.48	109.74	80.00	69.80	77.09	35.42	84.55
Tirunelveli	84.89	86.54	81.45	74.87	80.00	79.50	59.75	54.17	76.71
Nilgiris	217.27	24.36	77.01	3.85	65.00	49.30	10.64	0.10	37.98

N.B.: Weights given to Factors: Rainfall: Up to 30" =1.0; Between 31" and 74" =1.5; 75" + =0.5

Soil Fertility =2.0

Percentage of area irrigated =2.5

Workers per sown acre .. =1.4

All others .. =1.0

*The following weights are adopted in aggregating livestock

More than 3 years = 1

Less than 3 years =.5

Sheep and Goat =.2

acre, livestock, and ploughs and pumping sets, and oil-engines. The indices are shown in Table III.

The variations of actual productivity are related to the variations of potential productivity to indicate districts which suggest more efficient management of inputs.

Variations in Actual and Potential Productivity Indices

Districts	Actual Productivity	Potential Productivity	Deviation
Chingleput ..	124.49	135.37	— 10.88
South Arcot ..	119.54	122.32	— 2.78
North Arcot ..	119.98	111.02	+ 8.96
Salem ..	68.26	82.31	— 14.05
Coimbatore ..	91.71	84.63	+ 7.08
Madurai ..	92.66	87.84	+ 4.82
Tiruchirapalli ..	85.09	87.84	— 2.75
Thanjavur ..	149.65	153.14	— 3.49
Ramanathapuram ..	70.95	84.55	— 13.60
Tirunelveli ..	95.19	76.71	+ 18.48
Nilgiris ..	72.20	37.98	+ 34.22

The Nilgiris district may not be considered because the actual productivity index does not reflect the real picture. Among other districts, Tirunelveli, Coimbatore, Madurai, and North Arcot are districts in which actual productivity exceeds the potential productivity. This suggests that these are the districts in which there is better management and efficient use of inputs.*

Cropwise variations in productivity indices were found to be large. In respect of three crops, Coimbatore district is found to be prominent. A study of cultural practices of this district in relation to other districts will be helpful, though final recommendations regarding translation of these practices, will have to be based on the net returns position. The composite productivity indices, except for those weighted by crop-rating system, however, show much less variation. The composite index, weighted by crop-rating system, is influenced mostly by natural resource endowment. This suggests that improvements in available knowledge is much more important than translation of such knowledge from one district to another. Though marginal improvements are possible by the latter method, an examination of potential productivity with reference to actual productivity shows that Coimbatore, Tirunelveli, North Arcot, and Madurai exceed the potential productivity indices. The conclusions should however be considered tentative, particularly in respect of potential productivity indices, in view of the arbitrariness of weights given to the factors.

* This may be, but from the purely semantic point of view, the actual being higher than the potential does not make sense—**Editor**

REFERENCES

1 DUDELY STAMP, L: **Our Developing World,** p. 104, Cited by SG Sapre and VD Deshpande, in "Inter-District Variations in Agricultural Efficiency in Maharashtra State"—**Indian Journal of Agricultural Economics,** Vol. XIX No. 1, pp. 242-252.

2 DANDEKAR, VM, "Summary of Group discussion"—**Ibid.** pp. 263-266.

3 SUPREY, SG, and DESHPANDEY, VD, **Ibid.** p. 243.

4 See comments of Prof VM DANDEKAR on this paper. (**Ibid.** pp. 263).

5 A similar method is adopted by PS SHARMA in his paper, "A Zonal Study of Soils for Productivity and Pressure of Agricultural Workers—**Agricultural Situation in India",** Vol. XVII No. 5, pp. 491-503.

6 SHARMA, PS, **Ibid,** pp. 491-500.

7 SHARMA, PS, "A Regional Approach to Agricultural Development in India—Some Preliminary Results"—Published in **Indian Journal of Agricultural Economics,** Vol. XIX, No. 1, 1964, pp. 176-192.

GUNVANT PATEL

Director of Agriculture
Gujarat State

How Gujarat Tackles Problems of Production

The recent efforts of millions of farmers and extension workers in Gujarat to increase agricultural production, despite adverse climatic conditions, decreasing area under food crops, and highly inadequate irrigation facilities are briefly discussed by the State's Director of Agriculture who maintains that there has been no stagnation in agriculture in the State. He says that the approach of the Government has been "to select the most promising areas of production, with favourable soil, water, and climatic conditions, and to make concentrated efforts for providing crop loans, fertilisers, seeds, and other means of production."

SHRINKAGE in acreage under staple cereal crops like jowar and bajra, with corresponding rise in area under higher yielding cereals like paddy, and cash crops like groundnut and cotton, has been the characteristic trend in Gujarat.

It is significant that during the Second Plan, as compared to the First Plan, the overall yield per acre of food grains went up by over 22 per cent. The yield per acre of different food crops rose markedly—bajra 33 per cent, rice 30 per cent, jowar 15 per cent, and maize 10 per cent. Among food grains, the yield of wheat alone declined by eight per cent. The overall increase in food grains productivity by over 22 per cent was offset by a decline of nearly 11 per cent in the area under food grains, with the result that the net increase in output of food grains in the State of Gujarat was only eight per cent. But for this, however, the deficit in the State in

TABLE I

Area and production of important crops

Crops	First Plan 1951-56			Second Plan 1956-61			% Increase (+) or Decrease (—)		
	Area (Lakh acres)	Production (Lakh tons)	Yield (lb per acre)	Area (Lakh acres)	Production (Lakh tons)	Yield (lb per acre)	Area (Lakh acres)	Production (Lakh tons)	Yield (lb per acre)
Jowar	38.5	3.0	177	34.4	3.2	204	—10.7	+6.7	+15.3
Bajra	51.8	4.9	209	38.4	4.8	277	—25.9	—2.0	+32.5
Maize	5.0	1.5	732	4.9	1.8	806	— 2.0	+20.0	+10.1
Wheat	9.4	2.6	616	11.4	2.8	565	+21.3	+7.7	— 8.3
Rice	11.6	2.5	471	13.0	3.6	612	+12.1	+44.0	+29.9
Total Food grains	138.0	18.5	297	123.1	20.0	363	—10.8	+ 8.1	+22.2
Cotton	33.9	8.4*	96	43.2	10.7*	96	+27.4	+27.4*	—
Groundnut	21.1	3.6	380	40.5	10.2	574	+91.9	+183.3	+51.1

* In bales of 392 lb each

respect of food grains supplies would have been much large.

It is obvious, therefore, that efforts at increased production are showing the desired effects. During the Second Plan period, the consumption of N_2 fertiliser increased from a maximum of 5,000 tons of ammonium sulphate during the First Plan to 30,000 tons (annual average) in the Second Plan. The number of new surface wells and pumping sets increased by 40,000 and 15,000 respectively during the Second Plan, adding to the irrigation potential, so vitally important to the State. The contour bunding programme covered nearly 3,70,000 acres in the Second Plan, and the intensive production programme spread over 1,73,000 acres of paddy and 1,02,000 acres of wheat. The trend, however, of declining acreage under food grains continued during the Third Plan period. Table II gives the production of food grains during the first three years of the Third Plan. It can be seen that annual average

TABLE II

Production of Food Grains

(in lakh tons)

	1961-62	1962-63	1963-64	Average 1961-64
Jowar	3.2	4.4	4.0	3.9
Bajra	4.8	5.0	6.4	5.4
Maize	2.9	2.7	2.4	2.7
Wheat	3.5	3.0	3.6	3.4
Rice	5.1	3.7	4.8	4.5
Total	23.7	22.6	24.8	23.7

food grains production in the first three years of the Third Plan was 23.7 lakh tons, which was higher by 3.7 lakh tons than the annual average for the Second Plan, and in fact was higher by 5.1 lakh tons than the production in the last year of the Second Plan. This was in spite of a further decline of 5.2 lakh acres under food grains in the third year of the Third Plan, as compared to the last year of the Second Plan. Further, this increase in total production of food grains is due to higher production of each of the cereals over the Second Plan average.

Govt Approach

It is well known that the Third Plan was oriented to a significant higher level of agricultural production. The approach of the State Government was to select the most promising areas of production, with favourable soil, water, and climatic conditions and to make concentrated efforts for providing crop loans, fertilisers, seeds, and other means of production. The IADP as a projection of the paddy pilot scheme in Surat has set the pace for increased offtake of fertilisers. In this district, fertiliser offtake in 1961-62 was 70 per cent higher than in the previous year. In 1962-63, it further rose by 38 per cent over 1961-62, and reached the figure of 9,600 tons of ammonium sulphate in 1963-64. The increase in consumption for the State as a whole in 1961-62 was 33 per cent over 1960-61, and rose by 65 per cent in 1962-63 over the previous year. The consumption in 1963-64 was 65,400 tons of ammonium sulphate which is twice the maximum reached in any year of the Second Plan. Another fertiliser, namely superphosphate, is now used to the extent of 48,000 tons annually which is $2\frac{1}{2}$ times higher than the maximum consumption at any time in the Second Plan period. During the current plan, the number of wells and pumping sets has further increased by 27,558 and 22,723 respectively, which is an addition to irrigation facilities. An additional area of 3.78 lakh acres came under contour bunding. The fertiliser distribution and credit are arranged with special care and attention, in an area of 3.22 lakh acres of paddy, 1.25 lakh acres of jowar, 1.05 lakh acres of bajra, 2.25 lakh acres of cotton, and 1.00 lakh acres of groundnut. Intensive production through the Package Programme, in these areas, gives about 29 to 50 per cent higher yield than those not receiving the required attention in the same areas. Increasing attention in such areas is being extended from the existing 8.77 lakh acres to a total of 15.00 lakh acres in the remaining years of the Third Plan. To facilitate extension of crop loans, the number of cooperative societies increased by over 8,000, and membership more than doubled to 10 lakhs between 1960-61 and 1963-64. Cooperative credit (short and medium) expanded to Rs. 31 crores in 1963-64, as against less than Rs. 24 crores at the end of the Second Plan. This credit expansion has been matched by an equally expanding supply line of fertilisers. The number of selling points of fertilisers were only 652 in 1960-61 : this now stands at 1,862.

Successive Bad Years

These efforts were unfortunately partly offset by two successive bad years. In 1962-63, in nearly 650 villages, scarcity had to be declared, and in 1963-64, in two entire districts, even sowing could not take place due to the complete failure of rains. In spite of this, it is interesting to note that the annual average per acre yield of bajra, jowar, paddy, and maize were all higher than the Second Plan averages. The annual quinquennial average production of food grains stands at 23.7 lakh tons in

the middle of the Third Plan, higher by 3.7 lakh tons, than the quinquennial average of the Second Plan. Obviously, this is due to increased per acre yield, and in spite of decline in the area under these crops. In spite of the adverse climatic conditions of the last two years, decreasing area under food crops, and highly inadequate irrigation facilities, the results belie the sceptic's charge of stagnation in agriculture. The efforts put up by millions of farmers and extension workers, if looked against this background, are convincing proof of the earnestness and correctness of approach to the difficult problem of agricultural production.

Do You Know...

Kerala is the major producer of tapioca in India, accounting for more than 95 per cent of the total production. It is cultivated extensively in the former State of Travancore. The annual production is over 15 lakh tons.

Because of faulty storage at various levels now, as much as 15 per cent of the food is being wasted. Ten rats can eat as much as one man's food in one day.

The number of Agricultural Colleges in India had increased to 65 at the end of 1964 with an intake capacity of 8,000 per year against the Third Plan target of 57 colleges with a capacity of 6,200 students.

Our cotton production has increased from 17 lakh bales in 1948 to over 60 lakh bales. The yield will have to go up by nearly 30 lakh bales to meet the requirements at the end of the Fourth Plan without hoping to increase the acreage under this crop. Cotton yield still continues to be one of the lowest in the country.

Our farm implements and tools are largely primitive, powered by animals and people. Roughly 66 million bullocks, 30 million country ploughs and 120 million workers form the main operational resources.

Eighty-two per cent of India's population live in rural areas. Seventy per cent of our total working force is engaged in agriculture. We produce about 81 million tons of food grains from about 113 million hectares with about 131 million agricultural workers. But with a large work force—1.16 workers per hectare—our farm productivity is still only 0.62 ton of food grains per worker.

BN SAHU

Deputy Director (Statistics)
Bihar Electricity Board

Peep into Productivity in Bihar

What are the main objectives of planning? How can they be achieved by increasing productivity? What are the assignable and non-assignable factors affecting productivity? Again, how are we to segregate the contributions of the various factors responsible for increase in productivity? These questions are briefly answered in this paper. To study the overall increase in productivity, segregation of the contributions of the various factors may not be very useful, says the author, but he contends that it may prove useful in ascertaining the factors responsible for fluctuations in productivity, and also in controlling such factors.

THE main objectives of planning are eradication of poverty and hunger, improvement in the levels of living of the growing millions, liquidation of illiteracy, creation of greater employment opportunities, and reduction of inequalities in income and wealth. It is by now obvious that these objectives can be achieved only by increasing productivity.

Production may be increased by putting more of factors in operation, resulting thereby in an increase in the costs of production owing to the uneconomic use of human and natural resources, and, ultimately, decrease in income as a result of decline in productivity. Alternatively, productivity can be increased by optimum utilisation of natural resources and other factors of production. It means maximum return for each unit of material used, for each man-hour available; best application of the technical know-how and managerial ability available in the country, maximum return for each rupee spent; and getting the most

out of the available quantum of factors of production.

It is useful to study productivity under broad economic sectors such as agriculture, industries, and services for taking decision in regard to optimum utilisation of factors of production. A study of the trend of productivity in a given sector will reveal whether factors are being used efficiently. Such studies may help reach a decision whether more of certain factors are to be put in, or some of them may be diverted to other fields of production.

Increase in value accruing from land can be made possible by bringing more waste land under cultivation. It can also be brought about by the reallocation of acreage on the basis of market prices. There is, however, a severe limitation on this type of specialisation in crop production, because of the needs of consumption, lack of natural environment, and willingness on the part of growers.

'Not Real Productivity'

Increase in productivity may be owing to increase in value accruing from agriculture which may be the outcome of increase in prices. This inflated productivity, which is just the outcome of a complex price mechanism, is not real productivity. The effect of prices should be removed by computing productivity at constant prices.

Very obviously, rise in agricultural productivity depends on the better quality of seeds, adequate and right type of manures and chemical fertilisers, improved agricultural practices, etc. More and more use of agricultural tools and equipments, however, may increase the overall cost of production, and if the economy of large-scale production does not come in the agricultural industry, which is the likely case in an underdeveloped agricultural economy, it may increase the cost per unit of production.

What Cato Wrote

Even in early civilisations, tillage, a basic factor of good agriculture, occupied a pre-eminent position. Thus, in 200 B.C., Cato, the renowned Roman farmer, wrote :

"What is the first principle of good agriculture? To plough well. What is the second? To plough again; and the third is to manure."

There are many assignable and also non-assignable factors, other than the working force, which are responsible for the income arising from the agricultural sector. Thus, to divide the total increase accruing from agriculture by the total working force in order to arrive at productivity, is, to some extent, a very crude approach. A few of the assignable factors were listed in the preceding paragraph. The other set of assignable factors, significantly related to productivity, which are beyond human control, are: (i) weather conditions, (ii) amount of humidity, temperature and rainfall congenial for growth of agricultural crops, and (iii) protection of crops from grazing animals, pedestrians, plant diseases, and the havoc of locusts.*

The problem is how to segregate the contributions of the various factors responsible for increase in productivity. No doubt, to study an overall increase in productivity, such segregations may not be very useful, but to ascertain the factors responsible for fluctuations in productivity, and also to control such factors, if possible, it may prove very useful.

* How are these beyond human control? —**Editor**

M SRINIVASAN

Professor of Agricultural Economics
Agricultural College, Coimbatore

Farm Productivity Trends in Madras State

Since the scope for extension of cultivation is limited, India has to increase her agricultural productivity to feed the millions of existing and expected population. This paper examines the long-period trends in agricultural production, with special reference to Madras State, where, at the close of the 18th century and the beginning of the 19th, paddy yields were much higher than they are today. The author refers to historical records to show that the yields went on declining substantially—and this position was true of the country as a whole. Though the trend has been slowly, but consistently, upward since 1951, much scope still exists to make Madras and all-India productivity comparable to those of Japan, Spain, or Italy.

FOOD production in particular and agricultural production in general have to be increased to feed the millions of existing and expected population, and the industrial sector's need for raw materials. Since the cultivable area in the country is limited, the scope for extensive cultivation by reclamation of wastes and fallows is circumscribed. Hence reliance has to be placed in improving the productivity of agriculture. In the 1940s, Dr Burns pressed the technological possibilities of Indian agriculture; the Ford Foundation Team in 1959 came to about the same conclusion.

Historically, however, we have to face the retrograde phenomenon of declining yields. It is not generally known that at the close of the 18th century, and in the early years of the 19th, the paddy yields in Madras were 30 per cent to 50 per cent higher than they are now. According to official reports, in Chingleput

district in 1799, and in the Thanjavur district in 1800, the paddy yields ranged from 2,400 lb to 2,600 lb per acre. In 1807, the yield of paddy per acre in the Coimbatore district was estimated at 5,000 lb for the first crop, and 3,600 lb for the second crop. The Madurai Collectorate records mention, the yield of paddy in that district in 1796 as 2,647 lb per acre. From these historical records, the yield of paddy in Madras State has come down substantially. In the early 'thirties, it was estimated at 1,540 lb. A succession of bad years brought it down to 1,330 lb by 1950-51. Since then the trend has been slowly but consistently upward, touching the level of over 2,000 lb in the early 'sixties.

Rise in Yield

In the country as a whole, the trend is similar. The yields per acre of almost all the food crops have gone up significantly during the three Five-Year Plans, compared with the position till 1950-51. But they are still very low compared to the yields in other countries. Thus the per acre yield of rice in China is 1,500 lb, Egypt 3,155 lb, Japan 3,281 lb, Italy 3,105 lb, and Spain 3,234 lb. The average per acre yield of wheat in Denmark is 2,994 lb, and in New Zealand 2,286 lb. We have a long way to go before we can equal the performance not only in paddy and wheat, but also in cotton, oilseeds, sugarcane (say in Cuba or Mauritius), tobacco, etc.

High yields have been obtained by the Krishi Pandits in all-India or State-level competitions. Record yields of potatoes, sugarcane, paddy, etc., have been claimed and confirmed. Hence, scope exists for increased productivity not only compared to other countries, but also within the country itself. Recently, efforts are being made by important industrial units, which process agricultural raw materials for improving the efficiency of agriculture. The sugar mills in Maharashtra, Mysore, and elsewhere are already doing commendable work in this direction. The yield per acre and sucrose content of cane could be raised significantly over a large area if the growers were encouraged to adopt better methods of cultivation; similarly about

Index Numbers of Agricultural Productivity (Madras) for 1961-62

(BASE-AGRL. YEAR 1956-57 = 100)

Crop/Group	1961-62
I. FOOD GRAINS	
Rice ...	109.8
Jowar ..	121.8
Bajra ..	144.6
Ragi ..	100.6
Small Millets ...	103.4
TOTAL KHARIF CEREALS ..	114.4
TOTAL CEREALS ..	114.4
Gram ..	98.0
Tur ..	100.0
Other Pulses ..	87.5
TOTAL PULSES ..	92.7
TOTAL FOOD GRAINS	115.3
II. NON-FOOD GRAINS	
Groundnut ..	101.8
Sesamum ..	100.1
Castorseed ...	100.2
TOTAL OILSEEDS ..	103.3
Cotton ..	124.5
TOTAL FIBRES ...	124.5
Tea ..	125.2*
Coffee ..	98.9*
Rubber ..	115.1*
TOTAL PLANTATION CROPS	120.9
Sugarcane (Gur) ...	99.2
Chillies ..	101.7
Pepper ..	106.0
Tobacco ..	102.5
Potatoes ..	93.0
TOTAL MISCELLANEOUS CROPS	100.5
TOTAL NON-FOOD GRAINS ..	111.1
ALL CROPS ..	114.6

* Provisional

State Index Numbers of Agricultural Productivity – all crops

(Base : Agricultural Year 1956-57 = 100)

	State		1961-62
1.	Punjab	...	118.2
2.	Madras	..	114.6
3.	Himachal Pradesh	..	117.7
4.	Madhya Pradesh	..	94.3
5.	Mysore	..	108.3
6.	Maharashtra	...	105.2
7.	Bihar	..	121.2
8.	Rajasthan	..	112.5
9.	Kerala	..	99.6
10.	Uttar Pradesh	...	109.1
11.	Gujarat	..	130.4
12.	Andhra Pradesh	..	105.9
13.	Assam	..	98.5
14.	Orissa	...	107.7
15.	West Bengal	..	116.4

cotton and other crops. The Hindustan Lever has successfully experimented in obtaining increased yields in the crops in which they are interested. In Madras State also, some agro-industries have taken interest in agriculture especially in the Coimbatore district. If others do the same, the problem of increasing the yield of cash crops will be taken care of by the private sector, leaving that of food crops to Government experimental stations, demonstration farms, and panchayat union extension personnel.

In Madras State, experience shows that the difference between a really good season and an unfavourable one is a drop in production of 10 lakh tons or 22 per cent of the annual production. Hence the calculations of the result of the food programmes starting with the Grow-More-Food Campaign, the Integrated Production Programme, the Package Programme, the Impact Programme, and the recent Crash Programme have to be based on certain yardsticks, however imperfect and controversial they may be. Thus, it is estimated that an acre of uncultivated land brought

Index Numbers of Agricultural Productivity in India

(Base : Agrl. year 1949-50 = 100)

Commodity/Group		1961-62
I. FOOD GRAINS		
Rice	...	124.0
Jowar	..	97.2
Bajra	..	93.4
Maize	..	111.2
Ragi	...	123.0
Small Millets	..	101.6
KHARIF CEREALS	..	117.7
Wheat	..	128.6
Barley	..	125.8
TOAL RABI CEREALS	..	129.9
CEREALS	..	120.4
Gram	..	129.8
Tur	..	68.2
Other Pulses	...	87.9
TOTAL PULSES	..	101.2
FOOD GRAINS	..	117.8
II. NON-FOOD GRAINS		
Groundnut	..	85.6
Sesamum	..	84.5
Rapeseed & Mustard	..	102.2
Linseed	..	85.8
Castorseed	..	103.3
TOTAL OILSEEDS	..	95.8
III. NON-FOOD GRAINS		
Cotton	..	108.7
Jute	..	98.9
Mesta	..	124.8
TOTAL FIBRES	..	114.0
Tea	..	126.4
Coffee	..	189.2
Rubber	..	74.6
TOTAL PLANTATION CROPS		111.7
Sugarcane (Gur)	..	99.7
Tobacco	..	106.9
Potato	..	102.7
Pepper (Black)	..	104.0
Chillies (Dry)	..	107.9
Ginger (Dry)	..	138.1
TOTAL MISCELLANEOUS CROPS		109.8
NON-FOOD GRAINS	..	102.2
ALL COMMODITIES	..	116.5

Note : The indices for 1961-62 are generally based on partially revised estimates, and are, therefore, subject to revision.

under irrigation will give an additional yield of 1,120 lb of rice. The actual yield will depend on the quality of the soil, the crops cultivated, the agricultural practices adopted, and so is highly variable. As a result of the use of improved seeds of millets, the increase in yield will be 150 lb per acre for irrigated areas, and 50 lb for unirrigated areas.

Compost Dosage

On a standard dosage of 80 lb of superphosphate per acre the additional production will be nearly 67 lb per acre. The standard dosage of rural and urban compost of 5 tons per acre is expected to give an additional production of 1/8 ton of clean grain. As regards soil conservation measures, the additional production expected is 112 lb of paddy per acre on the plains. In the hills where potatoes are the main crop, the extra production expected is 4/5 ton of potatoes per acre. When virgin land is reclaimed, the additional production will be $\frac{1}{4}$ ton per acre. When correct fallows are reclaimed, the additional yield expected is 224 lb or 1/10 ton of rice per acre. As regards filter point wells, each well is expected to irrigate 10 acres, and the additional production, as a result of this irrigation, will be $\frac{1}{2}$ ton of rice per acre. Each oil engine distributed is expected to irrigate eight acres increasing production by $\frac{1}{2}$ ton of rice per acre. An electric motor pumping set can irrigate five acres, and the additional production is expected to be $\frac{1}{2}$ ton of rice per acre. As regards minor irrigation, the additional yield is $\frac{1}{2}$ ton of rice per acre on land newly brought under irrigation, and 1/8 ton for land which is already included in the ayacut of the tank which is improved, the increase being due to the irrigation source being made more dependable. These yardsticks have been evolved for Madras State as a result of a series of experiments conducted in 1950.

Additional Food Production in Lakhs of Tons in Madras State

Heads	Achievements in First Plan	Second Plan Target	Likely Achievements in Second Plan	Target in Third Plan
Major Irrigation	1.18	0.90	1.20	0.94
Minor Irrigation	1.66	1.10	1.06	1.97
Chemical Fertilisers	0.89	3.30	1.16	7.90
Local Manures	1.01	2.76	2.04	3.71
Improved Seeds	0.25	3.90	2.59	1.36
Land Improvement and Soil Conservation	0.30	0.53	0.26	0.66
Japanese method of cultivation and other improved agricultural practices	0.53	0.30	0.72	1.72
	5.82	12.79	9.03	18.26
Adjusted for Overlapping	—	—	—	16.54

In the First Plan, food production in Madras State increased from 38 lakh tons to 44 lakh tons and in the Second Plan to 53.24 lakh tons. The Third Plan target is 70 lakh tons, and the Fourth Plan target is 90 lakh tons. The production of rice, which is the staple food of Madras State would be pushed up to 50 lakh tons by 1971 compared to 34 lakh tons in 1963-64. As regards

water and electricity, Madras State has exhausted all the major sources of irrigation. There were 22 irrigation projects in the State when the First Plan started. Nine new irrigation projects were started in the First Plan, of which two were completed in the Plan period 1951-56. In all 1,32,000 acres were brought under irrigation increasing the food production potential by 66,000 tons. An amount of Rs. 3 crores was spent on improvement of 2458 minor irrigation sources increasing the food production potential by 88,000 tons.

Minor Irrigation

Minor irrigation figures prominently in the Third Plan, consisting of nine items, as desilting of and renovation of tanks, repairing, deepening or sinking wells etc.

Madras State leads all the States in the matter of rural electrification. Under this programme, 1,900 villages were electrified increasing the number of villages electrified from 1,610 to 3,500. As against the all-India average of 9.5 per cent Madras leads the rest of the country with 63.7 per cent of her villages electrified by March 1965 followed by Kerala 47.2, Punjab 35.4, Andhra Pradesh 16.2, and Mysore 13.2.

Improved Seeds: Two hundred State Seed Farms are working in the State. The links in the machinery for distribution of improved varieties are nucleus or breeders' seeds evolved at the Agricultural Research Station, primary seeds at the State Seed Farms, secondary seeds distributed by Gramasahayaks from their fields and tertiary seeds by cooperatives. South India has an ambitious scheme of increasing the area under improved seeds.

Fertilisers: Fertilisers have been used in Madras State for over 60 years. Madras cultivators hold the record for application of various kinds of fertilisers for growing different crops. The inadequate supply of chemical fertilisers was the main bottleneck in food production during the Second Plan—only one lakh tons of ammonium sulphate was supplied, while the optimum requirement was calculated at 4 lakh tons. The position has eased considerably during the Third Plan, and during 1963-64 the availability of fertilisers is expected to be doubled. Between 1953-54 and 1961-62, the consumption of fertilisers (in terms of ammonium sulphate) increased from 68 thousand to 156 thousand tons. Rice output in the same period went up from 26 to 36 lakh tons. The overall food grains production increased from 47 lakh to 53 lakh tons. Besides fertilisers, local manurial resources have also been mobilised through panchayats etc.

Much Leeway to be Made

The productivity per acre of food and cash crops has been consequently increasing in the State of late particularly in such areas as in the package district of Thanjavur. Much leeway, however, remains to be made to make Madras and all-India productivity comparable to the best of our competitors. The problem has been realised, and is being tackled: only the future will show the extent of success achieved.

Area under food crops to be covered with improved seeds during the Third Plan — 000 acres

Name of State	1960-61	1961-62	1965-66 Anticipated Achievement
1. Andhra Pradesh	1,230	2,251	12,780
2. Kerala	500	590	1,200
3. Madras	7,250	7,690	9,450
4. Mysore	4,869	5,684	8,876
All-India	55,441	69,252	1,48,253

HS BURTT

Chairman
British Productivity Council's
Agricultural Committee

Management & Productivity Go Hand in Hand

One of the "greatest weaknesses" in Britain's farming industry is management, says HS Burtt who stresses that good management and productivity go hand in hand. To the British farmer, productivity is aimed at reducing the unit cost of production. It is true that much has been achieved since 1950, but with the growing complexity of the industry much remains to be done. The British Productivity Council's nation-wide campaign since 1963, with the theme "Farmer—know your costs," has had a magnificent impact. It is mentioned that everybody connected with the industry's prosperity recognises that "the ultimate in productivity cannot in fact be achieved for;" however good the method may be, it is always capable of improvement. The job of management is to keep productivity moving as fast (and preferably faster) than technical innovation.

PRODUCTION, Productivity, Profit and Prosperity are perhaps the four most important P's in agriculture today. In particular, many farmers misunderstand the difference between Production and Productivity.

Increased **Production** is relatively easy to achieve in farming, and it is easy to define; it means producing more at any price.

Increased **Productivity** is really more difficult to achieve, and almost as difficult to define. It can, however, be described as producing the same amount at **less** cost, or alternatively more at the same cost.

As far as the average British farmer is concerned, productivity is aimed at reducing the unit cost of production; in other words, its object is to produce one pound of meat, a gallon of milk, a dozen of eggs, or a ton of wheat at a lower cost than at present. It is appreciated that in other countries the emphasis of productivity should be on producing a higher output for the same expenditure. Readers may as well

raise the question as to how this can be achieved when wages, rents, fuel, and transport and machinery costs continue to increase year by year.

In the United Kingdom, labour costs can be and are being reduced by employing fewer men, and paying more attention to scientific and technical developments. Some 250,000 farm workers have left British farms since 1950, but in spite of this our overall production has increased approximately 50 per cent during this period. Farmers' total wage bills are actually less today than three years ago, in spite of repeated wage increases.

Rising fuel costs can be alleviated by using more economical diesel tractors, and by using electricity to drive fixed equipment. Often unnecessary land operations and cultivations can be cut out altogether.

Transport costs can be and are being slashed by using bulk handling, and by adopting the pallet system.

Machinery costs can be reduced by using larger machines (one large combine harvester doing the work of two smaller ones, one large tractor pulling a six-furrow plough instead of two pulling three-furrow ploughs). The smaller farmer cannot do this, but can save by joining a machinery syndicate or even by hiring from a contractor. There are now some 550 machinery syndicates operating in England and Wales, compared with only 300 a year ago.

The British dairy industry is a good example of how increased productivity has enabled the milk producer to remain still in business in spite of falling milk prices during the last 10 years. All costs have risen, wages by not less than 50 per cent, and yet the farmer has succeeded in reducing his cost per gallon. This has been done by feeding less expensive concentrates, using more and better grass, and by drastically cutting labour costs in the cowshed. Labour hours per cow have fallen from 140 ten years ago to 90 today.

One of our greatest weaknesses in farming is management. Good management and productivity go hand in hand. Any business is only successful if the man at the top is constantly vigilant.

Nobody expects the managing director of a car firm to spend all his time on the assembly line, and the farmer cannot be expected to spend all his time on the seat of a tractor. He must have time for analysing and planning as well as finding out new techniques, all of which are vital to farm management. None of this though can begin until the farmer has some records to work from. The keeping of simple records then enables him to plan ahead, and instead of toiling from dawn to dusk with little reward, the result is more leisure and a reasonable profit.

Main Factor

Probably the main factor in raising agricultural productivity is to ensure that all the resources which we use on the farm (labour, machines, land, buildings, seeds, fertilisers, etc.) are employed to the best advantage. This requirement, in turn, necessitates a high level of efficient management, and it is particularly in this direction that the British Productivity Council's efforts are directed. The spearhead of the BPC's agricultural activities are the Agricultural Groups which are attached to many of its 126 Local Productivity Associations and Committees. The membership of these local groups comprises farmers and farm workers together with representatives of the National Agricultural Advisory Service, and of local agricultural educational establishments. These local

groups, for some years now, have been concerned with spreading an appreciation of the value of Work Study as applied to farming operations. Their method of approach has been to select a farm in the area for a "live" demonstration of the techniques. More recently the groups have been engaged in a nation-wide recording campaign which has had as its theme "Farmer—Know Your Costs". The object of this campaign has been to encourage farmers to undertake detailed record keeping. Since the inauguration of this campaign in October 1963, the National Farmers' Union and the National Agricultural Advisory Service have produced a Farm Analysis Record Book. This aims at standardising, as far as practicable, the system of record keeping. The records made by farmers under this system can be sent to the NAAS for analysing, and from this analysis it is possible to determine whether or not a particular enterprise is profitable. If an enterprise is found to be unprofitable then advice is given by the local NAAS officer on either extending one of the existing enterprises or introducing an alternative enterprise.

Serving these local agricultural groups is the central Committee of the BPC. This Committee comprises representatives of the main agricultural bodies in Britain including the National Farmers' Union, the National Union of Agricultural Workers, the Country Landowners' Association, and the Ministry of Agriculture. Currently this Committee, through Working Parties, is studying the likely structure of the farming industry in Britain 10 years hence, and the training requirements to meet these conditions. It is also studying in depth the various productivity techniques used in manufacturing industry to determine whether they can be applied (and if so, how) to the agricultural industry.

Everybody's Concern

It should be emphasised that farm productivity is not merely the exclusive concern of this central Agricultural Productivity Committee, or even of the BPC itself, but is the concern of every organisation and indeed of every person in the farming industry. A great deal has been achieved in the past 15 years or so, but with the growing complexity of the farming industry in Britain much remains to be done. Everybody concerned with the future prosperity of the industry recognises that the ultimate in productivity cannot in fact be achieved for; however good the method may be, it is always capable of improvement. The job of

...In Britain, we have reached a point when it is difficult to expand internally the sale of some of our produce, but in no way does it affect the issue of searching for the means of obtaining higher productivity...

management is to keep productivity moving as fast (and preferably faster) as technical innovation.

I have referred here, of course, to the approach as it mainly affects British farming, but the principle of reducing the unit cost of production applies to all conditions of farming in every country. In Britain, we have reached a point when it is difficult to expand internally the sale of some of our produce, but in no way does it affect the issue of searching for the means of obtaining higher productivity. Under British conditions it is possible, if a farmer wishes to do so, to raise productivity without raising production.

I am connected with a 200-acre school farm in Yorkshire. Our main income was from the dairy, although we prided ourselves that it was a mixed farm. We were surprised when we started a costing system to find that the pigs and free range poultry were losing money. The 10 acres of potatoes were profitable once every five years, but on average only broke even. The oats, the kale, the beans, and mangolds were nothing more than a nuisance, and cost much more than they were worth. We decided to make a clean sweep, and specialise by just growing wheat and grass for the dairy herd. Our total **production** has fallen by several thousand pounds, but our **productivity** has increased, and we are now making a useful profit.

British farmers sometimes ask why they should worry about farm productivity when their production is already good (94 per cent above pre-war) and their efficiency not too bad. The facts are that whilst at present British farmers may have a small lead on their European neighbours, they will be unable to retain this unless they are extremely progressive. Other European countries may have been late starters, but at present their productivity is increasing very rapidly. With the competitive threat from those countries British farmers' profits, and the future prosperity of their industry are dependent upon productivity.

A lighter note may perhaps illustrate the most important aspect of farming today, viz., planning. Many have heard of the old proverb about the farm's best fertiliser being the sole of the farmer's boot. Perhaps in the past the wearing out of the soles of the farmer's boots has been important, but I say in the future it will be just as important for him to wear out the seat of his pants sitting at his desk!

GOAL-SEEKING

Rats, it is true, maintain their metabolic balance, which is a biologically given norm, by a series of excursions after food, each of which is a goal-seeking; and some humans similarly maintain their solvency by periodic excursions after money.—From Sir Geoffrey Vickers' "Art of Judgment".

ITZHAK WOLF

Head of the Agricultural Division
Israel Institute of Productivity

Experiences of Work in Israel

How the Israel Institute of Productivity* entered the field of agricultural productivity, how they organised it, its working and achievements particularly in the context of the fact that, for the first time in world's history, an enterprising people, have, through the application of productivity techniques, made the 'desert bloom'. Friends and foes alike have paid tribute to the magnificent agricultural revolution accomplished by the people and the Israeli Government in a territory reputed to be hopelessly barren for thousands of years. This piece, remarkable for its intellectual honesty, shows clearly what sort of personnel is required for the Department of Agricultural Productivity, etc.

THE FAMOUS AGRICULTURAL PRODUCTIVITY DEPT. of the Israel Institute of Productivity was started in 1953 by a three-man team, fresh from a course of Productivity Technicians, which was organised by ILO experts. We had little idea of how to apply the industrial engineering principles we had learned in that course to agriculture, and so had an industrial engineer who was to guide our work.

We were helped very much by three people who formed a productivity council from the collective settlements, and who were chosen especially to advise us. These people knew the needs of their settlements well, and our meetings, several times a month, were useful. Their first suggestion was that we should penetrate agriculture—or rather the settlements—not by doing our first work in

*While we were planning this Special Issue on Agricultural Productivity, we

(Turn to Page 380 Col. 1)

agriculture itself, of which we had insufficient knowledge and might have failed. To do so might have hindered us in winning farmers who anyway are somewhat suspicious of new techniques. So our first work was done in services of some collective settlements, i.e., in a laundry and two clothing stores, where the clothes of the members are cared for after being laundered. This work, which lasted a few weeks, gave us our first contact with some of the people with whom we were to work.

When we finished this work, a kind of 'Productivity Day' was organised which was attended by several hundreds of leading members of the settlements. We gave lectures about our work and its results, industrial engineering in general, and what could be done in agriculture itself. In addition (or rather that was the main reason for assembling these people), we announced that courses in the principles of industrial engineering would be held by us as soon as possible from their settlements.

Training Courses

We hoped that there would be a productivity man in every settlement, and called for participation of suitable candidates in the courses. It was necessary to have a common language for dealing with these people, so that they could apply the results of our future studies and work. The people could also do studies of their own, help to organise jobs, particularly those in which many people are involved, from a new point of view, and, when it would be required, to collect data for our studies.

At that time three courses were held for people from collective settlements in which about 80 people participated. These courses lasted three months, with six weeks dedicated to lectures (about 300 hours), four weeks for a home project, where the student had a weekly visit from one of the instructors, and then again, one week at school for summing up where everybody brought his project before the class.

These courses were held in winter in the so-called dead season in agriculture, as this was the only time possible to recruit candidates. The courses were a great success, but not all the members remained active in this field, mainly because at that time public opinion in their settlements could not yet tolerate the idea that a person could be more useful by just "looking around," and seemingly doing nothing, rather than by doing

---

(Contd. from Page 379 Col. 1)

addressed a communication to the Chief of the Israel Institute of Productivity, requesting him to furnish us some information on as to how they entered the field of agricultural productivity. We thought we had much to learn from Israeli experience, particularly because, at that time, there was some thinking going on at the highest level in NPC that we might as well try to help our own country in the field of agriculture, as crisis after crisis was affecting the elementary subsistence of the common man. The reply was magnificent: this article actually is based on the text of Mr Wolf's letter which began thus:

> "Having worked with our agricultural section from the start, I was asked to reply to your letter . . .Your question of how we went about the organisation of our agricultural department, and in which way we make ourselves useful to agriculture, is not an easy one to answer. I can only try my best and hope this will be of some use to you."

These lines explain the background of the article printed in this issue. It is remarkable for a man of Mr Wolf's status to have the courage to say that as a department they have lost the momentum they once had, and, therefore, they are reorganising it as a separate institution . . .The books referred to by him are available in the NPC Library for reference. We are also arranging to have films from them for exhibition in India.—**Editor**

physical labour. Later on, several more of these courses were given, and, in addition, also a shorter version for people from the workshops of these farms (who generally are the builders of the improvements and devices designed by the productivity people) or foremen of branches of the farms. These courses were also an important step in providing a common language for the "new point of view."

To help these people establish themselves, many appreciation lectures were given to their farm members, mainly on Saturday, and in the evenings, by people from our department. In addition, lectures were, and still are, given on these subjects to seminaries and schools for managers of collective settlements, and branch managers like fruit growers, and vegetable growers.

This is as far as the courses are concerned. I have referred only to collective farming, and not to individual farmers, for two reasons: first, at that time most of the agricultural products were produced by collective farms where, today, their part dropped to 50 per cent owing to increase in the other forms of settlement. Secondly, it was much easier for us to work with these people owing to their specialisation and size of branches, and because prospective savings could be counted in work days, while in a family farm they may amount only to a few minutes a day for feeding chores, etc. (Who would be willing to change a building or invest considerable sums on such a prospect?).

In our field studies and surveys, we generally turned to problems in which much labour was involved, as there our efforts could yield the greatest returns. These problems concerned mainly the harvesting of vegetables and fruit—again mainly in collective settlements—and a few other larger undertakings. The first series of these studies concerned potato harvesting and sorting, sugar beet harvesting, and making of silage. Others followed, like harvesting and packing of table grapes, olive picking, and harvesting and sorting of deciduous fruit.

All those studies were accompanied and guided by professional committees composed of people from the growers' professional organisations (vegetable growers, fruit growers, etc.), and the Ministry of Agriculture. The tasks of these committees were, and still are, to point out the important subjects to be investigated, and to help and instruct the investigators with the technical agricultural aspects of the problems as, for instance, changes that might adversely influence the yields. Other tasks are to contact the team and growers, and to point out the places of interest to be visited. This last point amounts to learning what the farmers are doing, comparing their methods after breaking them down into jobs, elements, etc., and then evolving a better method composed of the best methods taken from various farmers. Really, our contribution is only a small part of the proposed methods. This kind of work needs good direction, and the right contacts. The proper function of the committee has much to do with the success of a survey. To have a good committee means to have at least one person who really cares, and is willing and able to spare the time and energy required.

Weak Link in Work

One of the problems of studies in agriculture is that it concerns seasonal work—sometimes of a few weeks' duration only. This means that one has to be ready with preparations at the start of the season. This is not always possible, it takes one season to learn the problems, and the prevailing methods, and the next season to compare and analyse them.

When a survey is finished, and the

report written, copies are sent to the committee members who then meet and comment on it, and decide what the final report should be like, and how it should be published. It is a good practice not only to distribute the reports to growers and farm advisers, but to hold field days with lectures, and, preferably if possible, demonstrations for the growers. This is not only important for the growers, who may profit by what they hear and see, but also for us who, through this contact, learn about the practicality of our suggestions, and their usefulness to the farmers. The implementation of the new methods is an important part of a study, and at times was a weak point in our work. Another weak link in our work always was the follow up of these newly established methods.

Practical Approach

After a certain period the new methods are not new any more, sometimes they even become obsolete, and in most cases they undergo many changes and improvements through practical application by the farmers. When there was no follow up, through lack of budget, personnel or time, we lost contact with the subject, and were no longer able to advise the farmers regarding it. An important point in getting the proposed methods to be accepted, is to be practical. In this, one has always to bear in mind for whom the new methods are intended. True, the propositions are always for the farmer or the grower, but it depends on what level he is operating. If he has a team of workers, he will accept hints on better organisation, but seldom will he go into training workers in better or more rational motions, either not having the time or the the patience to do so. But if he is the boss and the worker in one, he will try to use even better motions.

We found it therefore practical, when going down to the level of motions, generally not to propose different and better motions as these will not be applied, but to improve tools and implements, and even to devise new ones, as they have to be used in a certain way. Also, tools of this kind must be simple and foolproof, so that there will be no need for adjustment or repair while work is in progress. To sum this up—our work is only justified if it has immediately any practical application. To this day the subjects of our studies were chosen by the Ministry for Agriculture or the professional organisations of the growers. In most cases the subjects of study were important generally to branches of agriculture. In other cases, subjects were chosen because they seemed important to some of the people above choosing them. We now propose to carry out a survey of activities in agriculture in our scope of work, to find out what savings might be achieved by making the necessary investment required to improve them (to find out which will bring the highest return).

One of our activities, as I have already mentioned, is advising farmers, growers, and branch managers on subjects which we have studied, and in which we have acquired experience. The first people whom we advised were the people who attended our courses. We first fixed one day of the week on which we were available in our office to give advice, preferably with appointments made in advance. This turned out to be a good arrangement as they were sure to find the proper person in the office, and we were not disturbed on other days, or if so, had the right to turn people down. Many others who had attended one of our lectures, also came for advice on those days. Problems could not always be solved in the office. It was often necessary to see the setting of the problem: for instance, to see what a particular packing shed looked like. A

visit to a person's farm is a costly matter, even in a small country like ours.

Membership

Our Institute has devised a means of meeting this problem through what we call "Membership of the Institute." A member pays a yearly tuition fee. For this he will receive all the publications of the Institute at reduced prices, and our monthly bulletin free of charge (several copies depending on the size of the enterprise). The member can come for advice to our office on the proper days whenever he wishes, and, last but not least, he can have one visit to his place every year, free of charge. What he gets out of this visit depends mainly on him. If one day is not enough to cope with the problem, he has to put in an order for work and is charged per day of work, even when it is carried out in our office. As a rule, with exceptions, we do not give advice to people who are not members of our Institute, even in our office. A great many of the collective settlements, and some of the co-operative ones as well, have become members of our Institute.

About the Staff

There is another problem worth mentioning, and it concerns the people of the department itself. As we wish to give the maximum of independence in work, asking only for regular progress reports, we must select people who can be depended upon to do their best, without being goaded. It also takes people with good judgment in evaluating their work. First, concerning the work itself, they must be able to drop their own ideas when a better one comes from someone else, and they should not stick to an idea when it turns out to be impractical, only because it is their own. Secondly, they should see that the work of their colleagues is as important as their own, and not that their own is the most important in the world. A person like this may upset the whole team, and it is my belief that it is better to dismiss him as soon as possible.

This leads to another problem. When people work on their own, many of the contacts and relations established by them with farmers and growers are personal. It is in the interest of the Institute and the department, or rather for the continuity of these contacts, that they should not be made by one person alone; as such a person would become indispensable. This means also that people should see the importance of their department, institute or team, above their own. We have had one or two such people, and they caused us much distress in teams, and as individuals.

At the moment we have, as a department, lost much of the momentum we once had. This we hope will be remedied by a big change we are making. Our department (with about 10 people) will merge with three departments from other institutions to form a new institute. These participants are—the Institute of Agricultural Engineering, with whose work we have considerable overlapping, the Efficiency Department of the Ministry of Agriculture—a new department doing similar work to ours—, and, the Mechanisation Department of the Ministry of Agriculture.

Our Institute also produces films, and we have a few on agriculture. One of them is a training film for people picking cotton by hand. It is a 20-minute film, and in addition to the original Hebrew-speaking version, we have prepared English and French versions also.

Methods and Practices of Farms in USA

The agricultural expansion programme launched by Britain in 1947 set farmers the task of increasing the net agricultural output by 50 per cent over the pre-war. Early in 1950, on the suggestion of the National Farmers' Union, a five-member team, led by WRN Dawe, went to the USA to study the management of its agricultural labour and machinery. The team particularly observed the methods and practices of the intensively developed farms of the North-Central and North Eastern States, and the measures which it recommended for increasing the productivity of farm labour in the UK (published in book form by the Anglo-American Council of Productivity) are reprinted here as they are certainly to be of interest to the farming industry in India.

CLIMATIC conditions over much of the area we traversed are less variable and more predictable than they are in the UK, and cause less interference with the seasonal progress of farm work. Topographically, there is comparatively little difficult land, and what there is tends to remain uncultivated.

Labour is much dearer in terms of the products that the farmer sells in the USA than in this country. Land is more plentiful than here, so there is a tendency to obtain high output by using large machinery on an extensive basis rather than by intensive application of labour to smaller areas. The average size of farms shows signs of increasing in the USA.

The general pattern of farming is more uniform over wide areas of the USA than it is in the UK. Individual farms also are less mixed, and the number of separate enterprises on an individual farm is fewer than is the case in mixed

farming in Britain. This reduces the range of machinery needed, and the demand for capital investment.

Crop rotations are simple. Maize is a highly productive crop whether grown for grain or silage, and its production is capable of complete mechanisation. We saw no fodder roots being grown.

Benefit to Farmer

Cooperation in the use of machinery in one form or another is universal. This increases the range of machinery available to the small and medium-sized farms, and help to reduce the burden of heavy depreciation charges on expensive equipment.

American farmers take immense pride in their mechanical skill and knowledge which, indeed, is very great.

The family farm predominates in the USA, and family labour forms a higher proportion of the total labour force than it does in this country. High productivity, therefore, directly benefits the farmer and his family. There is no wide social distinction between the hired help and farmer, and the latter spends much of his time in working alongside of the former. Managerial and supervisory duties appear to take up a very small part of the American farmer's time.

Good Layout

Field operations are greatly assisted in the USA by good layout of farms, and the absence of permanent field boundaries.

American machinery tends to be larger than ours, and the change from horse to power equipment is more complete than in this country.

Tilling and cultivating operations are fewer and simpler, partly because of more favourable natural conditions, but also because of less striving after perfection.

In cereal production, the use of combined drills and combined harvesters, very frequently on a cooperative basis, is almost universal.

The use of processed seed is the most important labour-saving development in the growing of sugar beet. Mechanical blocking and thinning has only been partially successful, and experimental work is still continuing. Mechanical beet harvesters tend to be large, and are not in common use in the north.

Some pieces of potato-handling equipment such as haulm destroyers and two-row elevator diggers might be of use on farms in this country. On the whole, however, we saw few American practices which, if introduced in this country, would materially increase the productivity of labour in the potato field.

Developments in hay harvesting have been rapid, and varied. The buck-rake provides the cheapest means of harvesting, but a high proportion of hay in America is now baled because of the greater convenience in subsequent handling. The field chopper, which can also be used for silage-making, is also gaining in popularity. Balers and choppers are expensive machines, and require large acreage if costs are to be kept down.

The housing and care of livestock are receiving much thought and attention in the USA to reduce labour requirements. In regard to dairy farming this has led to fairly widespread development of the open-yard-and-milk-bail system. In existing stanchion type sheds close attention is paid to layout of feeding, cleaning, and mucking arrangements.

The deep litter system is most common for poultry-keeping. Emphasis is placed on the influence of the scale

of enterprise on costs of production and labour requirements. Labour can be reduced by housing large flocks in single units with well-planned feeding and watering arrangements.

Pigs are generally kept on open range, and are chiefly a summer venture.

Field Machinery

Further developments in field machinery are towards specialised and expensive equipment frequently involving some changes from past practices and methods.

The elimination of strain and fatigue is being achieved by better arrangement of work—"work simplification"—and also by the development of many items of equipment such as elevators and hoists, for use in moving materials in and around farm buildings. This process is greatly assisted by the availability of electric power on the vast majority of American farms. Electricity has very greatly increased the amenities of rural life.

The small tractor is only now being developed in the USA, but it is not likely to oust the larger tractor, which is in general use on farms of all sizes in the highly mechanised areas of the north and east.

There is a very close link between the machinery manufacturer and farmer in the USA. New ideas or modifications of existing machinery, which frequently originate on farms, are quickly translated into practice.

American farmers are very adequately provided with educational and advisory services which are extremely practical and forthright in character. The management and economic organisation of farms occupies a very prominent place in educational and advisory programmes.

The methods and channels for disseminating information and advice amongst farmers are numerous, and highly developed. The American farmer is extremely receptive to advice, and new ideas, and cooperates readily with research and advisory workers.

...There should be close and systematic collaboration between farmers, and manufacturers of, and dealers in, agricultural machinery. Electrification of farms should be pressed forward by every possible means...

Recommendations

Farmers should pay greater attention to farm planning so as to develop enterprises each of which will afford the greatest scope for the effective use of modern labour-saving machinery and equipment, and which together will provide full and continuous productive employment.

Farmers should cooperate freely with one another in the ownership and use of farm machinery in the full realisation that the larger the machine which can be justified, the greater are the benefits likely to accrue from its use.

To facilitate the use of large machinery, farm layouts should be altered or replanned where necessary.

Volume of Production

Farmers should specifically seek as a corollary to farm mechanisation an increase in the volume of production, or, if that is not possible, a decrease in the volume of labour employed.

Farmers should examine carefully their present practices and methods, and all operations that are not found necessary, or do not contribute to the sum total of production, should be rigidly eliminated.

To ensure the integration of the design and development of new machines and equipment with the changing needs of farming, there should be close and systematic collaboration between farmers, and manufacturers of, and dealers in, agricultural machinery.

Electrification of farms should be pressed forward by every possible means.

In agricultural education and advisory work greater emphasis should be laid upon the importance of management and organisation in farming. Farmers should be made familiar with the principles of farm budgeting, and the application to farming of such techniques as "job analysis" and "work simplification."

Specific and permanent arrangements should be made to bring to the notice of farmers, agricultural research and advisory workers in this country the results of the vast amount of agricultural research undertaken in the United States.

Result of Work Study

Work study in the United Kingdom has led to a rise of 50 per cent in the operating profit in six years on the poultry section of a mixed farm, partly by evolving a new model poultry house. It has been applied, too, in designing general farming equipment, in planning labour-saving routine and bonuses, and in costing.

At a Hampshire nursery garden, the cost of harvesting bulbs was halved in a year, output of pot plants raised by between 200 and 400 per cent, and the staff (largely girls) are earning more. These and other benefits came from the manager's interest in Work Study.

PUNJAB SETS UP ALL TIME RECORD IN FOODGRAINS PRODUCTION

21.6 per cent increase in the last year

Incentives to Tillers—

*Minimum crop prices to ensure economic return

*Electricity duty on tube-wells/pumping sets abolished

*Loans for wheat threshers

*Loans for purchase of seeds

*Subsidy on insecticides

*Crop competitions at Block, Zila and State levels and numerous other facilities

Inserted by

PUNJAB PUBLIC RELATIONS

NPC PUBLICATIONS

Industrial Engineering & Fuel Efficiency Service — Report of Conference of Specialists held at Madras — May 1965 — Rs. 5.00

Management Development: By Ellis O Keller. This book summarises the modern role of management, and sets out clearly and completely, yet concisely, the text and tenets of the subject of management development. Also contains instructive case studies from Indian industry to illustrate the applied side of management skills — Rs. 10.00

Business is People: Just the book for Management for higher Productivity through effective utilisation of human resources (richly illustrated in colours) — Rs. 3.50

Impact of Productivity: Book of selected case examples of fruitful use of Productivity techniques — Rs. 2.50

NPC TEAM REPORTS: Subjects relate to Refractories Industry (Just Released); Office Management; Printing Industry; Techniques of International Trade; Standardisation & Variety Reduction; Materials Handling; Cable Industry; etc.

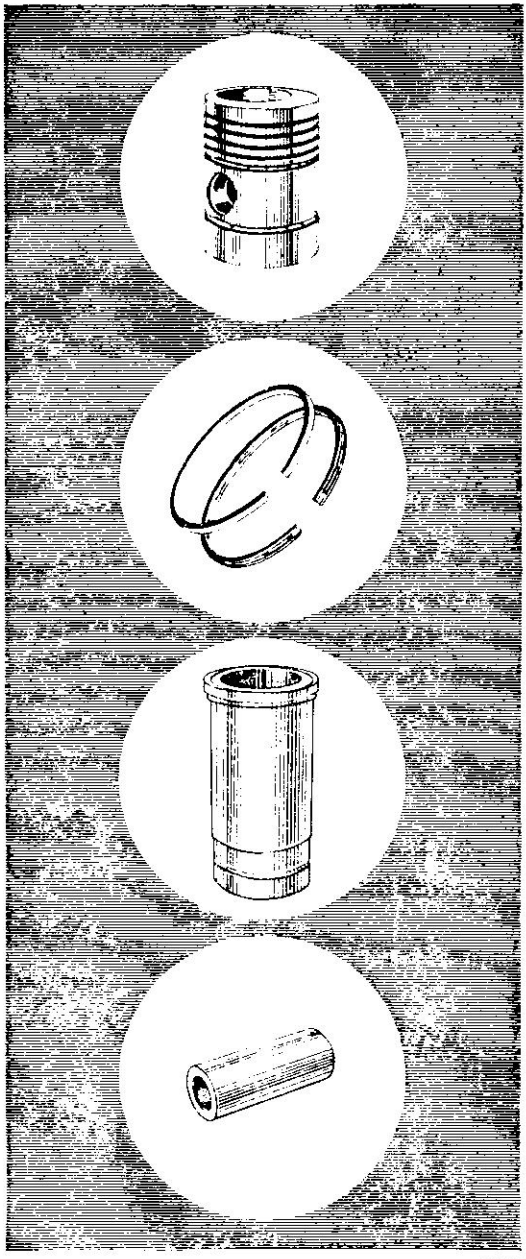
To Be Out Soon:

1. **NPC Team Report on Radio & Electronics Industry Rs 5.00**
2. **NPC Team Report on Coal Industry**
3. **NPC Study Group Report on Jute Industry**
4. **A Manual of Method Study:** By Brig K Pennathur
   Richly illustrated by case examples, this book is a **must** for students and practitioners of Work Study and Industrial Engineering. **(Tentative Price: Rs. 25.00)**

Ask For Free Catalogue Of Our Publications

National Productivity Council

38 Golf Links, New Delhi 3



PRODUCTS OF DISTINCTION KNOWN THROUGHOUT THE WORLD

MAHLE PISTONS
Known for their reliability, efficiency, durability and high performance

GOETZE PISTON RINGS AND CYLINDER LINERS
Engineered to outperform and outlast all other rings and cylinder liners

SÜKO PISTON PINS

Manufactured under licence
Sole Selling Agents:
ESCORTS LIMITED
AUTOMOTIVE DIVISION,
BLOCK H, CONNAUGHT CIRCUS, NEW DELHI

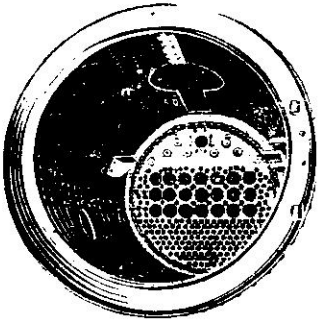
DISTRIBUTORS:

Sundaram Motors Private Ltd., 37, Mount Road, Madras. T.V. Sundram Iyengar & Sons P. Ltd., Post Box No. 21, Madurai. Central Automobiles Private Ltd., 466, S. V. P. Road, Bombay. Bengal Auto Distributors, 26-B, Park Street, Calcutta. Components & Machinery Corporation, 9-12, Lall Bazar Street, Calcutta. Eclat Auto Agency, Outside Gandhi Gate, Amritsar. Modern Motor Works, G. T. Road, Ludhiana. Siyaram Brothers, Kashmere Gate, Delhi. P. Sharan & Company, Kashmere Gate, Delhi. Kulwant Motors, Mirza Ismail Road, Jaipur. Aeicorp Private Limited, 10, Lall Bazar Street, Calcutta. Manohar Motors, Kashmere Gate, Delhi. Century Automobiles, 9, Mathew Road, Bombay-4. Diesel Corp. (Sec'bad) Pvt. Ltd., 148, Rashtrapathi Road, Secundrabad. Gupta Trading Corpn. (India) P. Ltd., Kashmere Gate, Delhi.

Falcon/AMD/389

E.R.W. BOILER TUBES

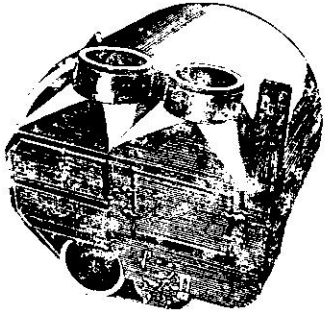
For trouble-free steam raising in all applications calling for rigid specifications, Electric Resistance Weld tubes are in every respect equal to corresponding seamless tubes. High frequency current ensures efficient welding, and normalising is carried out in controlled atmosphere furnaces to produce a ductile tube with a smooth, blue finish.





LOCO

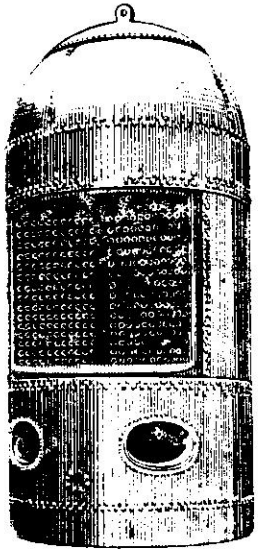
We supply E.R.W. loco boiler and superheater tubes from our Jamshedpur Works to meet the bulk of the Indian Railway's demand. These tubes meet all the technical requirements of Indian Railways.





MARINE

Our E.R.W. tubes meet all the tests specified by Lloyd's Register of Shipping. Indian Tube is on Lloyd's Register of Shipping's list of approved manufacturers.





LAND

Our E.R.W. tubes for land boilers are accepted by the D.G.S. & D. and comply with the Indian Boiler Regulations. We also carry ready stocks of this category at our Warehouses.

INDIAN TUBE THE INDIAN TUBE COMPANY LIMITED
A TATA-STEWARTS AND LLOYDS ENTERPRISE

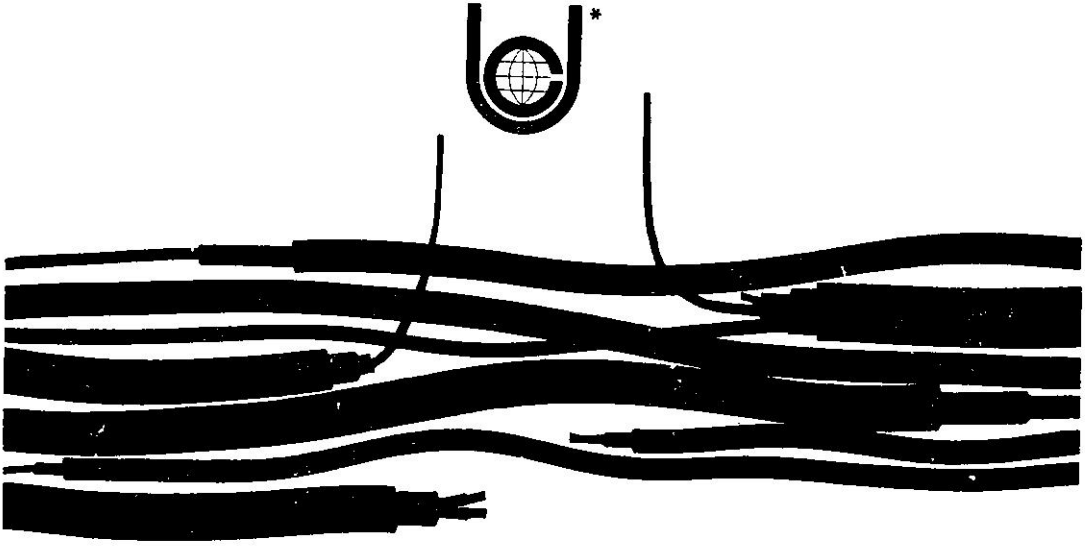
ITC-31

AT UNIVERSAL... THE ACCENT'S ON QUALITY

Power is the life-blood of industrial, agricultural, transport and defence systems. Safe and secure distribution of this precious energy is vital to their survival. Nowhere is this better recognized than at Universal...

Every power and control cable that bears the Universal name is thoroughly pre-tested to ensure its ruggedness and reliability in the face of natural strains and stresses. Other tests determine that only those cable lengths of proven high insulating properties and moisture resistance leave the factory. This keen accent on quality control plus original manufacturing techniques give Universal Cables the unique physical attributes that have made them the safety standard in power conveyance.

Where cable lines call for highly critical electrical, physical, ageing and performance characteristics combined with maximum job efficiency at minimum cost—only Universal will do.



UNIVERSAL CABLES LIMITED

Satna, Madhya Pradesh

* Registered trade mark

UC.G.10

Cattle Owners In Gujerat
TO SAVE RS. 40 LAKHS
annually in their cattle feed bills



India's first automatic and modern Rs. 41 lakh cattle feed factory at Kanjari in Kaira, produces 60,000 tons of nutritionally balanced cattle feed every year. This is expected to save as much as Rs. 40 lakhs annually in Gujerat's cattle feed bill. What is more, such balanced cattle and poultry feed will result in an amazing yield of milk, eggs and meat!

A wide range of balanced nutritive mixed feeds are being produced in this Buhler automatic cattle feed milling plant. The end product is cheap because large scale feed milling makes use of seasonal purchases, damaged grain and low cost material. There is no wastage and no drain on food resources needed for human consumption.

This 10 ton per hour capacity Buhler feed milling plant supplied and installed by Larsen & Toubro can now be manufactured locally; only 25 per cent of the components need be imported.

A concerted country wide effort to produce such nutritionally balanced cattle feed could result in an immediate 50 per cent increase in yield. Every step forward in this direction goes towards making India self-sufficient in food.

Information regarding cattle feed plants and green fodder dehydration plants can be had from Larsen & Toubro, P.O. Box 278, Bombay 1.

Read and advertise in

"ANDHRA PRADESH"

—an illustrated monthly journal for every family

Don't miss the following four interesting novels now being serialised in Telugu edition

* MIHIRAKULUDU By Sri Vishwanatha Satyanarayana
* ISWARYAM By Kodavatiganti Kutumba Rao
* BRATHIKINA COLLEGE By Palagumi Padmaraju
* ADAVI MALLE By Kum. Vasi Reddy Sita Devi

Circulation now over 80,000 copies per month

Published in Telugu, English, Urdu & Hindi

Price : Single copy 25 paise only

For further particulars write to:

T. Ramachandra Rao

Director of Information & Public Relations, Hyderabad

RAMKRISHNA BISCUIT CO. CALCUTTA

A Model Productivity Organisation in the field of biscuit manufacture

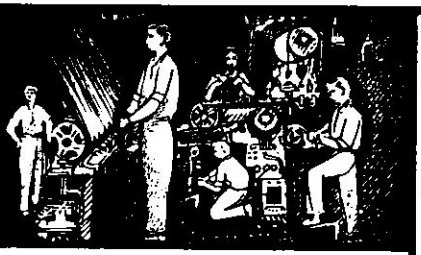
A modern automatic plant with a highly rationalised and hygienic set-up, engaged in making for the people of this country, highly nutritious 'food' biscuits: totally untouched by hand, highly appetising.....

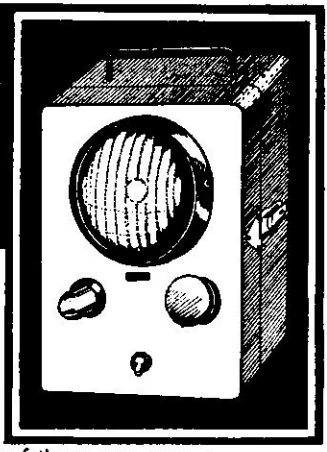
" The proof of the pudding is in the eating of it."

RAMKRISHNA BISCUIT CO.
manufacturers of quality biscuits



SUDDEN DARKNESS ?





Good bye Through

INSTALITE

INSTANTANEOUS AUTOMATIC LIGHTING FOR EMERGENCY

In factories, public places, hospitals, Banks, offices, etc, Power failures are common.

Why take a risk ? INSTALITE is *automatically* on when your power fails — automatically off, the moment current is on! A boon and a cheap insurance for industrialists! *For details, contact :*

INDIAN ENGINEERING COMPANY

Worli Naka, Post Box 16551, Bombay-18 Also at: Calcutta-New Delhi-Madras.

FOR HIGH QUALITY MALLEABLE CASTINGS

REMEMBER

R. M. ENGINEERING WORKS

(A Rohit Group Enterprise)

WE MANUFACTURE

* Pipe Fittings * Conduit Fittings AND MALLEABLE CASTINGS FOR YOUR REQUIREMENT OF * Automobile Components * High Tension Hardware * Cycle Components * Railway Components * Textile Mills Spare Parts

For further particulars write to :

R. M. ENGINEERING WORKS

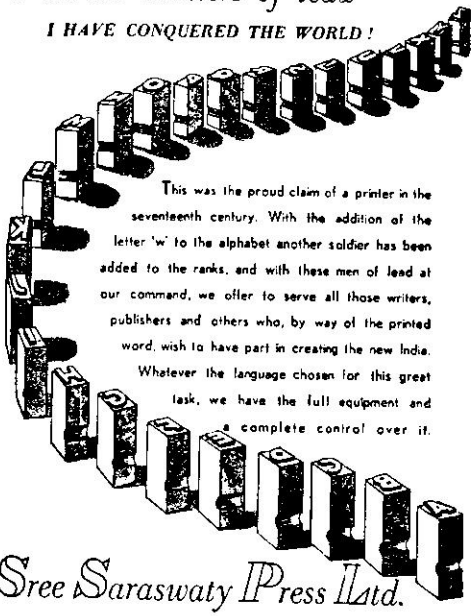
Rohit Mills Ltd., Ahmedabad-8.

Sole Dealers :

Mehta Corporation Private Ltd.,
Rohit Mills Premises,
Khokhra Mehmedabad, Ahmedabad-8.
9, Prospect Chambers,
D. Naoroji Road, Bombay-1.

With 25 soldiers of lead

I HAVE CONQUERED THE WORLD !



This was the proud claim of a printer in the seventeenth century. With the addition of the letter 'w' to the alphabet another soldier has been added to the ranks, and with these men of lead at our command, we offer to serve all those writers, publishers and others who, by way of the printed word, wish to have part in creating the new India. Whatever the language chosen for this great task, we have the full equipment and a complete control over it.

Sree Sarasvaty Press Ltd.

32, ACHARYA PRAFULLA CHANDRA ROAD, CALCUTTA 9

K PENNATHUR

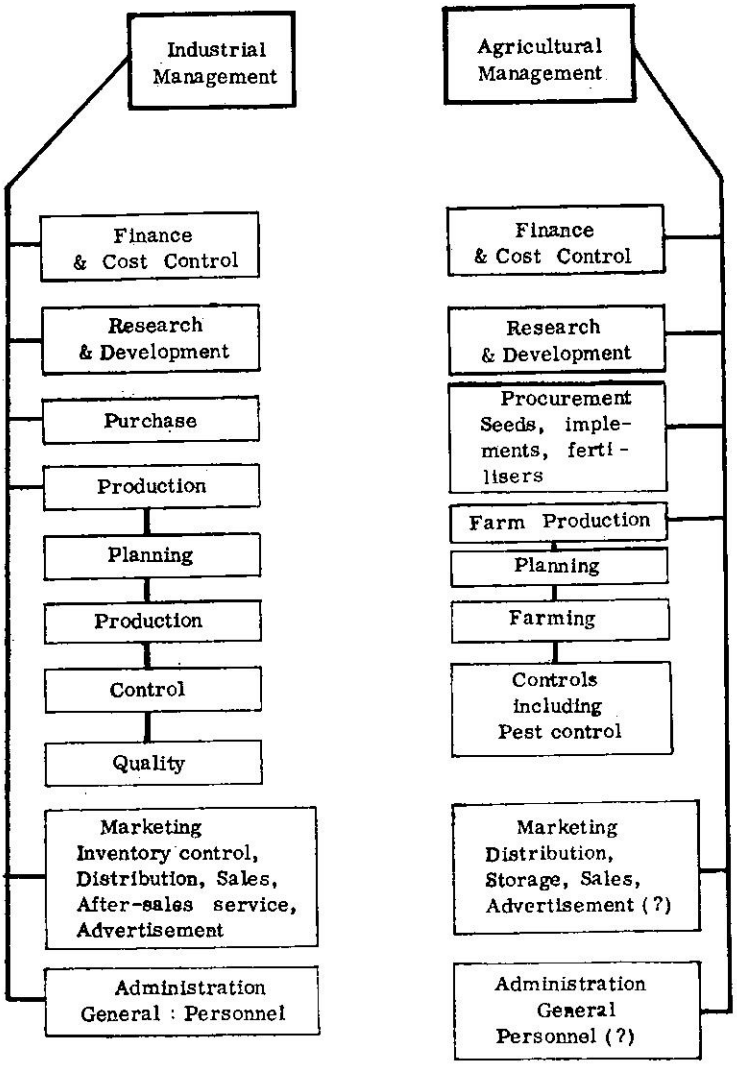
Dy Executive Director
National Productivity Council

Organising for Agricultural Productivity

NPC's Dy Executive Director outlines in this paper (presented to the APO Workshop Meeting in April 1965) 11 steps for organising an agricultural productivity drive. He refers to the problems of agriculture, and points out that agriculture is an industry, and has to be accorded that recognition, that the term 'productivity' is not the exclusive privilege of any one sphere of industrial enterprise, and that it is a valid argument that management of agriculture is broadly similar to the management of industry. Further he discusses the scope and areas of application of agricultural productivity, and the role of NPC in this context. As indicated in the opening paper of this special issue, we in India have already initiated a beginning in the field of agricultural productivity.

NORMALLY, there should have been no preamble needed for this paper. It is well known that the national economy of most of the Asian countries is based predominantly on agriculture. It is, therefore, surprising that this sphere of economic activity has not so far been given any serious attention from the productivity angle. The zest for rapid industrialisation to a degree comparable to that obtaining in more advanced nations has probably been one reason for neglecting agriculture. Again, agricultural activities have been in existence from the very origin of mankind, and, hence, there is greater diffidence about changing age-old patterns.

Nevertheless, there is an imperative need for us to address our minds to this all-important issue of agriculture for two reasons. The first is the obvious one, that our economy is primarily agricultural. The second may not be quite so apparent. If we concentrate on 'industrial' productivity to the neglect of 'agricultural' productivity, a stage is bound to come soon (if it has not



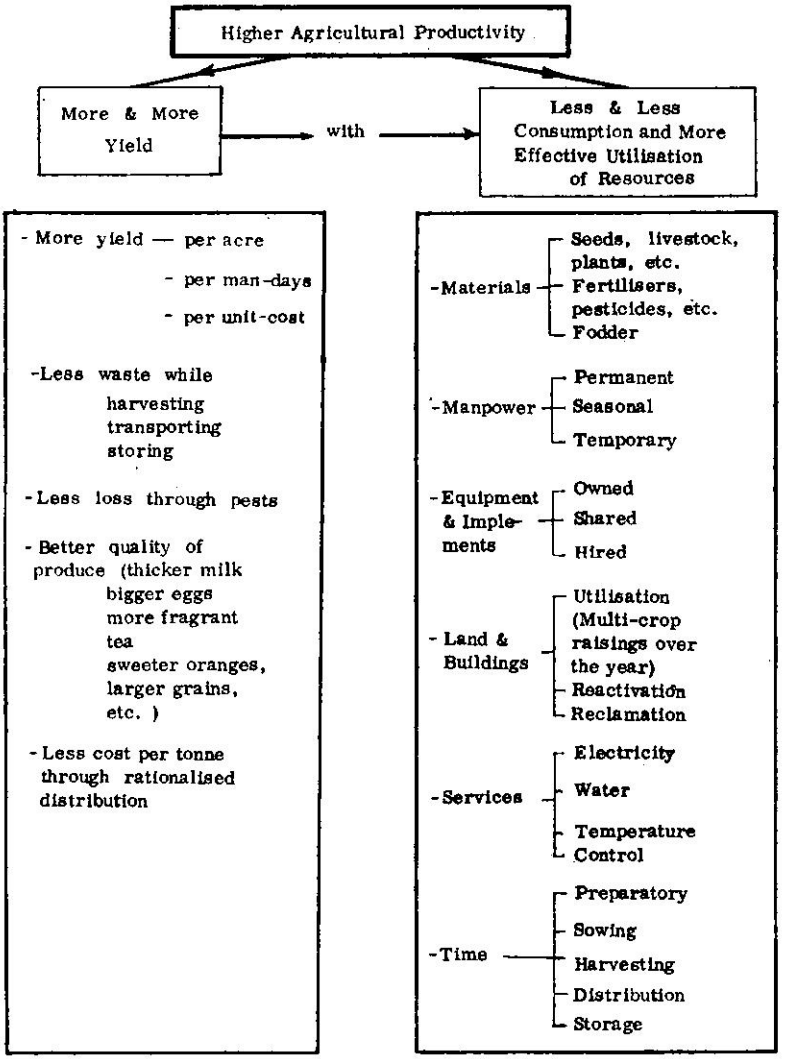
already come in some countries) when the imbalance between these two spheres will violently upset the economy of agricultural nations.

In spite of the known fact that the majority of the work force in most of the Asian countries is employed in the field of agriculture, there is a great deal of inhibition over accepting agricultural management as coming under the legitimate influence of scientific management principles. This is largely because agriculture is relegated to the status of a 'family' enterprise, and not accorded recognition as an industry by itself. Tradition, progressive fragmentation of holdings, absence of a central coordination

body, and other factors have contributed to the perpetuation of this attitude.

The simplified schematic mode on page 398 would reinforce the valid argument that management of agriculture is broadly similar to management of industry.

Some deviations are noticeable. Production Control, Advertisement, and Personnel Management do not have the same significance in agriculture as in production industry. The 'elements' have a large say in production control; in scarcity areas, advertisement is superfluous; in small farms (which are the order of the day) personnel management is synonymous with the management of



one's own family and a handful of seasonally hired labour. Storage and pest control, on the other hand, are major problems of agriculture. But, then, variations in accent must necessarily be there between different types of industry, of which agriculture is one.

We understand that the function of productivity is to supply more and more of goods and services to more and more people(s) with less and less consumption of real resources. In respect of the resources pressed into service in 'production' industries, we appreciate the significance of 'less and less consumption of real resources' in relation to cost reduction and higher yields. The significance should be equally evident while evaluating the resources consumed in the agricultural industry. The diagram on page 399 brings into focus the objectives (on the left), and the areas for analysis (on the right).

Combining what we have discussed so far under 'Management Perspective' and 'Evaluation of Resources,' we may crystallise the areas for study as follows. For the sake of brevity, tabulation has been resorted to.

Finance & Cost Control

a) Availability of funds.
Cooperative credit societies.
Governmental assistance through interest-free loans and less taxation.

b) Analysis of costs.
Inter-farm comparisons.

c) Small-Farm Management Programmes (for existing farm managers).

d) Development & Management Programmes for prospective farm managers.

e) Cost-Reduction Programmes for farmers.

f) Measurement of Productivity.

Research & Development

Enlisting the assistance of existing research organisations/laboratories, and helping in the dissemination of information; Demonstration programmes through 'Model Farms'; Assistance in the setting up and running of local information bureaus which should have a mobile element at each local point.

Procurement

a) Increasing the availability of requisite resources.

b) Reducing the cost of resources.

) Including the application of productivity techniques at source; governmental aid through reduced taxes or subsidy in early stages.

c) Rationalised distribution of resources needed in agricultural. Where

...Large-scale farms are few in Asia. Continuous fragmentation through generations and, in some cases, governmental ceilings on holdings have reduced the size of the farms. The accent must, therefore, necessarily be on small farms first, and on medium-scale farms next...

distribution is centralised, ending of favourtism or administrative delays.

d) Making the resources available in time.

e) **Functional evaluation of resources needed.**

Farm Production

a) Methods Improvement

b) Work Simplification

c) **Utilisation analysis of resources**

d) Incentives to farm workers

e) Pest control

Marketing

a) Harvesting { Speed / Waste reduction

b) Rationalisation in transportation, handling, and distribution.

c) Storage—Prevention of deterioration
—Pest control
—Handling in redistribution

d) Elimination of pilferage.

Most of these studies will come within the purview of Agricultural Work Study.

No Manpower Shortage

A powerful and potent term like industry has come to denote only a restricted zone of 'production' instead of embracing all spheres of human endeavour. Whether this has been because of original misconception or confined usage, or due to priority having been allocated to 'production' organisations like factories, the denotation is unfortunately limited in scope. It is hoped that the same mistake is not made with regard to the term 'agriculture.' This should not be confined merely to rice or wheat fields, but should take in all agricultural activities: plantations (tea, coffee, cocoa, rubber); by-product activities (poultry farming, animal husbandry, etc.); farm-management functions (research, procurement, distribution, storage, marketing, etc.), and so on.

It may be borne in mind that 'large scale farms' are few in Asia. Continuous fragmentation through generations and, in some cases, governmental ceilings on holdings have reduced the size of the farms. The accent must, therefore, necessarily be on small farms first, and on medium-scale farms next.

In most of the Asian countries, there is no shortage of manpower. In fact there is an excess of manpower for the requirements of the land, with the attendant lowering of utilisation of manpower. In this context it may be well worth considering only those types of farm equipment which

a) reduce the **physical** strain on the farmer;

b) improve the methods of farming which cannot otherwise be improved even by increased labour input;

c) do not cause unreabsorbable 'redundancy' in farm labour.

While in respect of all other real resources the aim is less consumption, in the case of manpower, better utilisation, and not lower employment, should be the objective. This is worth considering on sociological, economic, and political grounds.

We have so far discussed the scope and areas of application of agricultural productivity. At this juncture we must take into account other organisations and agencies which have started work in some areas or sub-areas of agriculture. Whether their progress has been good, indifferent, or bad, we must take cognizance of the fact that they are there and be wary of initiating activities in their field, lest the NPC be dubbed as an interfering body encroaching on other people's preserves. Where an understanding cooperation with such organisations is possible (and it is likely to be when the work of the other organisation

and of the NPC has been constructive in the past), then collaboration and joint effort are possible. Where, however, a common meeting ground is not possible, NPC would do well to avoid their particular areas or sub-areas, at least over an initial period of five years.

Barring the situations cited above, it is my personal opinion that the NPC should launch the Agricultural Productivity Movement. One good reason is that we call our organisations 'Productivity' councils or centres, and the term Productivity is not the exclusive privilege of any one sphere of industrial enterprise. And, agriculture is an industry.

Being, however, a new venture for the National Productivity Councils, the following points may be borne in mind:

(a) Organising for agricultural productivity would be a slightly slow process, and results cannot be expected overnight. One reason for this may be seen through a study of the steps enumerated in the succeeding para.

(b) Although specific areas for study and list of priorities among the selected areas and sub-areas might be formulated to suit the national requirements, the fields of application may have to be kept restricted in the first two or three years in order to

(i) enable our specialists to gain the necessary experiences and resultant confidence;

(ii) allow us to gather the necessary expertise and build up a body of specialist knowledge;

(iii) win over the cooperation of other organisations in the field through steady progress and concrete results achieved;

(iv) allow for propagational work, alongside field work, so that the necessary ground work is prepared for taking on other areas.

(c) The scope may eventually prove to be so vast as to be beyond the Agricultural Division of the NPC. Flexibility of approach must be retained to determine later the change in the organisational step required, or even to set up an associate body solely devoted to agricultural productivity.

(d) Constant exchange of experiences with other NPCs will help in overcoming initial 'teething troubles.'

Simple Formula

The formula in agriculture is a simple one, and can be stated in classic language thus:

"Give a man a piece of garden land and tell him that it is not his own, he will turn it into a desert. Give a man a piece of desert land and tell him that it is his own, he will turn it into a garden."

Data Collection

In regard to organising for farm productivity, the following stage of evolution may be considered:

Step 1: Open an Agricultural Dn. at the NPC Headquarters, staffed by

Agricultural Productivity specialists (This has been done).

Since the staff qualification is an over-simplification, we should select progressive-minded agricultural graduates, who have had experience of farming, and induct them into productivity techniques in general, and work study in particular. It is a time-consuming process which must be accepted.

Step 2: Allow the Agricultural Division of NPC **adequate** time for data collection, and interpreting productivity in relation to farming and preliminary propagational activities.

Step 3: (Concurrent with Step 2, but with a slight 'phase' difference)

a) Liaison with organisations already working towards the common aim.

b) Ascertain the degree of cooperation, coordination, and collaboration possible.

c) Convene a purposeful conference of interested bodies.

b) Forge out areas of—(i) exclusive work, (ii) consultative activity, and (iii) collaboration.

e) List out priorities of work to suit national requirements and problems.

Step 4: Training of trainers by the Agricultural Division's staff.

Step 5: Instal trained personnel at regional echelons and local centres.

Propagational activity.

Step 6: (Parallel with Step 5): Continuous training of more Agricultural Productivity specialists.

Step 7: Preliminary field work by regional/local agricultural productivity personnel: Liaison with local bodies; adjustments to control 'terms of reference' and 'list of priorities' to suit local conditions, with the prior concurrence of NPC Headquarters.

Step 8: Actual field work.

Step 9: After a reasonable period, a liaison conference of practitioners for evaluation, comparison, exchange, reorientation of methodology, and readjustments in areas of work and priorities.

Step 10: Expansion programme to cover, progressively, regional echelons so that the villages (which are the backbone of any agriculture-based economy) start reaping the benefits.

Step 11: (Simultaneous with Step 10): Propagation work for popularisation of the concept of Agricultural Productivity backed by 'Success Stories,' case studies, and demonstration of model farms.

Thanks to the pioneering lead given by Dr PS Lokanathan, Chairman of NPC, we in India have initiated a beginning in the field of Agricultural Productivity. The Governing Body of NPC set up a sub-committee to investigate the aim, scope, and potentiality of Agricultural Productivity, and recommend measures for activity in this field; and a set up at Headquarters has actually come into being. A conference of 'interested' institutions and bodies was convened in May 1965, to formulate areas of exclusive and collaborative activities. We have quite a few organisations which are doing purposeful work in some specific areas of agriculture, and we are confident that we can organise a concerted movement, with the NPC concentrating, initially, on areas which have not attracted the attention of others.*

We may, in fact, have much more to say on this subject by the end of our India Productivity Year (IPY-1966), in which special attention will be paid to the organisation of a massive drive in agricultural productivity.

* This special issue of the NPC Productivity Journal is itself an evidence—if one were wanted—of NPC's deep interest in Agricultural Productivity.

DH BUTANI

National Productivity Council

Incentives and Motivation in Farming

A system of incentives for maximising per acre yield has been strongly advocated in this paper which proposes six categories of well-planned productivity incentives. How to offer them, their advantages, etc., are mentioned, but the author feels that there is "nothing more powerful than individual incentives," though he goes on to add that it would be better still to have the family incentives system. Special incentives to make adequate water utilisation are also suggested since the percentage of its utilisation has been small despite massive investments in large-scale irrigation during the last 15 years. The motivation of the farmer is also important at the time he prepares the land and sows the seeds.

INDIAN AGRICULTURE is really an amorphous industry, or rather a set of industries, extending from general farming operations to such specialised occupations as horticulture, poultry, cattle-raising, and dairy. In large parts of the country, agriculture is a low-level, mixed type of occupation, the predominant motive being, for the mass of cultivators, to raise sufficient food and fodder for survival. Nevertheless, there has been in the post-Independence period, a considerable measure of commercialisation, and in some parts of the country, like the Punjab and the UP poultry, cattle-raising and dairy have become a sort of regular industry. For these occupations, it should be possible to work out special incentive systems in order to maximise output per rupee of investment.

It has to be emphasised that in these agricultural industries, as in other industries in India, it is Capital Productivity that is really the crucial factor, for

labour is not a factor for economising, particularly in the rural areas. This generalisation is essential in the context, because incentive programmes in this country have to be worked out in the context of a population of 480 million increasing at over two per cent per annum; hence economy in the labour content of the products of industry—incentives in Western countries are designed with this objective—is not the objective from an overall national standpoint in this country.

The Objective

The objective of an incentive programme in Indian agriculture is precisely the increase in per acre yields. Apart from the difficulty of statistical calculation, the immediate objective is not necessarily the increase in per man-hour output, though historically, from a long-term standpoint, it will work out that way, for as overcrowding on the land gets reduced through massive and extensive industrialisation, per capita incomes and labour productivity on the land will go up.

In this paper, we are concerned with the devising of such incentive programmes as would lead in the relatively short period to the maximisation of output per acre through the most effective utilisation of inputs in terms of water, fertilisers, etc. It is precisely because this has not happened that we have generally fallen short of the targets laid down in the Third Plan, except in the years of favourable weather, and history is likely to repeat itself, if we do not immediately devise productivity incentives, to realise the Fourth Plan target of 120 million tons of food grains

If we are going to make a massive impact in the area of general farming operations, we have to consider a variety of incentive programmes, to be employed with the same psychology as we do in a period of general mobilisation. The various categories of incentives, broadly proposed in this paper, are what may be called (i) Class Incentives, (ii) Price Incentives, (iii) Purpose Incentives, (iv) Credit Incentives, (v) Performance Incentives, and (vi) Special Incentives. Class incentives are essential because Indian agriculture is manned by different classes of people, with differing sociological and economic backgrounds. Obviously, the motivation of an agricultural labourer working seasonally on a daily-wage basis, with no right in the land or the crop, is different from motivation of the cultivator, who, whatever his right in the land, is much attached to it.

Then there are in the socio-economic power structure in the rural areas a large number of intermediaries, entrepreneurs, market operators, money-lenders, who, whatever the law may be, still persist in large areas of the country, with power to take a toll off the land. In varying degrees they do provide the necessary credit, management, enterprise, supply of seeds, fertilisers, etc. These functions are being taken over rather ineffectively, and inefficiently, by a number of institutions such as the cooperatives, government agencies, and panchayats. But it is the contention of this paper that the management function in agriculture is an essential factor without which it would be difficult to mobilise efficiently the various resources involved; and the various classes of managers, called by different names, may be properly organised and appropriately motivated.

These class incentives, however, need special studies. One fact may be emphasised here that a radical effort appears necessary to offer special incentives to the class of cultivators who form the core of general agriculture in this country. It should be considered a matter of general

regret that security of tenure does not really obtain in large parts of the country. The formula in agriculture is a simple one: "Give a man a piece of garden land and tell him that it is not his own, he will turn it into a desert. Give a man a piece of desert land and tell him that it is his own, he will turn it into a garden." Even the Soviet Union and Communist China have found that in the field of agriculture, it is the traditional capitalist incentives that avail; for no matter what the type of society is, it has to be so organised that people have at least the food to eat.

The more powerful incentives in Indian agriculture would be the price incentives. The Agricultural Prices Commission has been specifically asked to devise in-built incentives into the pricing structure for agricultural commodities. These, however, have to be very intelligently thought about, for the pricing system for industry works differently from that in agriculture, particularly in respect of the incentive element in the price. Operations in industry can be switched on or off, according to the degree of incentive the market offers the entrepreneur. He can almost immediately or over a short period, reduce inputs, cut his losses and practically walk off the market, if he feels so advised. Agriculture is not at all such an industry. Once the land is got ready and the seeds are sown, the cultivator has willy nilly to go through the operations and get what he possibly can from his land, even though the market collapses.

Hence the time element has to be carefully analysed in the context of price incentives. The motivation of the cultivator is important at the time he is preparing the land and sowing the seeds. At that time, the current price constitutes his incentive in a broad economic sense. It is with that expectation that he begins his operations. But the price that he actually gets depends on the market conditions prevailing at harvest time, and it is generally much different. In fact, here the pricing system for agriculture operates in a manner wholly contrary to the classical assumptions. The better the job the cultivators have done in terms of agricultural operations, the lower the average price they get, assuming other things remain the same i.e. the cultivators are actually penalised for what may be called their productivity. Hence the pricing system as it operates is a dis-incentive system.

Rewarding of Cultivators

Cultivation is undertaken under one set of price expectations, the rewards are obtained under a totally different set of circumstances, and the system is certainly, obviously, anti-social. Society wants to reward the cultivators for the good work they have done, while the market penalises them. In this context, a policy of agricultural price stabilisation at a level so as to obtain the maximum yield from the land is an imperatice of economic policy.

The circumstances for the beginning of such a policy are propitious, for its success depends upon surplus supplies being available at the disposal of the Government. It is now possible to build up buffer stocks through procurement from abundant harvests such as we had in 1964-65, and from the supplies obtained under PL-480 programmes, expansion of warehousing facilities, etc. If we do not do this immediately, the mass of cultivators will suffer, and they will have less faith in the Government's policies and programmes.

The third category of incentives (Purpose Incentives) are offered so that certain specific objectives may be achieved in respect of proper preparation of land, improved implements, improved seeds, proper irrigation of land,

...Maximum productivity in agriculture can only be attained by linking into one progressive social system the mass of agriculturists on the one hand and the government officials working for them on the other...

use of fertilisers, etc. These may be offered in the form of price concessions, availability of supplies, etc., and may be linked with performance or credit incentives.

Credit incentives are especially important. The main handicap of farmers has been the lack of capital, and the absence of credit at reasonable rates of interest. In the post-Independence period, however, the Reserve Bank has entered the field of agricultural finance in a massive way. Just as the private money-lender had a hold on the agricultural economy and exploited it for personal gain, it should be possible for the RBI, as the primary source of large-scale credit for agriculture, to devise incentives, which may be linked up with the offer of credit facilities at reasonable rates, for credit can be given in terms of the actual supplies of fertilisers, improved seeds, implements, etc. Credit incentives can also be linked with price incentives, and further with warehousing facilities, for as soon as the cultivator deposits his grain with a warehouse, it should be possible to advance him sufficient credit to prepare for the next crop.

The State Governments have been experimenting for some time in what may be called performance incentives through the institution of Krishi Pandits, etc. During the time of the last scarcity, several State Governments offered special incentives on a performance basis. This system needs to be adopted on the most extensive scale, for it will tap the primary source of individual psychology. In fact, there is nothing more powerful than individual incentive. Probably, it would be better still to have family incentive systems, for the unit of labour in the rural areas is the family; and the women and children can be profitably brought in. Women and children of cultivators, whose performance is exceptional, may be rewarded through offer of things such as radios which women like, and educational scholarships for children. In British industry, they have experimented with incentives, indirectly offered to the wives of male industrial workers. A firm which wants to make a success of its incentive programme maintains a show window of luxury articles usually beyond the reach of industrial workers, but the carrot is held out that if the workers accept the incentive programme, their women will have the opportunity of getting some of those things. We can experiment in some of these showpieces in the rural areas as part of the Community Development Programmes.

Lastly, we may consider certain special incentives to make a success of mechanisation in certain directions, adequate water utilisation, or the designing of improved farm implements. The

Estimates Committee of Parliament, in fact, has recently suggested that the Government should give generous rewards for designs of improved agricultural implements, such as seed-drill for small grains, and thresher for wheat and paddy.

Probably, the best dividends in terms of return to capital investment can be obtained through incentives for water utilisation. Massive investments have been made in large-scale irrigation during the last 15 years or so, but the percentage of water utilisation has been small. While we have made enormous investments to make water available for irrigation, for a large variety of reasons, the cultivators do not make a full use of it. To the extent that there are physical impediments, these may be removed, or incentives offered for construction of channels, etc., where these are necessary to carry water to the fields. Where the obstacles to adequate utilisation of water are economic, it may be advisable to offer irrigation water at nominal rates in the first instance. Once the cultivator gets used to irrigation water, he will buy it at what may be called the market price.

HL Experiment

Another class of special incentives may be thought of by way of private industry offering incentives for assured supplies of raw materials. In this context, the case study of Hindustan Lever, appearing elsewhere in this Journal, appears rather significant. During 1964-65 the company made a contribution as processors of an appreciable quantity of groundnut towards raising the per acre yield of these important oilseeds. The company actually provided the farmers in three blocks of 20 acres each in UP with free supplies of good quality seeds, fertilisers, and pesticides, and its agricultural staff made sure that the optimum quantities of these resources were, in fact, used by the farmers. The results were a much higher average yield of 725 kg per acre, as compared with the national average of 295 kg. During the current year, Hindustan Lever proposes to extend the coverage of this experiment, and they have expressed the hope publicly that the company's entry into this field will mean an additional income to the farmers, improved farming practices, efficient livestock management and vegetable growing, for, in their last annual report, it is mentioned that "well-planned incentives are being provided to the milk and vegetable producers in Uttar Pradesh in order to increase their production."

It is through these experiments of the private sector that the public sector has to learn a good deal. It is probably worthwhile to make the point here that unless the village level workers, the extension workers, and the various Block Development Officers have also an incentive to make their services and supplies available to the agriculturists, so that the per acre yield may be maximised, not much can be achieved. The Government system is a non-incentive system.

The fact is that in agriculture maximum productivity can be attained by linking into one progressive social system the mass of agriculturists on the one hand and the government officials working for them, on the other. It is a point to consider whether we could not have performance incentives for agricultural and community development staff on the basis of increases in the per acre yields obtained in their respective areas. In agriculture, surely, significant results can only be achieved through appropriate motivation of all the parties involved in the productive process, particularly the cultivators, and the extension workers.

GK NAYAR

Senior Economist
National Productivity Council

Productivity Efforts in Agro-Industries

The partnership between agriculture and industry is a welcome trend in post-independent India. Major industrial establishments are contemplating to diversify into agro-industry : the case study of Hindustan Lever (see pp 192-95), for example, indicates how it has already extended its activities to milk products, dehydrated vegetables, and animal feedstuffs. The Cooperative Milk Supply Scheme at Kaira, Gujarat, is a good example of the progress of agro-industries. Agro-industry has now been recognised as a key to some of the urgent problems of agriculture, its low yields, etc. The author refers to the factors necessary for the success of the agro-industrial scheme, and says that the more affluent farmers should take the initiative for developing the agro-industrial movement in the rural areas.

A DETERMINING factor for the success of the agro-industrial programme is how promptly the farmers' needs are met, and how efficient and far-reaching are the means adopted for stimulating farm output. A measure of what can be done to generate larger farm surplus is furnished by the painstaking experiments conducted by the Vanaspati industry in stimulating groundnut yields in the different regions. By using plant protection measures, better seeds and more fertilisers, the industry has been able to improve yields, and increase productivity considerably.

Tobacco growers in Andhra Pradesh are given similar facilities by the organised effort of the manufacturers. The tobacco companies extend the necessary credit, and realise the same at the time of crop-cutting. The Cooperative Milk Supply Scheme in Kaira district, Gujarat,

is a shining example of the progress of agro-industries.

It has to be recognised that initiative for the agro-industrial movement in the rural areas can come only from the more affluent farmers. They alone are equipped to make agriculture a commercial proposition, to form the first line of agro-industrial leadership. There is evidence to show that those farsighted among the farmers are both willing and eager to break new ground. The enthusiasm shown by the progressive farmers of Maharashtra, Gujarat, and Andhra Pradesh is typical of the new spirit in the country.

Key to Economic Growth

Indian agricultural scientists are of the belief that farm productivity is low because the Indian farmer does not know how to utilise the existing resources at his disposal in an efficient manner. There is, however, another point of view, equally, if not more significant. Prof TW Schultz, of Chicago University, who had made a careful study of the ailments of agriculture in developing countries, in a recent article wrote :

> "First it will come as a surprise to find that the farmers in the poor countries are in general not inefficient in using the agricultural factors of production that they have at their disposal. Yet, the reason once understood is simple. These farmers are, as a rule, subject to particular economic restraints that are typical of traditional agriculture; specifically they are subject to a set of preferences for acquiring and hoarding wealth, and to a state of arts both of which have remained virtually constant for generations. As a consequence they have long since attained a type of stationary equilibrium. Thus the popular assumption that a different allocation of the existing poor resources in these countries would substantially increase agricultural production is inconsistent both with economic logic as applied to the behaviour of farmers in such an equilibrium and with the available empirical evidence."

When it comes to investment to increase agricultural production, farmers who are bound by traditional agriculture have, in general, exhausted all profitable opportunities to invest in the agricultural factors at their disposal. This means that the marginal rate of return on investment in agricultural factors of the type which farmers have long been using, is low—so low that there is little or no incentive to save and invest.

Rapid economic growth of the type now envisaged cannot be based on traditional agriculture. Expansion along traditional lines means, in practical terms, the digging of a few more wells and channels for irrigation, several more draft animals and implements, and other forms of reproducible capital of the type farmers have been using for generations. These techniques will hardly increase agricultural production: so little in fact that it hardly can be called a rate of return. According to Prof Schultz, two factors hold the key to economic growth from farming. They are, first, improving the quality of agricultural inputs, and second, supplying them at a price that will make it worthwhile for farmers to acquire them and to learn how to use them efficiently.

READ

The special issue of the

NPC Journal on

TRAINING IN INDUSTRY

BIKRAM SINGH

Member
National Committee on Extension and Training, New Delhi

A Farmer's Tips for Doubling Farm Output

For about a decade now, the Governments, Central and State, have been offering farmers special incentives on a performance basis through the institution of Krishi Pandits, etc. The author, who has his farm in Meerut District, Uttar Pradesh, offers here a few tips for the doubling of farm output. In narrating his experience, he says that, by adopting improved methods, he was able to raise his yields from 12 maunds to 50 maunds per acre in the case of food grains, and by 100 per cent in the case of fruits, vegetables, sugarcane, etc.

OUR FARMERS can surely raise their agricultural productivity, in spite of their meagre resources, if they sincerely work for it. Luckily, our Government is fully equipped with finance, expert advice, improved seeds, implements, pesticides, fertilisers, etc., which are essential to achieve the maximum level of production. I say this from personal experience. By adopting improved methods of cultivation, I have been able to raise my yields from 12 maunds to 50 maunds per acre in the case of food grains, and by 100 per cent in the case of fruits, vegetables, sugarcane, and other agricultural products, in a matter of four years.

My farm is situated at village Chobla in Meerut District (UP). By using hybrid maize seed in 1961, I obtained an yield of 25 maunds per acre when other farmers of the area could not get more than five to 10 maunds. In 1962, I improved my maize cultivation methods still further, and by sowing

Ganga Hybrid-101, obtained an yield of 45 maunds per acre compared with 10-15 maunds per acre of the other farmers. A cultivator who adopted my methods got an yield of 35 maunds per acre. In 1964, I obtained the highest yield of 50 maunds per acre in spite of heavy rains.

Specialists Consulted

After maize I used to grow wheat in the same fields, but there was only a slight increase in production. This was perhaps owing to the inferior variety of wheat I used, and lack of fertiliser. I consulted the specialists of the Indian Agricultural Research Institute, New Delhi, and they advised me to grow the N.P. 824 wheat variety. I found that the plants had a very good growth. N.P. 824 has yielded up to 40 maunds to the acre. By growing another improved variety C 281 I have obtained even 50 maunds. I have also grown wheat SONARO 63 on a trial plot, and it has given me 74.5 maunds per acre. I am extending it to a larger area.

Apart from the determination and will to improve our farm productivity, the following suggestions, if adopted, will help us in achieving our goal.

(i) Each extension worker should be required to show concrete results of his efforts to educate the farmers in improved methods of cultivation.

(ii) Small tractors, tillers, seed-drills, hoes, etc., may be supplied to needy cultivators on easy terms, and at reasonably low prices. Cultivators will agree to purchase such agricultural goods, stores, etc., even on cash payment.

(iii) Arrangements should be made to supply improved seeds, fertilisers, and pesticides to the farmer at his doorstep.

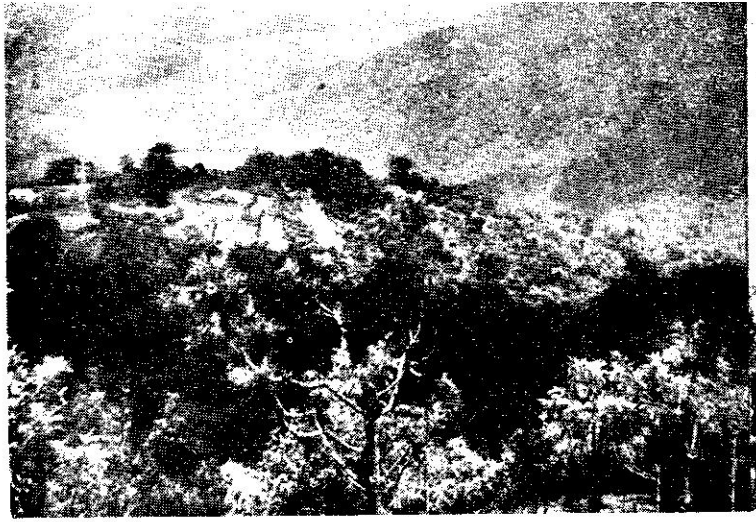
(iv) Independent arrangements for irrigation should be made for intensively cultivated fields, as these fields require immediate irrigation, and not by turns.

Thus they spoke:

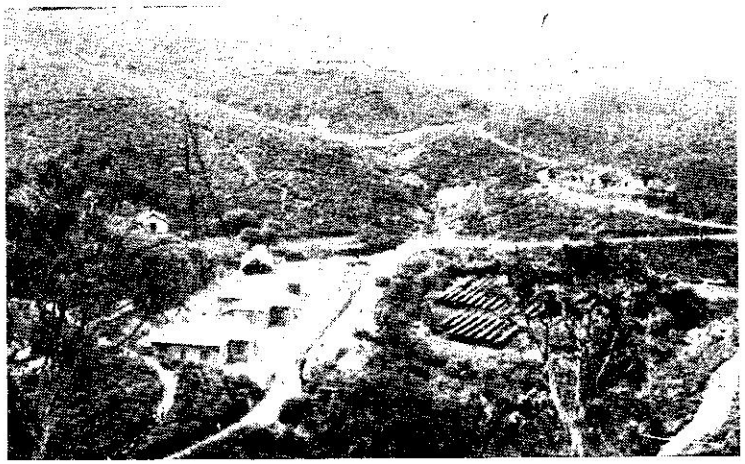
President Radhakrishnan (at a meeting): Make the peasants feel proud of the work they are doing. We are not doing that and hence agricultural production is poor.

Mr M Bhaktavatsalam (distributing prizes to successful farmers in State level group competition): The land will never fail a person who devotes proper attention to it.

Mr C Subramaniam (Speaking in Rajya Sabha): The position today is that agricultural production is nobody's baby—the Centre can blame the States and the States can blame the Centre.



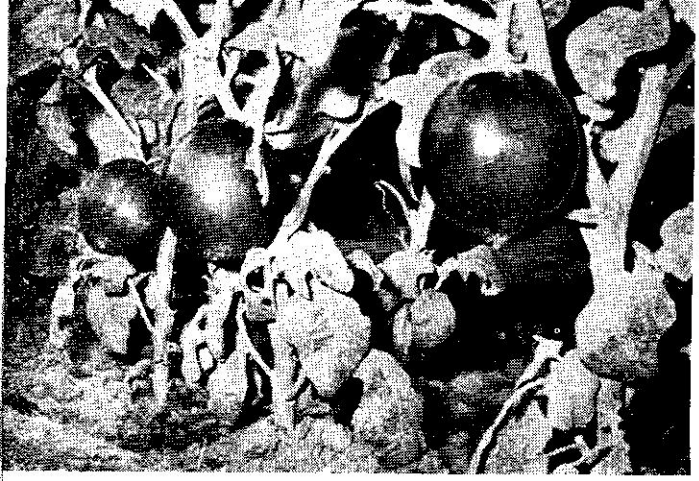




NEW HORIZONS IN FARMING:

Agriculture, in its widest sense, includes animal husbandry, horticulture, and plantation crops, the chief of which are tea, coffee, and rubber. Photo shows LEFT: A view of a tea field. TOP: A view of a typical plantation area, and (Right) of a woman worker plucking tea leaves. BOTTOM: A view of a coffee plantation. (See article on Productivity in Plantation Industry (pp. 459-62)





Vegetable cultivation is a constant source of income to many in India's villages. Photos show cultivation of brinjals and cabbages, and students being trained in correct maintenance of vegetable plants.



Cultivation of Vegetables

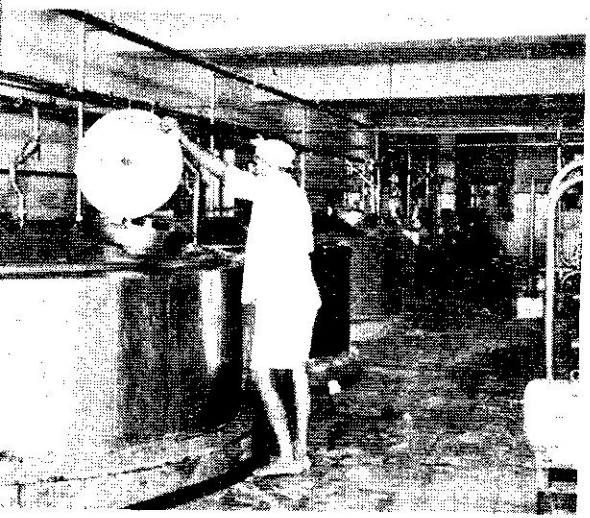




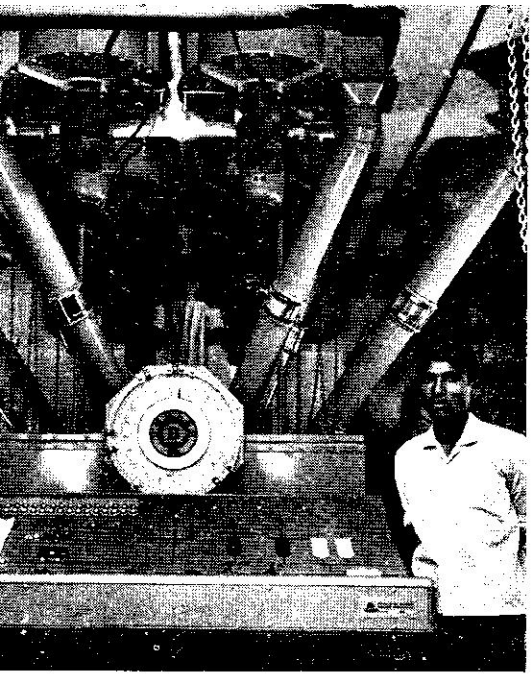
An irrigated field provides lush fodder for cattle, and the cattle yield more milk



A lush pea crop scientifically produced in a farm of Hindustan Lever in Uttar Pradesh. Planting and harvesting of fresh tender peas involves careful planning. (See article by PL Tandon)



Milk processing section storage tanks in the Kaira Dist Cocperative Milk Union Ltd., Anand. This Cooperative h been an "effective agency for developing the dairy industr and the rural economy in Gujarat", says Orion Ulr
(See article, pp. 209-219)



A feed-milling plant. The punch card system with a synoptic panel enables a man to control centrally all the operations of the plant automatically (See article pp. 422-429)

More Pictures on pp. 465-472

Harvesting of Table Grapes in Israel

The packing of table grapes has been an irritating problem for years. The Agricultural Division of the Israel Institute of Productivity, a few years ago, developed a new system—the pack-while-harvesting method—the adoption of which has resulted in lesser damage to grapes than had the fruit been brought to the packing shed from the vineyard since it would have meant too much of handling. Further, this system simplifies work, preserves the quality of the fruit, ensures greater supervision by the vineyard manager, and avoids investment in a shed and its equipment. Presented here are details of the devices used for packing-while-harvesting, the methods of using them, and also their advantages and disadvantages.

IT WAS the practice in Israel, until recently, to pack table grapes in a packing shed to which the grapes were brought from the vineyard. This method requires much labour, and the quality of the grapes is affected through too much handling.

To reduce the number of work-days required for harvesting and packing as well as improving the quality of the fruit, the Agricultural Section of the Israel Institute of Productivity developed the pack-while-harvesting method. This method was put into practice together with the changes that took place in the last two years in the methods of packing, which include the single-layer packing method, on a tray holding 10-12 kg, instead of packing in two layers into boxes with lids. This practice alone decreases the quantity of culls, and makes

possible the packing of table grapes in the vineyard.

An additional factor essential for the success of the method is the absence of culls or deteriorating grapes. In certain vineyards, the workers said that their grapes contained a considerable amount of culls due to insect bites and pests. The pack-while-harvesting method made them suffer lighter losses than otherwise, because had the fruit been hauled to the packing shed, the damage would have been much greater.

The pack-while-harvesting method was tried in 1960 on a large scale, and in the following year it was used by a great number of collective settlements to their full satisfaction.

Packing-while-harvesting can be done with two devices:

(1) Sledge-type carrier for grapes of the same grade. (2) Cart for two grades of grapes.

Packing on to Sledge-Type Carrier

The carrier has a frame of 10 mm iron and weighs 6 kg. There is place for two trays on it. The upper tray is slanted towards the worker, and in it are packed the grapes for marketing. The lower one is slanted away from the worker, and is intended for lower quality grapes without packing. This tray protrudes about 20 cm more than the upper one in order that it would be possible to throw into it culls from the bunches being packed, without the need for bending or leaning out on the part of the worker.

Packing paper sheets are placed in a special container on one side of the carrier. There is also a rack for the turning shears. The carrier is pulled forward by means of a handle attached to the front. Details of the **method of work** are given below:

a) Before he starts packing, the worker covers the tray to be packed with a sheet of packing paper. One edge of the paper falls exactly along the length of the tray, and it continues down the bottom of the tray to the opposite side, and hangs down on the outside. This hanging part is used at the end of packing for covering the fruit.

b) The worker picks a bunch, removes the culls (into the lower tray or on the ground), and starts to pack in the slanting tray starting at its lower end.

c) When the tray is full, the worker gives it a general checking by sight, and removes, if necessary, further culls and long stems (stems should not be cut too short). The worker covers the fruit with the hanging part of the packing paper sheet, inserts its edge carefully between the bunches and the opposite side, and then takes down the tray and lays it in the shade among the vines.

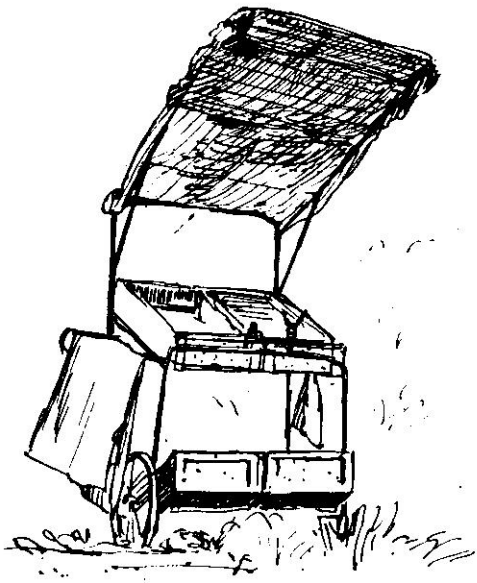
d) The packed trays are collected from the field, and hauled to the final dispatching station.

Following the recommendation of the Agricultural Section of IIP, the double weighing of the grape trays in the vineyard and the marketing agency stores was stopped. Now it is enough to weigh once only in the stores of the marketing agency.

Advantages

a. As a result of unifying two operations —harvesting and packing—there is a 10 per cent to 40 per cent reduction in the amount of work required (depending on variety, type of vineyard, region, available labour, etc).

b. The quality of the grapes is improved as a result of holding each bunch only once, and reducing the shaking and jerking of the fruit by doing away with the need for hauling all the collected grapes to the packing shed near-by.



The cart for two-grade packing while harvesting

c. Because of performing both harvesting and packing operations at one place, there is no need for co-ordination between harvesting, hauling, and packing, thus achieving considerable simplification in the organisation of work.

d. There is no need for big financial investments in equipment and the building of packing houses.

Disadvantages

a. This method is suitable only for slanting trellis, three-wire trellis, and arbor vineyards. It is unsuitable for one-wire trellis. Experiments are now under way to design a lower device to fit the latter.

b. This method calls for a permanent work-team, responsible and well-trained—which is difficult to attain in many collective settlements where the vineyard workers are subject to continual change. This disadvantage is the main reason for the unwillingness on the part of the vineyard managers to use the method. However, experience has shown that by providing proper training and supervision it is possible to train workers in a matter of hours to attain a presentable form of packing.

c. Another difficulty is experienced in very hot regions and with the soft varieties grown on three-wire trellis. However, experience has shown that it is possible to continue packing till noon with no fear of damaging the grapes if a small couch is added. (See below, in the paragraph of the cart for two-grade packing).

Cart for Two-Grade Packing

The cart is made of a thin-walled pipe with an external diameter of 1.9 cm. In the upper part of the cart there is place for two trays, in every one of which it is possible to pack grapes of only one grade. In the lower part it is also possible to put two trays—one for culls and the other for fruit of lower quality which does not need packing. Attached to one side of the cart is a special container for packing paper (as in the case of the sledge-like carrier).

The cart has a top covered with jute cloth which can be removed when there is no need for it, or when the cart is in storage. The cart moves on two wheels attached to its front end.

Method of Work

Work with the cart is similar to that done with the carrier, with the exception that here it is possible to pack at the same time fruit of two grades. The cart is suitable for three-wire trellis, slanting trellis, and arbor. Experiments are being carried out to fit it for work in single-wire trellis vineyards. The advantages of the pack-while-harvesting method when used with the cart are similar to those in the case of the sledge-like-carrier, but there are two

additional advantages, viz., the possibility of packing two grades of fruit simultaneously; and the top protects the fruit from the heat of the sun, and makes it possible to work in very hot regions.

The pack-while-harvesting method has proved to be quite efficient by decreasing the number of work-days necessary for the harvesting and packing of table grapes, as well as for improving their quality. The vineyard manager must determine, in the light of local conditions, which is the best method, and which device to choose.

Packing Between Vine Rows

This method was first used in Kibbutz Sa'ad, in the southern part of Israel (the Negev), due to particular conditions in this Kibbutz, such as the need to pack big quantities of fruit at the same time, and the lack of permanent, trained labour which can pack-while-harvesting. For this method a device was designed, composed of a three-meter-long conveyor. One end of the conveyor rests on a two-tray packing station from 10 mm iron.

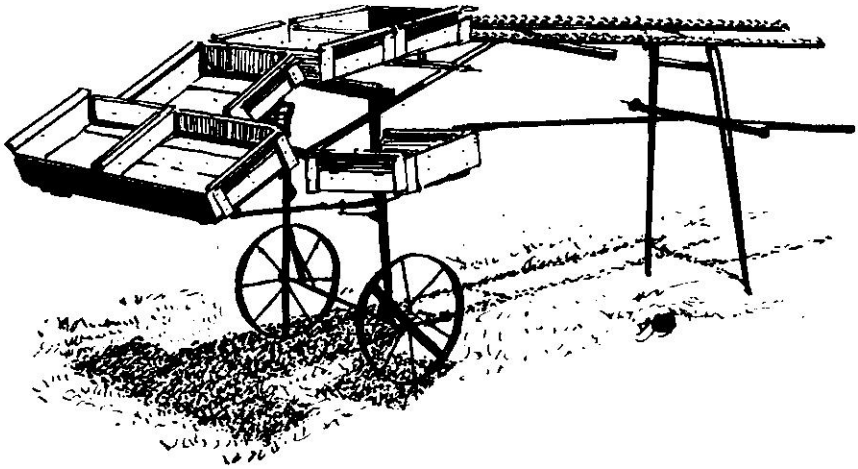
Under the packing station there are two wheels. By raising the back end of the conveyor it is possible to move the whole device easily. This method is suitable for all types of cordon (trellis) systems.

Method of Work

a. The fruit is hauled from four rows (depending on the amount of yield,



Pulling the cart is that easy



The device designed for packing between the rows

work rate, and size of the work team) to the space between the two inside rows.

b. The packing device is placed alternatively at different points along the row. A special worker is employed to put the fruit containers on the conveyor, and from there the fruit is taken by the packers.

Advantages

Since the fruit is not hauled to the shed, and there is no need for hauling empty trays, the amount of work is considerably reduced. (One tray only is filled, the emptied trays start coming after the packers have packed the fruit).

The quality of the fruit is preserved because it is not hauled to the packing shed. Work is simplified, and greater supervision by the vineyard manager is made possible. There is also no need for investment in a shed and its equipment. Further advantages are: Packing is done by trained workers, and better supervision over the workers in harvesting is achieved because several workers are assigned to one packer.

This is the only method that can be used in single-wire trellis vineyards. (So far no device has been designed for packing-while-harvesting for this type of trellis). It is also possible to use a greater number of workers for harvesting for a short period of three hours, and to continue afterwards to pack using a few packers only.

Disadvantages

Every bunch is handled twice, which means additional work and bruising. The trays require added care and handling, because they must now be collected and brought together, which also calls for more work.

SV BHAT

Larsen & Toubro Ltd
Bombay

Standardisation & Manufacture of Cattle and Poultry Feed

Numbering about half of the human population, India's cattle are, unfortunately, poor in quality and yield, because of their haphazard feeding. In the West, truly scientific concentrate feed-making and feeding have resulted in rapid increase in the yield of milk, meat, eggs, etc. The author says that feed-making plants enable production of cheaper and nutritive balanced rations for the livestock by using cheaper ingredients and other wasteful feed-stuff. He explains the working of the feed-manufacturing plant of the Kaira District Milk Cooperative Union (the first of its kind in India); suggests how to organise and coordinate scientific feed-manufacturing and feeding of cattle and poultry on a national basis; lists the important advantages of pelletting feed mixture; and finally indicates the need to plan and control the management and marketing of feed-manufacturing throughout the country as a compact unit.

A VARIETY of mixed feeds* produced by the small-scale units, either manually or with a combination of mechanical and manual processing, for available in the market, but the farmer who buys such feed mixture does not know whether it is the right quality of feed he needs. Such small-scale feed manufacturers need to be helped to organise their processing methods on a scientific basis, with a minimum of capital outlay. The Animal Husbandry Directorate of each State should control the feed manufacture in their State by making available a variety of feed formulae with cheap and available ingredients for different types of cattle. The different feed mixtures so

*A suggestion has been made in this article that, besides the ingredients mentioned in Indian Standard Specification

(Turn to page 423 Col. 1)

manufactured should be capable of being identified for purchase from the market for different types of cattle by individual farmers. This is possible only if feed manufacturers would give out sufficient information in each bag, such as the nutritional values, type of cattle, and quantity of ration to be fed.

It may not be out of place to stress that some kind of control is necessary to organise and co-ordinate the feed-making industry, and this can most probably come within the scope of the activities of the Animal Husbandry Department of each State. To avoid adulteration, it is suggested that the feeds for cattle and poultry shall be in the form of pellets.

In the case of well-organised dairy farms and/or cooperatives who could control the feeding of a large number of cattle and poultry, large-scale production of feed under their management would be justified, and, therefore, encouraged by both the State and Central Governments. The feed-manufacturing installation should have the facility of an experimental farm and up-to-date laboratory.

Feed Milling

Feed milling, on a commercial scale, is in its initial stage in India, but a rapid expansion of this industry can be forecast in view of the present need to increase the yield of milk, meat, eggs, etc., now increasingly required by the armed forces in particular, and the public in general. The feed-making plant now under construction by the Kaira District Cooperative Milk Producers' Union Ltd., in Boriavi, is the first of its kind in India. It has been designed taking into account the latest developments in the field of mechanical equipment, and plant lay-out. When in full operation, this plant will turn out 10 tons of cattle feed per hour. A modern feed plant consists of different sections in which different operations are performed in order to convert the raw material into balanced feed in accordance with the feed formulae worked out by animal nutrition specialists.

The following sections and operations, as a general rule, are common for manufacturing cattle and poultry feeds:

Handling and Storage of Raw Materials: This section plays an important part in the efficiency and economy of the plant, as it enables the management to take advantage of such benefits which will result in producing cheap feeds. The benefits generally are (a) seasonal purchase of raw materials in bulk, (b) advantage of price fluctuation in the open market, (c) lower handling costs, (d) use of damaged grains, and (e) maintenance of buffer stocks to keep the plant running uninterrupted, etc.

In this section, raw materials are got either in bulk, in bags in railway

(Contd. from page 422 Col. 1,)

(IS : 2052—1962) for Balanced Feed Mixtures for Cattle, each State should prepare a list of other ingredients cheaply available in that State for cattle feeding. The nutritive composition of these ingredients should be made available by the Animal Husbandry Department for the guidance of the feed-mixing industry. It has also been suggested that the feed for cattle and poultry should be made in the form of pellets to avoid adulteration. The maintenance of an up-to-date laboratory and experimental farm for actual feeding trials of cattle and poultry should be made compulsory for every large-scale feed-manufacturing organisation... Mixed feed scientifically processed in homogeneous mash, or in pellets, provide the animal with the right proportion of the required feedstuff in kind and quantity with a maximum utilisation of nutritive substance, and minimum of labour for feeding. Truly scientific concentrate-feed-making and feeding in the West have greatly contributed to the rapid increase in the yield of milk, meat, eggs, etc.

wagons, or in road trucks, weighed and cleaned (if need be, as for example, in the case of grains), and stored in bulk silos or in bags in a conventional warehouse (godowns). The conveying of raw material either to the silos, or for processing in the plant, is done by means of Buhler chain conveyors and bucket elevators. Silo bins used for storing grains are equipped with outlet slides, whereas the bins for mealy products are equipped with special bin dischargers, because, in the former case, grains are free flowing materials, and in the latter case, mealy products, such as bran, oil meals, are hard flowing. The silo is equipped with a fumigation plant which will fulfil the dual function of blowing the fumigant into grain bins for fumigating or blowing the air into grain bins for aerating.

Processing: This section is the heart of the plant as the final feed is processed most scientifically, and according to the international standards of grinding, weighing, and homogeneous mixing, molassing and pelletising. Homogeneity in mixing is the forelore of the feed manufacture, because even a fraction of a per cent, let us say, of vitamin or any other substance could be mixed thoroughly. The mixing proportion of the mixer for Kaira plant is 1 : 100,000. In other words, even a gram of the final feed will, on analysing, show all the ingredients, in the pre-determined proportion, according to the formula. The Kaira plant is equipped with the most up-to-date punch card system by which a great variety of final compound feeds can be prepared for different variety of cattle and poultry with great accuracy and speed. Moreover, the secrecy of the formula is maintained. In a smaller capacity plant, this kind of automation may not be necessary from the viewpoint of economy.

Grinding: Material is received from the two bucket elevators. Mealy products are sifted on a vibrating screen; the fines are conveyed directly to weighing section while off-tails (coarse material) flow into the grinding bins for being ground by a hammer mill. Electronic vibro-feeder above the hammer mill ensures a uniform and even rate of feeding of the hammer mill to obtain optimum grinding efficiency. The ground material is then pneumatically conveyed to the dust collector where ground particles are separated from the carrying air. The material is then transferred to the weighing bins.

Weighing and Mixing: The most delicate operation of the manufacturing process is performed here. It comprises 16 weighing bins equipped with bin discharges, a batching weigher of 1,000 kg capacity, a batch mixer of the same capacity, an intermediate hopper, and a fluidlift line.

There is a bin for each ingredient used; the number of ingredients in cattle feed mixtures rarely reach 16 (inclusive of premixes); therefore, the plant is provided with 16 proportioning bins. However, it must be pointed out that no additional equipment or machine will be needed for the manufacture of feeds for other animals, e.g. poultry or pigs. According to the feed formula, the individual ingredients are extracted one after the other from the corresponding bin, and weighed in a batch weigher. When a batch of 1,000 kg is completed, a valve below the weigher container is opened pneumatically and the material drops into the mixer where it is thoroughly mixed during four minutes by means of a double spiral mounted on a shaft. When the mixing operation is done, a valve below the mixer is opened pneumatically and the homogeneously mixed meal is then either led to the molassing, pelleting, or sacking-off section by a fluidlift line equipped with tubular switches, according to the kind of feed to be

made, pellets or mash, molassed or non-molassed.

Premixes, i.e., mixtures of vitamins and mineral salts with a carrier substance are prepared on the same mixer, and transferred to the corresponding proportioning bin. If concentrated vitamins and minerals are used, these are dumped by hand into the batch mixer. The operations of weighing and mixing are performed automatically by means of punch-card control system. The feed formula is punched on a plastic card, which, when inserted into the control desk, will start and stop the mechanical operations of weighing and mixing. The correct sequence of these operations is ensured by an interlocking system: for instance, the pneumatic valve of the weigher will not open unless the batch mixer is empty. Alternatively, these operations can be controlled manually by means of push buttons.

Molassing: This section consists of a bin with a bin discharger, a molasses mixer, and a fluidlift line. Molasses stored in a tank are dumped to a preheater, and then enter the mixer at a temperature of about 40°C. A constant flow of hot molasses is obtained by a pump, valves, and flow meter. Molasses are injected through nozzles, and mixed with the meal by an agitator rotating at a high speed in the molasses mixer. A mercury switch fitted above the molasses mixer stops the pump when the material flow from the bin is interrupted. Molasses meal is then transferred by fluidlift line to bagging section, or to the pelleting bin.

Pelleting: This section consists of a bin with a discharger, a pellet mill with steam fittings, a pellet cooler, a bucket elevator, a pellet sifter, a fan, a cyclone and steam-generating plant. Molassed or non-molassed mash extracted from the bin is fed into the pellet mill through the feeding device. Steam is injected and mixed with the mash to obtain proper conditioning for the pelleting* process.

Because fresh pellets coming out of the pellet mill are hot, and contain excess moisture, they are, therefore, dried and cooled in a pellet cooler. A stream of air produced by a fan penetrates the mass of pellets, and removes heat and moisture as well as fine particles. Fines are separated in a cyclone, and led back to the pellet mill. The cooled pellets are then conveyed to the pellet sifter where the broken

... In selecting the raw ingredients for cattle and poultry feeds, care should be taken not to drain the food resources required for human consumption ...

* Pelleting means conversion of meal into compact pellets by squeezing the meal through a pair of rolls and a rotating cylindrical die with holes. Two scrapers separate the pellets from the rotating die, the distance between the die and the scrapers is adjusted to the desired length of pellets.

and intact pellets are sorted out. The broken ones are led to the pellet mill. The intact pellets are then ready for bagging, or for bulk despatch.

Dust Aspiration: This plant is equipped with three dust aspiration systems—one for the silo, one for the processing plant, and one for the grinding section. Each system consists of a dust collector which can be a cyclone or some type of filter dust collector, and necessary aspiration pipings connected to the dust-producing machines, bins, and hoppers. The dust and air are separated in the dust collector. The collected dust is either bagged off, or returned to the manufacturing process and the cleaned air is let-off to the outside atmosphere.

Handling and Storage of Finished Feeds: Finished feed can either be bagged and stored in the warehouse for finished products for despatch, or if consumers can be reached at an economic distance bulk deliveries may be introduced because of the advantage of lower handling costs. The Kaira plant has both the facilities.

ISI Specification

The Indian Standard Specification for Balanced Feed Mixtures for Cattle (IS: 2052-1962) gives a fair account of the scope procedure of sampling, the kind of ingredients, nutritive requirements, packing, marking, and also includes some feed formulae for the guidance of those interested in the compounding of balanced feeds. It is gratifying that ISI has spent considerable time and efforts in publishing these specifications which could serve the small-scale feed manufacturers who cannot afford a full-fledged laboratory to carry out various tests enabling them either to make their own feed formulae or make suitable modifications in the feed formulae according to the locality, season, and availability of ingredients. However, these specifications do not cover the field of scientific manufacture in its entirety, and, therefore, ISI could now try to establish a supplementary specification in respect of daily rations for different types of cattle and poultry specifying the exact percentage of digestible crude protein, and total nutrients (indicating the percentage of crude fat and fibre).

In the case of large-scale feed manufacturers, either in publiic sector by large-scale Government dairy farms or by cooperatives, the permission to set up a feed mill should be conditional to installing an up-to-date laboratory, and also owning an experimental farm of cattle and poultry to try their feeds and introduce necessary changes in any formulae either by introducing new ingredients for reasons of cheapness and market availability, or by changing the proportions of various ingredients. The experimental farm could employ different types of cattle, calves, and buffaloes to try various types of feeds, and obtain results before sending such feeds to the farmers or into the market.

India is a vast country with a vast cattle wealth numbering almost half of the human population, but, unfortunately, as stated in the earlier paragraphs, the yield is very poor. While considerable thought is being given by the authorities and the ISI in the field of feed-making and feeding of cattle and poultry, now comes the need to plan, organise, co-ordinate, and control the management and market of feed manufacture throughout the country as a compact unit. At the State level, we have Animal Husbandry Departments. At the Centre, we have the Department of Food and Agriculture to co-ordinate the activities of these departments at the State level, and to formulate basic policies to augment the agricultural and food production.

By and large, increase in the yield of cattle and poultry means increase in the food productivity of the country as

the milk products, meat and eggs are of daily public necessities. To organise and co-ordinate scientific feed manufacture and feeding the cattle and poultry on a national basis, the following suggestions may prove useful:

The Directorate of Animal Husbandry of each State should classify different cattle breed in the State from the point of view of milk yield, and size, and specify the normal daily ration in terms of digestible crude protein and total digestible nutrients as far as the processed feeds are concerned. Such processed feeds could, according to the season, be made either supplementary to green fodder, or if at any time of the year, fodder is not available, the quantum of daily ration of the processed feed shall be specified.

To achieve this objective, the Animal Husbandry Department should own cattle and poultry farms in different districts of the respective States, and also instal either a central research laboratory at State level, or, if means would justify, laboratories in important districts. The idea of having an experimental farm and a laboratory is to enable the animal nutrition specialist to evolve effective feed formulae according to the locality, season, and availability of the ingredients, and try out such feeds on the cattle and poultry of the experimental farm, simultaneously carrying out various tests at the laboratory and assessing the possibility of maximum increase in yield by such feeds. When satisfactory results are obtained, the effective feed formulae could be made available to feed manufacturers, both in the private and public sectors.

If possible, the Animal Husbandry Department of each State could also engage the services of a qualified animal nutritionist with vast experience and knowledge in the field, and open a centre for training nutritionists. Each experimental farm, should have services of a well-trained animal nutritionist who could seek the guidance and advice of the chief foreign or local nutritionist attached to the Animal Husbandry Department.

Education of Farmers

The primary duty of making processed feed scientifically is to raise the present yield of milk, meat, eggs, etc., and this should be a 'sucker' of all research and developmental work in this field. Emphasis in evolving standards for different classes of cattle breed should be laid in the use of cheap feed-stuff available in different parts of the country which so far may have been wasted or neglected. In selecting the raw ingredients for cattle and poultry feeds, care should be taken not to drain in the food resources needed for human consumption.

Educating farmers should also be made a guiding principle for future research and development in this field. Farmers' visits to experimental farms should be encouraged where they should be shown around and convinced that feeding their cattle and poultry with the right proportion of processed feed containing the required feed-stuff in kind and quantity, with a maximum utilisation of nutritive substance, and minimum of labour, is a cheap proposition, and results in higher yield. Increase in yield and availability of cheap processed feed only can change their outlook.

The various sections and operations explained in the working of the feed manufacturing plant of the Kaira District Cooperative Milk Producers' Union Ltd., can be considered standard in any feed plant, whether it is a small-scale unit or a large-scale unit, and are capable of turning out balanced feeds not only for cattle and poultry, but for other useful animals in the form of homogeneous

mix with or without molasses or in pellets of different sizes as may be convenient for feeding. It is necessary to emphasise that pelleting feed mixture have the following important advantages :

a) Impossibility of admixing other materials by unscrupulous dealers, i.e. adulteration;

b) Simplification of handling practices;

c) Reduction of dust;

d) Prevention of waste;

e) Homogenisation of feeds;

f) Reduction of volume, and, therefore, reduction of storage capacity needed;

g) Cleanliness in feeding; and

h) Psychological effect on farmers because pellets reflect advanced manufacturing techniques.

Recommended Feed Formulae by ISI for milch cattle and working bullocks

For Oil Mills (which can use their by-product oil cakes), Bulls etc., in the preparation of cattle feed :

i		ii	
Mustard and rape oilcake ..	25	Mustard and rape oilcake ..	40
Cottonseed oilcake ..	25	Barley	40
Wheat bran	20	Wheat bran	20
Barley	30		
	100		100

iii		iv	
Cottonseed oilcake (decorticated) ..	20	Gram chuni	35
Groundnut oilcake	15	Guar	15
Gram husk	15	Rice bran	15
Gram chuni	35	Cottonseed oilcake	35
Wheat bran	15		
	100		100

v		vi	
Linseed oilcake	35	Gram	35
Gram chuni	40	Maize	40
Wheat bran	25	Groundnut oilcake	20
		Gram husk	5
	100		100

vii

Coconut oilcake	20
Tapioca flour	30
Groundnut oilcake	15
Gram chuni	35
	100

ix

Coconut oilcake	20
Groundnut oilcake	15
Gram chuni	20
Tapioca flour	20
Mangoseed kernel (dried)	15
Wheat bran	10
	100

xi

Wheat bran	50
Mustard and rape oilcake	30
Gram chuni	20
	100

xiii

Groundnut oilcake	10
Cottonseed oilcake	20
Rice bran	10
Maize	30
Gram	30
	100

xv

Cottonseed oilcake	25
Wheat bran	20
Maize	55
	100

xvii

Sesamum (til) oilcake	25
Gram chuni	20
Jowar	25
Mangoseed kernel (dried)	20
Rice bran	10
	100

xix

Groundnut oilcake	20
Wheat bran	30
Maize	40
Gram	10
	100

viii

Tapioca flour	25
Horse gram	25
Groundnut oilcake	25
Wheat bran	25
	100

x

Linseed oilcake	25
Groundnut oilcake	10
Tur chuni	20
Oats	20
Mangoseed kernel (dried)	15
Wheat bran	10
	100

xii

Mustard and rape oilcake	30
Barley	50
Oats	20
	100

xiv

Groundnut oilcake	15
Gram	40
Maize	40
Gram husk	5
	100

xvi

Mustard and rape oilcake	25
Cottonseed oilcake	25
Wheat bran	20
Barley	30
	100

xviii

Groundnut oilcake	20
Wheat bran	30
Barley	30
Gram	20
	100

(See Pictures on Page 416)

TA RAMSUBHAN
SK GOEL and
BM SHARMA

Indian Agricultural Research Institute, New Delhi

Farm Resource Productivity Relating to Wheat Crop

This study relates to the productivity of land, labour, and capital resources used for the production of wheat crop in a few farms selected around Delhi. The analysis—based on the data for 1960-61 obtained from the Farm Management Survey done by the IARI for 1959-60 to 1961-62—aims at a comparison of the productivities of these resources under unirrigated, well-irrigated, and canal-irrigated conditions. The authors had in their original piece submitted to us prefaced their analysis by an Introduction, which, though not quite relevant to their main thesis, makes some important points (see Appendix 1) in respect of the general problem of low agricultural productivity.

THE IMPEDIMENTS affecting the progress of agriculture owe their origin to institutional factors. Individually and collectively they bring about a state of very low agricultural productivity. The data presented here is based on a study of the productivity of land, labour, and capital resources used for wheat production in a few farms near Delhi.

Eight villages selected at random, with eight farmers in each village, comprised the sample of 64 holdings. This, however, was reduced to a size of 60 as four farmers dropped out when field work commenced. Of these 60 farmers, one did not grow wheat crop in the year under reference, thus reducing the size of the sample to 59 farmers. For our present analysis these 59 farms have been stratified, as presented in Table I (see page 431) on the basis of the source of irrigation available. This stratification helps to reduce the inter-variation obtaining in these farms.

TABLE I

Number of Farms under Different Irrigation Situations

Strata	Number of Farms
1. Unirrigated farms	12
2. Well-irrigated farms under 5 acres	29
3. Well-irrigated farms above 5 acres	20
4. Canal-irrigated farms	6
	67

Eight farms have been counted twice in the above table as all the plots in these farms are not entirely irrigated or entirely left unirrigated. A few plots in each of these farms received irrigation, while others did not. However, as the quantities of inputs and outputs were available plotwise, the question of obtaining the relevant input-output data for each of the above strain did not pose a serious problem.

It may be seen from Table I that the farms under well irrigation have been further sub-divided (on the basis of a graphical examination) into those having five acres or less under wheat crop, and those having more than five acres under the same crop. These two sets of farms exhibit different characteristics. The yield of wheat per acre for the group having five acres or less for wheat works out to 19.7 maunds, whereas for the other group growing more than five acres of the crop it is only 14.3 maunds. The average size of holdings for these two categories are of the order of eight and 19 acres respectively, the average investment on farm buildings, machinery, implements, wells, draught animals, as apportioned to wheat production, stands at about Rs. 3,350 and Rs. 7,600 respectively. The holdings putting up to five acres of their land to wheat have two men, two women, and two bullocks per farm, and the same for holdings with more than five acres of wheat are three each. The proportion of gross earnings from wheat to the total from the crop enterprise as a whole is almost the same for these two sets of holdings, viz., 50 per cent and 52 per cent respectively. In other words, about one-half of the total earnings from all crops is attributable to wheat in both the cases. As shown later in this paper, a plausible reason for this near-equality appears to be that the labour and capital resources are not keeping up with the land requirements for farmers growing wheat on more than five acres. The division at five-acre level has incidentally also provided the additional advantage of comparison of these farms with those falling in the remaining two strata (unirrigated and canal-irrigated), as the farms belonging to them also grow five acres or less of wheat crop.

Production Functions

Four production functions have been fitted, one each to the above strata. Keeping in mind the number of input variables to be included, and the total number of farms available in each group, a Cobb-Douglas equation is fitted. Expressed in logarithms, this is

$$\log Y = b_o + b_1 \log x_1 + b_2 \log x_2 + \ldots b_6 \log x_6$$

(where y is the yield of wheat in maunds, x_1 is the area in acres under wheat, x_2 and x_4 are the human and bullock labour days respectively actually spent on irrigation operation, x_3 and x_5 are human and bullock labour days actually spent on operations other than irrigation, and x_6 is the amount in rupees of capital and material services).

The inherent disadvantage arising out of the use of cross-sectional data for our analysis poses a limitation in the interpretation of the study in that the analysis is one of inter-firm rather than intra-firm type. The function has to be understood as one reflecting the average situation of all the farms included in the

respective group, and they may not necessarily agree with the condition of any one particular farm. All the same, the fact that we have adopted a considerable degree of refinement in stratification of the entire group of farms in the region, helps to minimise, to some extent, the seriousness of the above-said limitation. On the other hand, the same factor, viz., stratification, has reduced the number of farms (i.e. observational units) in each group with the result that, despite using a function like Cobb-Douglas (which involves a very small number of constraints by way of estimated constants), the number of degrees of freedom available for statistical test of inference is not sufficiently large for the last-group consisting of canal-irrigated farms. As only six farms are available, the function fitted for this group is not amenable to further statistical treatment.

Table II gives the average level of use of the different input factors and the corresponding yield of wheat under different situations. The first figure in the different cells of the Table refers to quantities per holding, and the second to quantities per acre. The per farm average figures bring out well the differences existing in the resource position on farms under different categories. In farms with less than five acres under wheat, the per acre inputs of capital and of labour on irrigation and on other operations combined are the lowest for unirrigated, and highest for canal-irrigated, with well-irrigated ones holding intermediate position. The yield per acre also follows the same trend. However, the difference in per acre yield between well-irrigated and unirrigated farms is not appreciably high in favour of the former. In inquiring into the reasons for this, it was found that the rainfall in the region for the year under study was abnormally high in comparison to the previous year. Possibly that has favoured the unirrigated land to raise its yield to a comparable level with the irrigated one. Of course, in addition to rainfall, other factors like water-table, moisture retention power of

TABLE II

Levels of Various Quantities as Input and Output Factors Per Holding and Per Acre

Situation	Number of holdings	Land (Acres)	Human labour days on irrigation	Human labour days on other operations	Bullock labour days on irrigation	Bullock labour days on other operations	Capital (Rs.)	Yield (Mds.)
Unirrigated	12	1.6	—	56.1	—	27.3	164.7	28.8
5			—	32.0	—	15.2	91.8	18.3
Well-irrigated	29	2.6	36.9	70.3	21.8	34.9	291.6	49.6
5			14.4	26.6	8.7	13.4	111.9	19.7
Well-irrigated	20	9.2	106.7	185.8	63.9	86.8	861.0	132.3
5			10.1	19.1	6.4	8.7	86.0	14.3
Canal-irrigated	6	1.2	1.8	60.1	—	24.5	159.5	30.5
5			1.4	49.3	—	18.4	133.4	25.7

TABLE III

Multiple Correlation Coefficients and Elasticities of Production with their Standard Errors

Situation	Number of holdings	R^2	Land x_1	Human labour days on irrigation x_2	Human labour days on other operations x_3	Bullock labour days on irrigation x_4	Bullock labour days on other operations x_5	Capital x_6	Sum of the elasticities
Unirrigated <5	12	0.92	1.2108** (.2281)	—	—0.2557 (.6436)	—	0.1698 (.6959)	—0.0975 (.1920)	1.0274
Well-irrigated <5	29	0.88	0.7576* (.2771)	—0.0970 (.1406)	0.4373 (.2737)	—0.0473 (.1080)	—0.1358 (.2483)	0.3230* (.1384)	1.2378
Well-irrigated >5	20	0.76	0.6802* (.2988)	0.3128 (.3559)	1.0649 (.5267)	—0.1484 (.3503)	—0.7522 (.5558)	0.2051 (.2043)	1.3624
Canal irrigated <5	6	—	0.6830	0.5305	—0.4815	—	—0.2870	0.2850	0.7300

* Denotes significance at 5 per cent level
** Denotes significance at 1 per cent level

the soil, etc., will have exerted their influence on the outcome. For farms with more than five acres under wheat (all of which are well-irrigated) the yield is only as much as 14.3 maunds per acre. At the same time, the different input quantities available per acre are also the least in these farms. The limited resources at the disposal of these farmers do not appear to be commensurate with the land requirements, and thus adversely affect the yield.

Table III gives the estimated values of the constant b's for the different functions fitted along with their corresponding standard errors (given within brackets). The results of the test of significance as also the degree of goodness of fit of the data, as indicated by the coefficients of determination $R.^2$, are shown.

The values of R^2 show that percentage of total variation in the logarithmic value of the output associated with the log values of the different input variables included in the function are as high as 92, 88, and 76 for the first three situations respectively. For reasons explained earlier no statistical tests have been conducted for the function relating to the last group containing canal-irrigated farms. Thus, while a very large portion of the variance in total output has been explained by the variable included in the function, the unexplained part (which, in effect, is only small) can exist as a result of variations between farms, errors in reporting the original data as well as on account of differences in the management factor of the farms.

Elasticity Coefficience

As mentioned earlier, the 'b' values shown for different input factors in the body of the table are also the corresponding elasticities, which under the first

three situations are 1.2108, 0.7576, and 0.6802. Thus an addition of a unit change in acres of land for wheat will bring in relative changes in the yield of the order of 1.21, 0.76, and 0.68 respectively. These elasticities are also found to be significantly different from zero. A significant elasticity, viz. 0.3230, is obtained for capital in farms having well irrigation and growing wheat on less than five acres. Although a diminishing marginal return is, therefore, indicated for this input, it still makes a significant contribution to the total output. While we expect a significant return on capital for farms with more than five acres also, the reason for the failure in not being so may be on account of large investment on items like farm buildings, which, in comparison to expenses on seed, manures, and fertilisers, are not productive. In these farms, however, the human labour yields an increasing return, and is to the extent of 1.0649 which is found to be significant at about seven per cent probability level. The other elasticity coefficients are not statistically different from zero.

Increasing, constant, or decreasing returns to scale are said to exist according as the sum of the elasticities (shown in the last column of the table) is greater than, equal to, or less than one. Based on this criterion the first and third group of farms are functioning at the level of constant scale returns with land for the first and land and labour for the third as the contributing factors of inputs, while the second set of farms is operating on a scale of increasing returns with land and capital both as important inputs.

Table IV gives the average and marginal productivities for the different input items used in the four groups of farms. These have been obtained at the geometric mean level. The average productivity of an input is the mean yield realised per unit application of that input. The marginal productivity, on the other hand, measures the amount by which the output is expected to increase on an additional unit of the input being made available. It is important to note that excepting the case where only one input variable is included in the production function, the marginal product value for a particular resource will depend on the values assumed for other resources. The marginal productivity quantities, in the following table, given under each resource for the four irrigation conditions, indicate the yield returns which are predicted from the corresponding production functions for an "average" farm in each group, if one more unit of that resource is added.

Returns from Land

The table shows that the marginal returns from land for all the groups of farms, and from labour for well-irrigated farms having more than five acres of wheat, are substantial as the corresponding elasticities also show. The same from capital for farms with less than five acres and having well irrigation is also large in comparison to other groups. Even for canal-irrigated farms, land, human labour on irrigation and capital, all to some extent, appear to contribute considerably towards output. All these inputs (except land under unirrigated conditions) have their marginal productivities less than the corresponding average productivities, thus indicating that, on average, rationality of production with respect to these inputs exists.

The table also shows that the negative marginal productivities for human labour occur in those farms where family labour is generally in plentiful supply. In the case of well-irrigated farms, with more than five acres of land under wheat, the family labour is supplemented by hired labour, and the marginal value returns to labour on those farms is many times more than the prevailing

TABLE IV

Average and Marginal Productivities of Different Inputs for Farms under Different Categories

Situations	Land	Human labour days on irrigation	Human labour days on other operations	Bullock labour days on irrigation	Bullock labour days on other operations	Capital
	x_1	x_2	x_3	x_4	x_5	x_6
Unirrigated	18.20	—	0.52	—	1.08	0.17
<5	21.67	—	—0.13	—	0.18	—0.02
Well-irrigated	19.67	1.09	0.73	1.64	1.42	0.16
<5	14.38	—0.13	0.31	—0.11	—0.19	0.05
Well-irrigated	14.30	1.09	0.72	1.87	1.53	0.15
>5	9.73	0.38	0.75	—0.30	—1.15	—0.03
Canal irrigated	25.66	16.14	0.52	—	1.25	0.17
<5	17.42	9.26	—0.25	—	—0.36	0.06

NB: Figures in the first line represent the average productivities and those in the second line, the marginal productivities.

wages. The use of bullock labour has resulted in giving negative marginal productivity throughout, thus showing the excessive use of this input in almost all the farms. Finally, we see from this table that, in the case of unirrigated farms, the marginal productivity for land is more than the corresponding average productivity, and those of other inputs of labour and capital are negative. The average farms in this group thus seem to be operating on irrational phases of production. The above resources are perhaps being handled inefficiently. There appears to be a considerable scope for reallocation of these resources, so that, with their current use-level, higher yields are obtained or same yields as realised now are possible by using these inputs at lower levels than at present. Unlike this set of farms, however, the irrigated ones operate in that phase of production where economic rationality is possible; but simple calculations show that they are quite a distance away from optimality.

Some of these findings, though important, lack enough statistical support, and should, therefore, be considered as tentative, and of an indicative nature. Again, locational characteristics of the region under study is an important determinant influencing these results. More studies, with larger sample sizes spread over representative regions, are therefore needed to help in the formulation of any policy-level action.

APPENDIX I

In the present context of the Indian economy where one of the two main limbs, viz., agriculture (the other being industry), is diseased, it is imperative to diagnose the root cause of the malady. Many of the impediments arresting the progress of

agriculture owe their origin to 'institutional' factors. Individually and collectively they bring about a state of very low agricultural productivity. Poor productivity prevails with respect to all the input categories: land, labour, and capital, not excluding management. In the present state of affairs, the first three input factors are almost beyond the control of the individual small farmer. He faces helplessly the scarcity of land or capital, or both, or sometimes a plentiful supply of labour without the means to alter the situation to his advantage. Exogenous forces really shape or determine these levels at the same time they react endogenously as it were affecting production and productivity on the land. So far as skill or management is concerned, it is only a matter of chance that a farmer is, more or less, efficient than his counterpart in the neighbouring field. Tradition-bound as he is, there is no planned attempt, either individually or collectively, to attain to higher levels of skills or management on the land.

Problems similar to the above do exist in the industrial sector. Unlike agriculture, however, questions of inadequacy regarding skilled labour and efficient management personnel are sought to be tackled in industry through training programmes organised at various levels. Growth of any enterprise, either in agricultural or industrial sector, depends on the extent of success achieved in handling the various input categories. But agriculture, unlike industry, presents additional dimensions to the above problems in the form of risk and uncertainty arising primarily out of weather and prices, as well as on account of the presence of very large variations between farms in the product outputs and factor inputs.

APPENDIX II

The study, the authors claim, uses the technique of the production function associated with Cobb-Douglas. In their original Mss, the authors had given a historical and methodological account of the production function, which reads thus:

Among different methods of carrying out productivity analysis in agricultural research, that employing the production function is the most recent in India. In this article, the authors have used this method to obtain productivity values for farm resources utilised in growing wheat crop in some Delhi farms.

The earliest models relating to farm production were hypothesised by economists like Ricardo and Malthus; Knut Wicksell was probably the first economist to provide an algebraic form for such a model. The soil scientists took keen interest in production functions: realising the potentiality of this tool for analysis, the agricultural economists followed suit. The use of the production function for farm studies received impetus after its application by Douglas and his co-workers to industrial enterprises. By way of methodology, estimation, etc., the general economists and statisticians have helped a good deal in the studies using production functions.

The production function provides a scientific method, enabling the analyst to obtain a proper assessment of the concomitant variations in the various input factors giving rise to one or more outputs. Using the concepts of elasticity, marginal productivity, and returns to scale, among others, the farm-researcher determines the changes in output corresponding to relative changes in inputs, the rates of such changes as well as the changes in the level of production resulting from the productivity levels of different resources used.

Estimating a functional relationship between inputs & outputs (which essentially is the production function) for farm situations entails considerable difficulties. A wide degree of heterogeneity in major sources of inputs, as also the techniques of production between farms, necessitates the adoption of suitable stratification resulting in a fair degree of homogeneity with respect to the above aspects. Next, as a function cannot involve an unlimited number of variables, judicious decision in the matter of the aggregation of different input factors and the levels of aggregation has to be made before the analyst commences the work of fitting a production function. The extent of aggregation must be such that the number

of variables finally selected should be large enough to be able to measure the relative contribution of the major variables affecting production without introducing multicollinearity and few enough to render the computations of the functions readily manageable. Another difficulty that the production function analyst faces is the choice of algebraic form of the model to be finally fitted. There is no single objective criterion by which the true algebraic equation for a given farm situation can be found, if such a 'true' equation ever exists. Out of the innumerable functional forms available, the ultimate selection of one or more forms is very often guided by (i) the nature of equations used in previous investigations of similar type, in order to render useful comparisons; (ii) the logic (the physical as well as the economic) of the production process involved; (iii) the ease with which the equation can be estimated and statistically tested; and (iv) the resources available in general for computation.

Assuming that enough care has been exercised in the proper classification and aggregation of the various outputs involved, as well as in the final choice of the type of equation to be fitted, the production function analysis is a powerful and refined tool which can shed light on the productivity of different production agents involved as well as help in focusing attention on the efficient allocation of the available resources. It provides an insight into the agricultural structure operating in a given region or in a given period of time. While this method of analysis is no substitute for that of programming, for example, which essentially is a technique designed for intra-farm purposes, the former, under conditions of reasonable inter-farm homogeneity serves as a complementary aid to the latter and throws up information useful for decision-making by the individual farmer as well as for the policy-maker whose decisions would be applicable to the population of farms to which the analysis pertains.

As noted earlier, the production function analyst has a choice among a large number of production functions. In this, he is guided by certain pragmatic considerations. To the extent the actual data fits in with the empirical function, the researcher's conclusions are tenable. The Cobb-Douglas function has been finally decided for this study for the reason that, apart from the fact that earlier investigations relating to data on Indian agriculture have employed this function, it automatically ensures diminishing productivity of each resource, and makes the productivity of any one resource to be dependent on the magnitude of others without having unduly to sacrifice a considerable number of degrees of freedom. While a linear function equation does not allow diminishing returns to come into play, a quadratic equation incorporating the above properties would include linear, squared, and cross product terms for each one of the six input factors, thus requiring in all 27 constants to be estimated as against seven in the Cobb-Douglas function. This is of serious consideration in our present case. Besides the computational feasibility, or otherwise, of determining a large number of constants, every constant thus fitted entails the loss of one degree of freedom for purposes of statistical tests of significance, and in the context of having the number of farms as shown in Table I, we have chosen the Cobb-Douglas function which conforms fairly well to the physical as well as to the economic logic concerning the production process, and, at the same time, necessitating the loss of only a small number of degrees of freedom. This function has also the added advantage of providing the elasticities immediately as they are identical with the regression coefficients, viz., b'_i.

PRODUCTIVITY OF CHINESE AGRICULTURE

"In the places where the thought of President Mao is correctly applied, the rice harvest has greatly increased..." (KS Karol in NEW STATESMAN)

DN KHERDEKAR

Director
Agricultural Implements Unit
Ministry of Food & Agriculture

Standardisation of Farm Implements and Equipment

Good equipment makes a farmer better. In boosting agricultural production, standardisation is an important factor as it creates confidence about the quality of the product, and enables interchangeability of parts in the case of machinery. For various reasons, farm implements are not easily amenable to standardisation, but the author says that, even on a regional basis or type, standardisation should be adopted. He refers to the work of the Indian Standards Institution in standardising improved farm implements, and stresses that besides prescribing 'material standards', it should also give 'dimension standards'.

COMPARED with the progress of standardisation in other spheres, the standardisation of agricultural machinery and implements in India has been rather slow. While the parts of such machines as bicycles and sewing machines can be standardised without much difficulty, agricultural implements are not so easily amenable to standardisation. The reasons are obvious. Soil, climate, and crop-patterns differ from area to area. Even the size of the bullocks used to draw the plough varies. These and other factors necessitate the farm machinery to be of different sizes and designs. Only in respect of stationary machines, such as chaff-cutters, threshers, winnowers, paddy shelling machines, groundnut decorticators, etc., quick-standardisation is possible.

In respect of cultivation machinery, such as ploughs, harrows and cultivators, it is not possible to evolve a single

standard for all areas and all crops. Standardisation on regional or type basis has to be adopted. In the case of the plough, for example, it may be necessary to standardise 10 different types—one for the paddy area, one for the wheat area, one for the black cotton soil area, and so on. However, as far as possible, the number of standardised ploughs must be kept to the minimum.

The Indian Standards Institution has been helping to standardise improved agricultural implements. The ISI has published standards for 12 types of farm implements: Blade (guntaka type); Chaff-cutter blades; Forks for plantation and estates; Garden rake; Mouldboard plough (fixed and turnwrest types); Paddy weeder (rotary type); Pruning knives (hooked & curved); Ridger (animal drawn), Sugarcane crusher (bullock driven type); Transplanting spade and SEPRANG and Hedge shears (straight edge type).

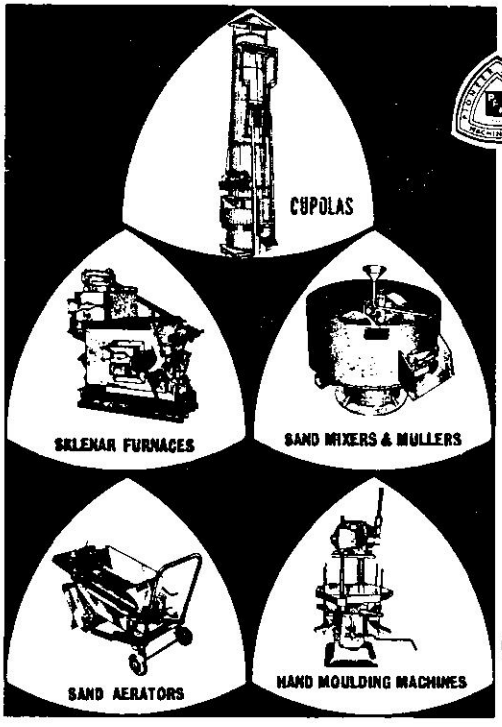
The 1963 All-India Conference on Agricultural Implements and Machinery recommended that the pace of standardisation should be speeded up. The ISI has already circulated the following standards for examination: Olpad thresher; Puddler (animal-drawn); Green manure trampler; Levelling karah; Soil scoop; **Triphali** (three-tyred cultivator); Bund former; Harrow **patela**; Wheel hoe; Sharma hand-hoe; Singh hand-hoe; Single-row cotton drill; RN Cultivator; Disc harrow (animal-drawn); Hand maize-sheller; Paddy thresher; Pruning saw; Pruning secateurs; Rubber drainage and trapping knife; Dah, Tungle cutting; Budding and grafting knife; Billhook, single and double edge; and Three-tyred cultivator with seeding attachment.

The standards prescribed by the ISI are "material standards". "Dimension standards" are not usually given. It has, however, now been proposed that along with the material standard prepared for an improved agricultural implement, a dimension standard should also be attached as an example. This will facilitate the construction of the machine without in any way restricting the different types of manufacture.

Major Difficulty

A major difficulty in the way of standardisation is the lack of high-carbon steel, alloy steel, or special steels required for either the soil-working parts or the crop-working parts, such as shares of ploughs, dises of dise harrows, cutting edges of budding and pruning knives, blades of chaff-cutter, etc. The type of steel required for manufacturing these is not available in India, and due to foreign exchange difficulties, it has not been possible to import adequate quantities. Efforts are, however, being made to manufacture high-carbon or alloy steel. It is expected that in a year or so this difficulty will be over, and then the manufacturers of agricultural implements and equipment would be in a position to procure this type of steel. They would, it is hoped, readily adopt the prescribed standards.

The next phase in preparation of standards for farm implements would be to take up certain common parts, which are required in very large numbers for standardisation. Already a beginning has been made by standardising chaff-cutter blades. Parts such as shares of light ploughs, spacers used in disc harrows, bearings for pneumatic tyre bullock carts, etc., can also be taken up for standardisation. Apart from helping the farmers to get quality equipment and spare parts readily, and at cheap prices, standardisation would also help in setting up industries in rural areas. Thus, standardisation is a very important factor in increasing agricultural production.



"PFM"—the dependable name for

FOUNDRY EQUIPMENT

• CUPOLAS • SKLENAR FURNACES • LADLES
• SAND MIXERS & MULLERS • SAND RIDDLES
• VIBRATING SCREENS • MOULDING BOXES
• HAND MOULDING MACHINES • KNOCK-OUTS
• TUMBLING BARRELS • GRINDERS, Etc.

AND

for sound castings
always insist on popular

PMC

FLUXES (under HARMARK license)
OF PROVEN PERFORMANCE
Let us advise you on all foundry problems:

PIONEER EQUIPMENT CO., PRIVATE LTD.

H.O 129, MEDOWS STREET, P.O. BOX 1909, BOMBAY-1.
3, Esplanade East, Calcutta-1. 36-B, Nizamuddin West, Ground Floor, New Delhi-13
22, Royapettah High Road, Madras-14

For Your Problem !

Representations and Liaison Work in or around Calcutta, and eastern region of India, and also State of Nepal, Sikkim and Bhutan

Please write :—

S. R. SAMADDER
162/80, Lake Gardens,
CALCUTTA-45.

Post Box No. 2767, Calcutta-1.
Phone : 46-8149, Gram : LONGSTAND

We Serve The Nation
With D. D. T.
in its fight against
DISEASE & HUNGER

HINDUSTAN INSECTICIDES LTD.

(A Government of India Undertaking)

Regd. Office :— C-255, Defence Colony,
NEW DELHI-3

Works

Industrial Area,
New Delhi

Udyogamandal P.O.
Kerala State

UNTAKEN HARVEST ! ! !

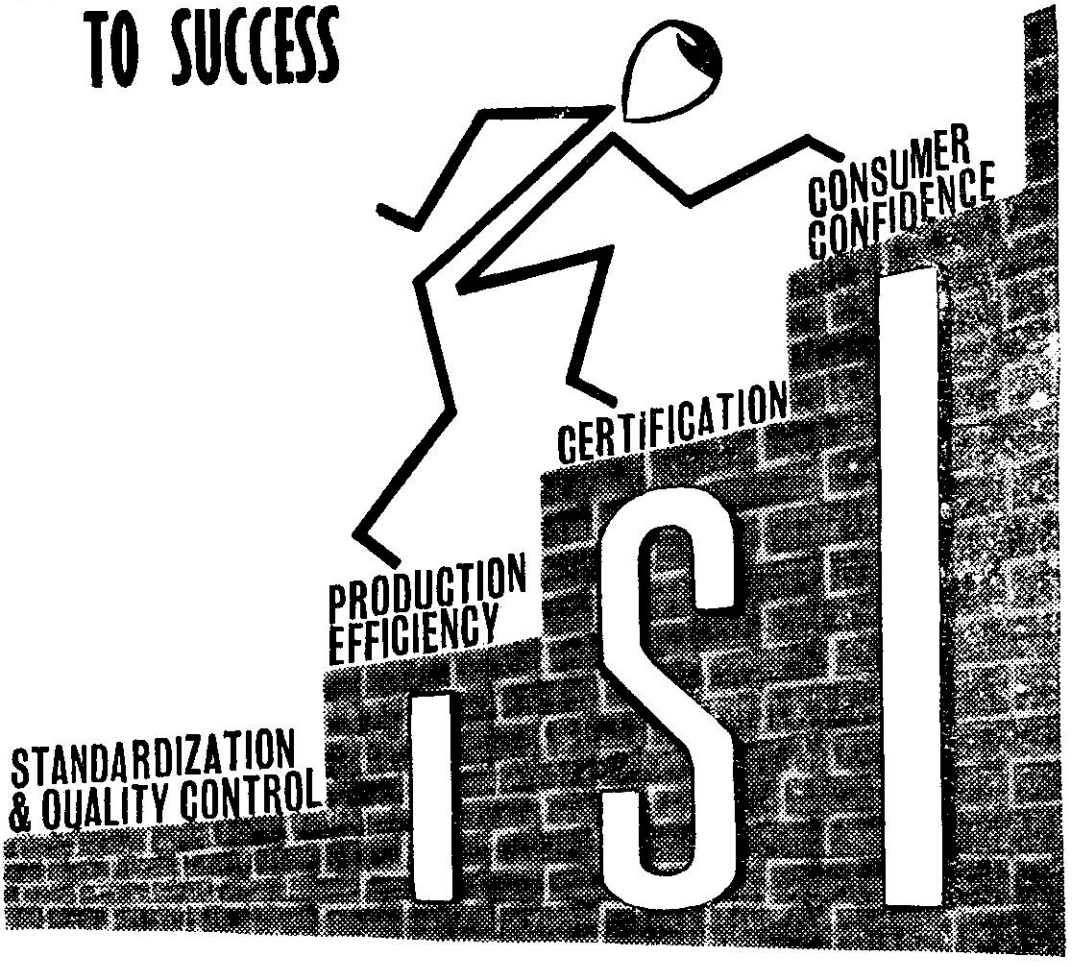
This is the story of Ramu the Farmer, who had heavily fertilized his crops and was hopeful of a bountiful harvest. However, the tall luscious crops invited calamities in insects, diseases, weeds etc., and Ramu saw crops wither before his eyes.

Ramu's neighbour Gopal came to his help and directed him to the local Agricultural Officer who advised Ramu to protect his crops with HEXAMAR Agricultural Chemicals, the symbol of "Increased Crop Production."

BHARAT PULVERISING MILLS (P) LTD.,

'Hexamar' House,
28, Sayani Road,
BOMBAY 28.

STEPPING STONES TO SUCCESS



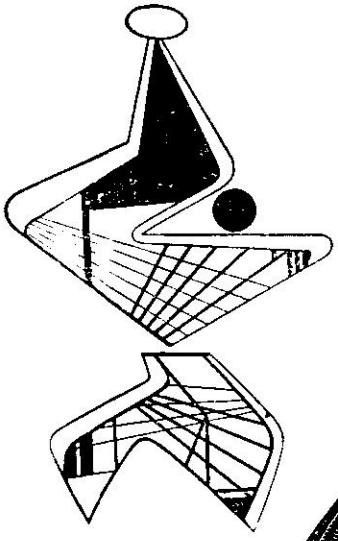
The ISI Mark of Certification has earned the trust of the consumer

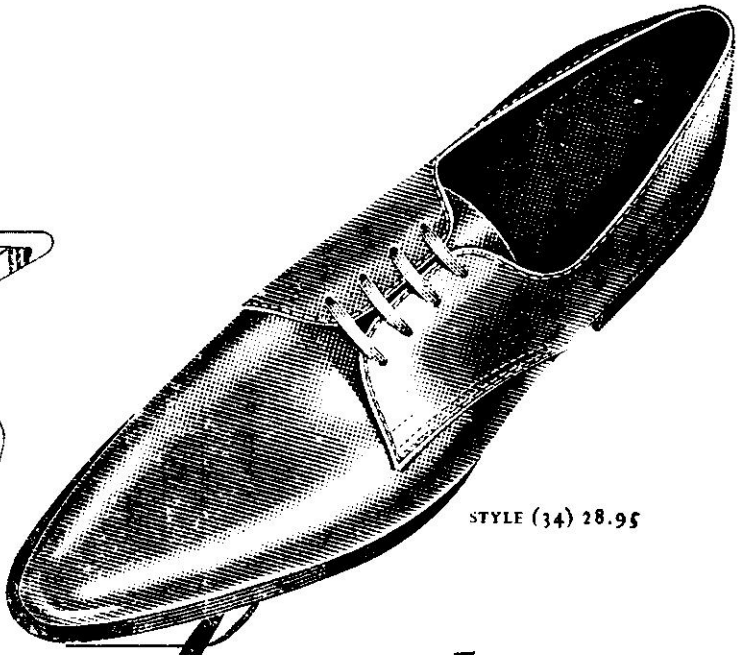
Increase the selling potential of your goods by obtaining licence for certification of their performance and quality from

ISI INDIAN STANDARDS INSTITUTION

NEW DELHI

BOMBAY CALCUTTA KANPUR MADRAS





STYLE (34) 28.95

Bata Exclusive

A bold new concept in men's shoe styling

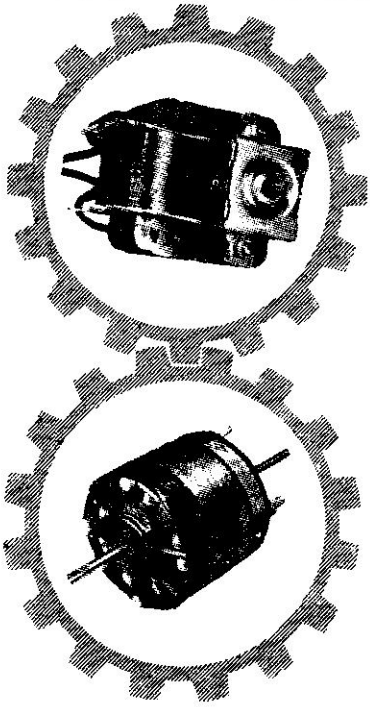
Polished, persuasive, discreet, Bata Exclusive is a bold new concept in men's shoe styling, with an appearance, a feel, a heft, a comfort—men's shoes haven't known for a long time: the result of new developments in construction. You get more shoe with less weight and bulk than ever before, with full sole wear. Men are saying wonderful things about the Bata Exclusive. Bata say wonderful things about you.

STYLE (36) 28.95



F. H. P. MOTORS

1/200 H. P. TO 1/3 H. P.



** free-aligning universal bearings*
** thermal overload protection*
** precision produced*
** engineered to customer's specification*

AMERICAN UNIVERSAL ELECTRIC (INDIA) LTD.

40-F CONNAUGHT PLACE,
NEW DELHI-1
(IN COLLABORATION WITH
UNIVERSAL ELECTRIC CO. U. S. A.)

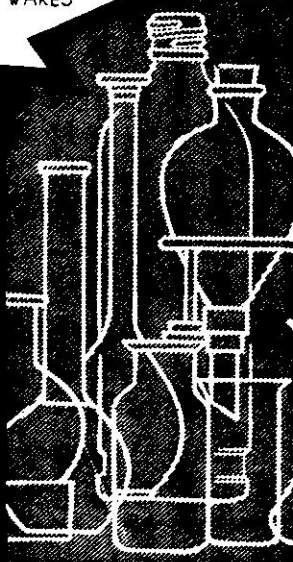
GRAM : 'GOODMOTORS' TELE : 45066

MANUFACTURERS
HEAT RESISTANT AND
SCIENTIFIC
GLASS WARES

BLOOD TRANSFUSION AND
GLUCOSE SALINE BOTTLE
SPECIALITY AND
CAN TAKE UP THE
FABRICATION OF ANY
TYPE OF WHITE BOTTLES

BOMBAY OFFICE
Co-operative Insurance Bldg.
2nd Floor, Sir P. Mehta Road.
Bombay 1

Phone : 251791
Gram : NUTRALGLAS



LAB THERMOLAB GLASS PRODUCT
PVT. LTD. POON

Works
Bombay Poona Road, AKUDI Phone : 88/31
CHINCHWAD, Poona 19 Phone : 88/31

DID THE ADMINISTRATIVE STAFF COLLEGE TURN YOU DOWN ?

There were nearly 10 applicants for each seat for the course on Materials-Management conducted at Hyderabad by Mr A.R. Palit, our Editor-in-Chief. After all, even Professor Andrew Towl of Harvard's Graduate School of Business Administration has called him "one of the bright spots in Indian Management development."

Mr Palit conducts less-publicized courses for this journal. We'll tell you when, and where, if you wish.

Ad interim, try reading the journal. You can pick up useful tips on cost-reduction. Twelve copies a year for Rs. 32.

Excerpts from the 1963 and 1964 issues are available in book form for Rs. 14.50.

Business Manager

Materials-Management Journal of India

D-409 Defence Colony,

NEW DELHI-3

PUBLICATIONS OF
THE INDIAN INSTITUTE OF PUBLIC ADMINISTRATION

	Rs. P.
The Communal System of Yugoslavia by B. Mukerji	.. 1.75
Administration of Traffic Enforcement with Special Reference to Delhi by T. S. Khanna	.. 1.50
Training for Social Welfare Work: Courses and Institutions	.. 1.50
Staff Councils and Associations in the U.K. and India	.. 1.50
The Development and Impact of British Administration in India—A Bibliographic Essay by Bernard S. Cohn	... 3.00
The Press, The Public, and The Administration by V. K. Narasimhan	.. 3.00
The Industrial Management Pool: An Administrative Experiment by H. K. Paranjape	.. 4.00
Claims Determination and Hearing Procedure Under the Employees' State Insurance Act by Ralph F. Fuchs & V. Jagannadham	.. 2.00
The Damodar Valley Corporation: A Brief Study	.. 2.00
The Flight of Technical Personnel in Public Undertakings: A Study Report by H. K. Paranjape	.. 10.00
The Planning Commission: A Descriptive Account by H. K. Paranjape	.. 5.00
Jawaharlal Nehru and the Planning Commission by H. K. Paranjape	.. 0.50
Good Government: The Administrative Malaise and Connected Issues by S. G. Barve	.. 1.00
Revenue Inspections at the District Level by A. Avasthi	... 7.50
The Caste in Changing India by A. P. Barnabas & Subash C. Mehta	.. 4.00
Reports of Seminars, Conferences & Short-Term Courses	
The Study of Public Administration at Indian Universities	.. 1.25
The Pattern of Rural Government	.. 2.00
Improving City Government	.. 3.50
Morale in the Public Services	2.50
Revenue Boards & Divisional Commissioners	.. 3.00
A Bibliography on Public Administration in India: The Central and State Governments	.. 1.00
Changing Role of the District Officer	.. 7.00
Reports of Study Groups	
Delhi Municipal Bus Transport	.. 1.50
Case Studies	
Cases in Indian Administration (five cases)	.. 7.50
The Abolition of the Labour Appellate Tribunal by B. S. Narula	.. 10.00

(Postage extra)

Available from:

The Administrative Officer,

Indian Institute of Public Administration,

Indraprastha Estate,
Ring Road,
New Delhi-1.

With Best Compliments From :

THE DHARAMSI MORARJI CHEMICAL CO., LTD.

Registered Office :

317-21, Prospect Chambers,
Dr. Dadabhoy Naoroji Road,
Fort, Bombay

Phones : {**Office : 25558 1/2**
Godown : 76496

Grams : "DHARMAJAYA" Bombay.

FACTORIES :

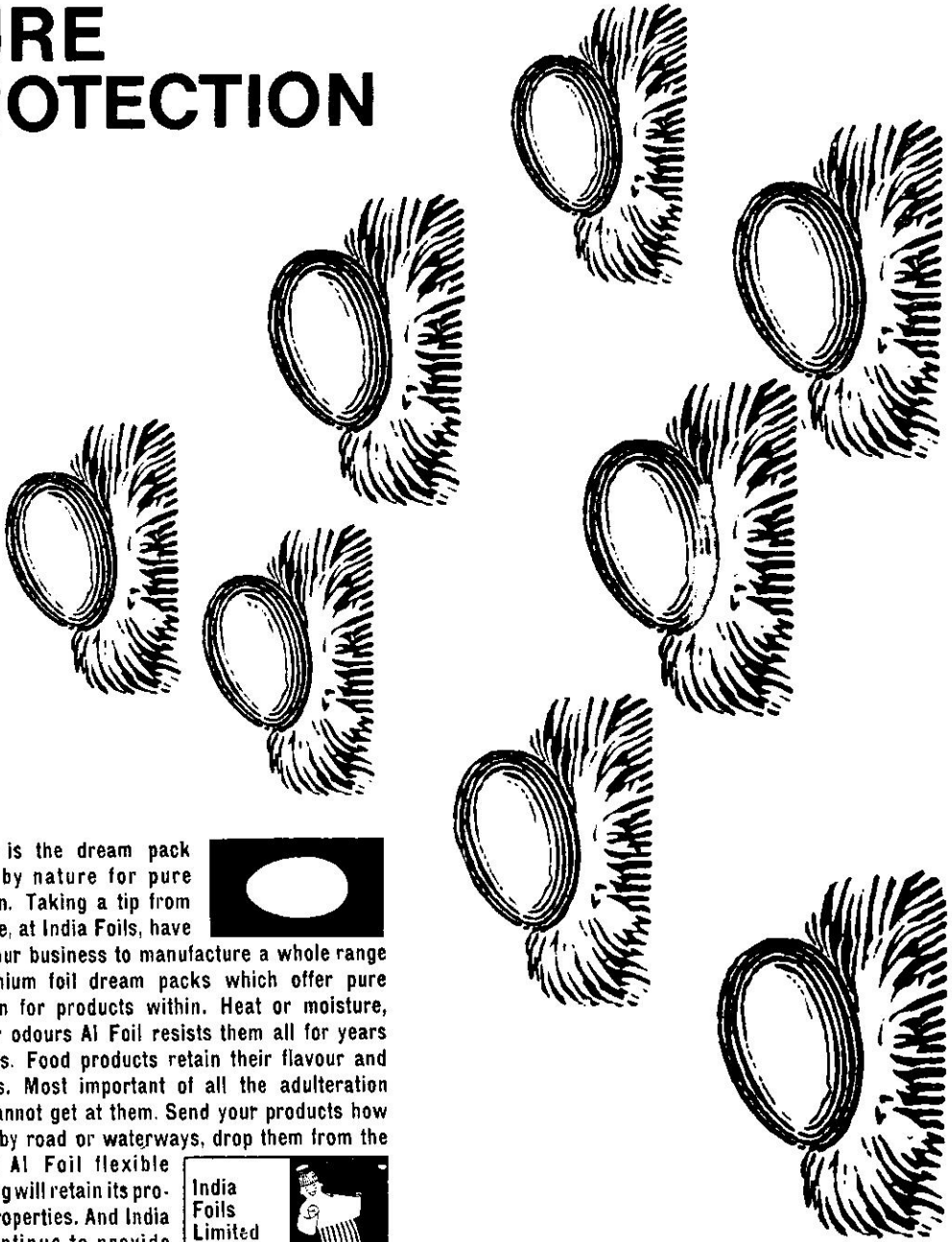
AMBERNATH
(near Kalyan) C. Rly.,
Maharashtra State
Gram : "CHEMICAL"

KUMHARI
(near Raipur) M.P. State.

Gram : "AVANTIKA"

SERVING INDUSTRY AND AGRICULTURE

PURE PROTECTION



The egg is the dream pack devised by nature for pure protection. Taking a tip from nature we, at India Foils, have made it our business to manufacture a whole range of aluminium foil dream packs which offer pure protection for products within. Heat or moisture, germs or odours Al Foil resists them all for years and years. Food products retain their flavour and freshness. Most important of all the adulteration expert cannot get at them. Send your products how you like by road or waterways, drop them from the air and Al Foil flexible packaging will retain its protective properties. And India Foils continue to provide pure protection to a wide range of products, which we need almost every day.

India Foils Limited
(Incorporated in Great Britain)

Branch : Bombay Mutual Buildings, Parliament Street, New Delhi.

IFOC-68

BKS JAIN

Mechanisation Can Lead to Swift Change

In analysing the role of various factors contributing to increase in farm production, the author explains the position of the peasant farmer, the middle class farmer, and the big farmer, who, though small in number (4 per cent), has one-third of our cultivated area. It is this farmer, with resources to carry out farming with modern techniques, who should be encouraged to make a swift change to 'power' farming. It is pointed out that at present our farm productivity is just 0.62 tons of food grains per worker. If properly harnessed, farm mechanisation can significantly step up our farm productivity. We should study the experiences of other countries in the field of mechanisation, and find out the ways most suited to our conditions. The responsibilities of the management and dealer are indicated, and the author makes a vigorous plea for a National Institute of Agricultural Engineering.

A COMPARATIVE STUDY of the role of various factors contributing to the aggregate increase in farm production over a period of three decades in the USA revealed that one-third was due to use of chemicals, one-third due to better varieties and healthier seeds, while another one-third was due to improved farm machinery. This can just as well apply to our conditions. Our farm machinery, however, has not received the "one-third" importance due to it. Let us review the situation.

Intimately concerned with farm machinery are four agencies—the farmer, the Government, the dealer, and the manufacturer.

Our farmer-users can be broadly divided into three categories. In the absence of a better criterion, we choose the holding size. The dividing line is

not a fixed boundary of mathematical numbers (in this case, of acres), but is for guidance only.

TABLE I

Category	Holding size	% of farm households (total approx. 65 million)	% of area cultivated (total approx. 350 million acres)
I	0— 5	71	17
II	5—26	25	50
III	Over 25	4	33
		100	100

In numbers, peasant farmers are the largest (71 per cent), but they cultivate only 17 per cent of our land. Their problems are unique. They have small plots of land which again may not be in one piece. They have practically no resources. They are now greatly dependent on the State. They have to be given the basic education and technical guidance. They must have good seeds, fertilisers and manures, water for irrigation, and good equipment to raise their crops.

Countless Models

Draft animals (we have about 66 million) continue to be their only source of power. The local plough will, of course, have to give way to steel mouldboards, and the wooden wheels of the cart to pneumatic tyres. The farmer does need cheaper implements, but what is more important, they should be good ones—not the ones made from scrap. When we in India can make a good bicycle, can't we give our farmer good tools? Must his tools be outdated, without the advantages of modern technology? Must they be clumsy and difficult to use, just because they have to be cheap?

Further, the farmer should not be confused with a multiplicity of implements. There are at the moment countless designs, makes and models of steel mouldboard ploughs for cultivators. It is true that there must be some variety: we can't have one, we may have three or six. Must we have 60? There is a notion that each State needs a different implement—not only this, but every region in the State calls for a new tool. An implement does not have to change with the language of the region. We should be able to choose a few which will meet the needs of large parts of the country. Minor adaptations may be necessary for exceptional local specifications. For example, the same plough can take different sizes and shapes of shares. This will simplify production, and ensure to the farmer a better product at good prices . The product can be mass manufactured and can be continuously improved upon. While standardisation of a complete implement is not desirable, there should be standardisation of components—such as shares, bolts, and nuts.

If we pursue these policies, we may be able to provide simple tools to the small farmer to enable him to do a better job faster. Because of the limitations of this group of farmers, one should not, however, expect a significant contribution towards greater farm productivity. The holding is too low an economic unit. Gradually, but surely, they should be encouraged to take to other vocations. Neither the holding can give them fair wages, nor can they get the best from the holding.

Twenty-five per cent of rural families in group of middle class farmers

plough half of our land. They certainly have a big potential for development. They can form cooperative societies, but they should take 'cooperation' voluntarily. They should treat farming as a business. They should be trained in efficient farm management. Management is a big movement today in the industry. Why shouldn't this be in agriculture?

The middle class farmer should also receive prompt financial aid, since finance may be one of his limitations. But availability of loan should be discreet. He should receive loan if he has the capacity to repay. Farmers shouldn't be on 'doles.' Sometimes loans may give rise to artificial and temporary trends in demand. If there is a loan facility for an implement it may sell in large numbers. If loan is discontinued, demand will drop suddenly. This is neither good for the industry nor for the user. In fact, loans and subsidies have made the farm machinery industry, to some extent, a State controlled one.

The farmer's source of power will gradually shift in favour of mechanical prime-movers. Bullock prices are rising. We can ill-afford the valuable land to produce fodder for animals instead of food grains for human beings. On the other hand, enthusiasts of elephant farming must work within limits. Caution has to be exercised while advocating the role of power tillers. They have a place in our economy. But they should meet our dual agricultural requirements —of tillage and haulage.

Small farms in this group may need universal frames with an efficient range of tools. Work on such tool carriers is in progress abroad too, for tropical conditions, in particular at the National Institute of Agricultural Engineering in the UK and the Centre National d'Etudes et d'Experimentation de Machinisome Agricole (CNEEMA) in cooperation with Bureau de Liaison du Genie Rural et de la Technologie Institut de Recherches Agronomiques Tropicals in France. A start was made in our country, but lot of work yet remains to be done. Other farms in this group will need power tillers and power-driven tool carriers, while others—somewhat bigger ones—small tractors. The purchasing power of the farmer will have to improve so that he can invest in better prices for his produce. These farmers require bigger and better implements, and not necessarily the cheapest.

It is unfortunate that a sort of prejudice has developed against the big farmer. He may be small in number (4 per cent), but has one-third of our cultivated area. He has the resources to invest in tubewells, tractors, etc., to carry out farming with modern techniques. What he lacks is encouragement and recognition of a place in the production of food for the nation. He has played an important role in increasing farm productivity. Today he is in an uncertain state of mind. Ceiling on his holdings looms large on him. He is withdrawing his rural investments for urban utilisation. This is a dangerous phenomenon. He can't get the equipment or the chemicals he needs. He feels he is harassed, instead of being assisted, in the task of great national magnitude. Taxation on agricultural income is arbitrary,* while income is dependent on the vagaries of the monsoons. Future Government policy will determine whether he will change his attitude to farming.

This farmer has to be encouraged to make a swift change to power farming. Tractor population has been steadily

* How so?—**Editor**

TABLE II

Tractor Population on Indian Farms

Year	Number
1945	4,524
1951	8,554
1956	20,980
1961	34,483
1963	Over 40,000

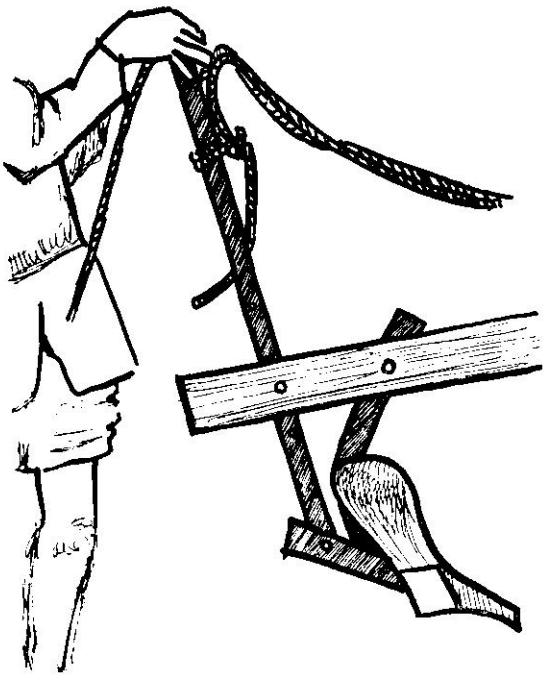
rising, but now it will have to be a steep-rising curve. The Perspective Planning Division (Planning Commission) estimate demand for tractors at 25,000 a year towards the end of the Fourth Plan (1970-71). It is not necessary to design special implements for him. What we have to do is to adapt proven implements to our conditions. A vast amount of data is available on farm mechanisation from countries such as Germany, UK, USA, and USSR. These countries took to power farming during the last three decades or so. While studying their experience and methods we will have to find out for ourselves, ways most suited to our own conditions.

The Government has three important roles to play—first as an administrator (and a policy maker), second as an extension agency, and third as a research organisation. Its policies will have to be farmer-oriented. Problems of farmers in different categories required different approaches. The farmer should be encouraged to look to farming as a worthwhile profession. Care has to be exercised so that imposition of ceilings does not adversely affect food production. The farmer should develop a faith in Government Extension Agency. He should be able to look at officials as friends and well-wishers. Present set-ups dealing with farmers are too many, unwieldy, and expensive. Can all the departments dealing with agriculture be combined and their effort co-ordinated? Today we have at least eight (in practice many more) departments of food, agriculture, animal husbandry, forests, community development, panchayat raj, irrigation, farming cooperatives, etc., concerned with farm activity.

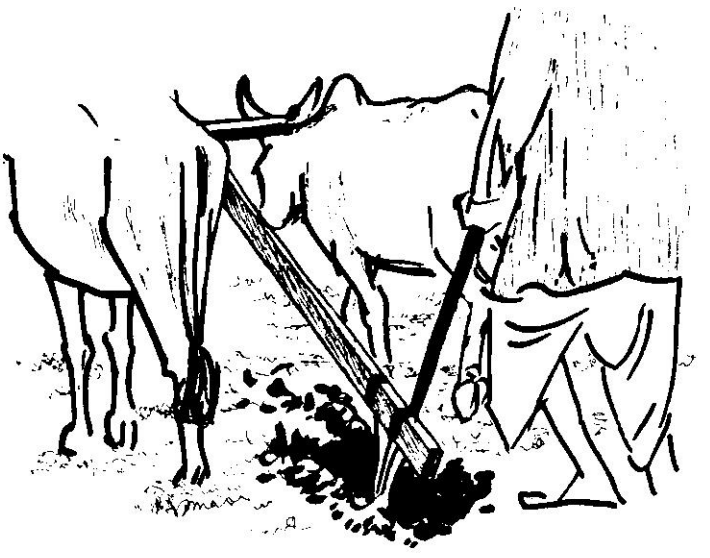
Research Work

In farm machinery, greater help for research work has to come from the Government. Industry has not been able to afford such a necessity. Efforts should be made to make the best of money allotted. We should avoid duplication. Our men and material are limited, so is our time. We are short of agricultural engineers. Let them be properly utilised. Research schemes need proper co-ordination and control. We have too many bodies with advisory roles. We need a strong executive body with adequate powers and responsibilities to deliver the goods. Allotment of more funds, and opening of more research stations do not necessarily advance research. In research, it is not quantity but quality which produces results. I am in favour of a National Institute of Agricultural Engineering, and a high-powered Directorate of Agricultural Engineering. Agricultural Engineering as a career does not attract many because prospects do not favourably compare with other engineering vocations such as mechanical, electrical, and civil.

Dealership networks to cater for rural engineering requirements are required. At present, the weak points of the dealers are finance and after-sales-service. In the main, a dealer is anxious to make quick money. He is willing to supply equipment, but not very anxious to keep machines or spares in stock. Today, many dealers act as post offices. They collect the order from a farmer, and relay it to their Principals for



LEFT and BOTTOM: A simple type of improvised plough developed with TCM (now US-AID) assistance, to aid India's campaign to grow more food



execution. What they are keen to collect is the discount.

To build efficient dealerships throughout the country, certain factors must be taken into consideration. To render proper service, a dealer will have to maintain an adequate sales and service staff, and stocks of spare parts. Records must be kept in order, and business run on scientific lines. To meet these obligations, the dealer has to undertake many risks, and should be able to recover satisfactory returns for his services. He has to incur expenses to maintain up-to-date service outfit, and to ensure the parts he stocks do not become obsolete. It is a gamble to deal in parts.

Another problem the dealer faces is finance. In dealing with Government/semi-Government bodies, the dealer's bills get delayed by several months. He starts business with a limited capital. Therefore, unless his bills are promptly paid he will be unable to render the services required. He is unable to secure advances or loans from a bank easily and promptly.

The dealers have an important role to play in the success of rapid mechanisation of our farms. Their role is vital in keeping the machinery going, so that the farmer is assured of round-the-clock operation of his equipment during the peak of the season. The best utilisation of machines will reduce the farmer's cost of operation.

Demand for Tools

The demand for farm implements has been small. There is no single farm implement today that is mass produced (except perhaps for the spade). In the absence of the industry lending itself to mass manufacturing techniques, it has not attracted large-scale entrepreneurs. Returns on the industry have been comparatively poor. Small-scale industries can play an effective role in farm equipment industry if properly harnessed. Today there is a haphazard growth in this industry.

Manufacturer's problems can be summarised as uneconomical production, difficulty in availability of raw materials, lack of skilled workers and trained artisans, lack of reliable data on demand and trends, and unstable official policies. Range of equipment is very wide. For items where demand is very small, such as for combines, it will be advisable to continue imports. Imports should also be allowed for attachments and spare parts of farm machinery already in use to ensure their maximum utilisation. Import licences for parts should be given to accredited distributors and licensed manufacturers for economy and promptness, instead of toying with the idea of grant of actual user licence to an individual farmer. The necessity of an efficient and prompt after-sales-service, including supply of parts, has not been given the attention due to it. Parts availability has to be treated like supplies to a front line in case of war.

To increase food output, power input on our farms has to be considerably stepped up. Present installed horsepower on the land is estimated at only 0.24 per cultivated hectare. This has to be multiplied at least five times to meet basic needs—more for intensive farming.

We produce over 80 million tons of food grains from over 110 million hectares with over 130 million agricultural workers. With a large work force—1.2 worker per hectare—our farm productivity is only 0.62 ton of food grains per worker. Farm mechanisation, if properly harnessed, can significantly step up our farm productivity. Good equipment makes a good farmer better. "Yield is proportionate to tillage (the reference is to equipment) as happiness to wisdom," says a Telugu proverb.

Development of Farm Machinery in USA

Mechanisation has benefited farming in the USA, USSR, UK, and Germany. Its universality in the north-central and north-eastern States, is a striking feature of US farming. There has been widespread cooperation in the use of machinery from the early 'thirties. The advent of electricity to farms has greatly assisted in the elimination of strain. This article, based on the observations of a five-member British team which visited USA in 1950, is taken from its report, "Productivity in Farming." It describes the salient features of the development of farm machinery in the USA, and comments briefly on recent trends. It is the team's view that farmers should devote as much attention to increasing the productivity of labour and the fullest employment of machines engaged in the industry as they formerly did to increasing the productivity of land. The higher rate of labour productivity and machine utilisation in agriculture will contribute not only to national well-being, but also to the economic welfare of those who live by the land.

THE INTENSIVE mechanisation of American farming is said to date from the middle 'thirties. Although, therefore, the process of change from a comparatively unmechanised state started some four or five years earlier than in this country, it is, nevertheless, a comparatively recent development. In these circumstances, it is all the more surprising to find with what degree of uniformity and balance that mechanisation has grown. Indeed, the universality of farm mechanisation is one of the more striking features of farming in north-central and north-eastern States of the USA that the UK Farming Productivity Team visited.

The reasons for this are numerous, and some of them have been outlined in the team's report, **Productivity in Farming.** Some are connected with the uniformity of farming systems and their comparative simplicity, others with the

attitude of mind of the US farmer, no doubt engendered by his general environment, in which machinery and labour-saving devices of all kinds occupy an extremely prominent place. He has accepted the advent of the machine, and shown a very acute understanding of the benefits to be derived from properly planned mechanisation. He recognises, too, that planning in this context means not only the substitution of mechanical power for human or animal power, but also a reorganisation of the farm business in order to make the farm fit the available machines. We consider that it has been more widely realised than in this country that the farm as well as the machine is capable of modification, and that mutual adaptation is in fact necessary for the achievement of optimum results.

In both countries the first phase of mechanisation appears to have been characterised by a substitution of mechanical power for animal power unaccompanied by any fundamental changes in the methods and practices of farming. Whereas British farm mechanisation is still largely in this first phase, in the areas of the United States that we visited we judge this phase to be complete, and a second phase to be well advanced. It is characterised by the development of new equipment involving new principles and considerable changes and departures from old methods and farm practices.

It is in this light that we view the recent great increase in the use of the baler, or the limited but increasing interest in the field chopper in the hayfield, the developing popularity of yard-and-parlour milking systems, and the development of self-feeding methods in the care of livestock. This process of further mechanisation is creating new, or intensifying old, problems. Specialised machinery is frequently expensive and elaborate, and for efficient operation requires crews which are beyond the resources of individual farms. In these circumstances the scope of operations has to be widened, and we have in this context already remarked on the widespread cooperation in the use of machinery in the USA and the tendency towards the amalgamation of farms in larger units. In other instances, the development of new techniques and equipment has released labour for other farm uses. In the United States, the development of alternative farm enterprises or the intensification of existing enterprises is facilitated by a comparatively plentiful supply of feeding-stuffs and other raw materials. In this country the opportunities are less, and we consider that, in future, research in this direction should be at least as vigorous as research in the development of new machines.

The American farmer takes no pride, and sees no virtue, in heavy physical toil. In fact he very generally realises that physical strain is one of the prime enemies of high labour productivity, and he welcomes any developments which help towards making the last hour of his daily work as effective as the first. We should do well to recognise these facts ourselves. The elimination of strain has been greatly assisted in the USA by the advent of electricity to farms. There is a remarkable development in the use of small electric hoists in and around farm buildings, and in the use of elevators, with mounted electric motors, for grain, bales, and bags. Equipment of this kind can, of course, be powered by petrol or paraffin engines, but the loss in convenience as compared with electricity is considerable.

In this country it is estimated that not more than 40 per cent of farms have electricity. In the USA as a whole, more than 85 per cent of farms have mains electricity; in the highly developed

agricultural States of the north and east, the percentage of farms with electricity is over 90. These figures are even more striking in view of the fact that in 1935 only about 10 per cent of farms had electricity. This extremely rapid development is largely the achievement of a Federal agency—the Rural Electrification Administration, set up in 1935, made loans available to farmers' cooperatives, municipalities or private companies to finance the construction and operation of power plants and lines designed to provide electricity for rural users. It also provides loans for the wiring of establishments, and the purchase of appliances by those receiving the service. Loans are repaid with interest over an extended period, and preference is given to non-profit-making borrowers. The success of the scheme is obvious. Electrification is revolutionising the work in and around farm buildings, increasing immensely the amenities of rural domestic life. American methods of bringing electricity rapidly and efficiently to the countryside are described in another Productivity Report, **Electricity Supply**, and might well repay further investigation.

Two conditions are predominant in the field of agricultural machinery manufacture. First, the bulk of farm machinery manufacture is concentrated in the hands of comparatively few manufacturers, but is nevertheless highly competitive. Secondly, the uniformity of farming over wide areas of the USA is such that the market for almost any line of farm machinery is huge. Both have operated to the advantage of farmers.

Large firms producing for large markets are able to devote considerable funds to basic research and development



of machinery. They are able to employ advanced and expensive research techniques both in the laboratory and in the field.

These large firms keep in touch with the farmer through a well-organised market intelligence service which is invariably founded on the intimate relationship which exists between the local dealer and the farmer. Generally, the dealer is called upon to make regular and systematic reports to area supervisors, and thence to the firm's headquarters. Written and formal reports are supplemented, from time to time, by regional conferences and discussions. In this way, farmers' wants and ideas are transmitted rapidly to those responsible for development and production. The need for such rapid transmission of information is emphasised by the frequently-repeated statement that the majority of new ideas in farm mechanisation in recent years have originated at the farmers' end, and not the manufacturing end of the chain. Indeed, the manufacturers appear to have been concerned, to a lesser extent, with invention and initiation than with secondary development and adaptation of new inventions to mass production.

All the land grant colleges we visited had large and well-equipped agricultural engineering departments. In general, however, the emphasis in these departments is laid upon instruction in the use and care of the existing types of commercially-produced machinery. In some instances we saw some work being done on the adaptation and modification of machines, but general basic research into the design and development of new types appeared to be in the hands of commercial interests.

Tractors in use on small and medium sized American farms tend to be larger on average than tractors on similar farms in this country. It is true, however, that nearly all the main tractor manufacturers in the USA are paying some attention at the present time to the development of baby tractors.

Why can't we do it?

"Recent experiments in milk production in Britain", says the TIMES OF INDIA, in an editorial, "provide a contrast to the listless practices in this country".

The editorial adds: "There is a full-fledged grass research station in Wales, where practical lessons about quick-growing grasses are daily learnt and applied to food production programmes. Having studied the grazing habits of milch cattle, farm technologists have adopted new techniques. Quick-growing types of grass are sown in a large area, and sections of it are fenced off with charged wire. Cattle are let into this area and grazed intensively, being prevented from straying out by the charged wire which, on contact, gives a very mild (six-volt) electric shock. When this area is fully grazed the wires are removed to ungrazed areas."

"The cattle do not have to wander far while feeding, thus conserving their milk yield; there is neither undergrazing nor overgrazing; and while they have completed the last patch, the very first patch is ready once again for regrazing. There is nothing startling in this technique; it is merely applied common sense. The milk yield averages 10 gallons per milking, and there are prize cattle which, in their useful life time, have given as much as 100,000 gallons of milk."

VI CHACKO

United Planters' Association of South India, Coonoor

Productivity in Plantation Industry

Agriculture, in its widest sense, includes animal husbandry, poultry farming, plantation crops, and horticulture. Though a productivity movement of industry-wide significance has not yet come into the plantations, the author says that "below the surface, plantation management is in ferment, traditional methods are being questioned, and new machinery and equipment are being invested, tested, and adopted." Tea, coffee, and rubber are the important plantation crops, and there are well-organised management systems, with inter-estate comparisons as a ready measure to establish productive efficiency at the highest level in any one of the estates. Presented here is also data of studies made by UPASI to understand trends in the growth and use of capital, employment, output, and their relationships.

PLANTING provides a fruitful field for inquiry and experimentation in agricultural productivity in India. Plantations are invariably large enough units for the maintenance of regular employment; they are usually under systematised management, and possess fairly adequate records of operations.

Plantations differ from common agriculture in that they aim at highly specialised mono-crop production. For a study of the basic essentials of the system of operations, and the progress achieved in productivity, it is better to confine ourselves to the three major plantation crops—tea, coffee, and rubber —which have certain special features.

Plantations are located in two widely separated areas of India. Nearly 78 per cent of the area under tea is in the States of Assam and West Bengal, mostly in the Assam Valley. About 22 per cent of the area under tea, and the whole of coffee and rubber grown in India are in

three Southern States of Kerala, Madras, and Mysore. Approximately 1,650,000 acres (662,000 hectares) are covered by these three crops.

The labour employed in plantations has always been drawn from agriculture in the plains, and the change-over from the rather casual, highly seasonal, and tradition-bound agricultural employment to the distant plantations, under markedly different environment and social and physical conditions and organisation of work, presents a number of difficult problems. Each operation has its seasonal sequence for relevance to the total purpose of the estate, and variations between one and another both in the intensity of the operation and its periodicity. These variations make generalisation, except in basic terms, extremely misleading, and each estate rests greatly on its own experience and particular requirements. Machine plays a significant part in improving work efficiency, but its scope is limited, although the ratio of capital invested in machinery and equipment relative to land and its development varies from one crop to another.

Successful Planting

As manufacturing equipment in a factory, the land, and the plants comprise the productive capital on a plantation. Successful planting aims at more output per given area of crop bearing land, or the number of plants. The ratio of labour to the crop-bearing land, or to the volume of output, has assumed importance only in the past few years, and a productivity movement of industry-wide significance has not yet taken place although the stirrings towards it are now evident.

Corporate ownership is substantial enough in the industry, although in rubber some 70,000 small owners represent approximately 70 per cent of the area under it, and in coffee some 45,000 small growers are present. Many of the planting companies own several estates—in many cases, in widely dispersed areas. There are several managing agency companies specialising in plantation management, serving a number of planting companies. Both these types of companies have well-organised management systems, with inter-estate comparisons as a ready measure to establish productive efficiency at the highest possible level obtaining in any single operation in any one of the estates. This induces cross-fertilisation of ideas, and a general trend towards individual experimentation on the estate and working methods, and the introduction and adaptation of proved improvements in all the estates of a group. This kind of change filters through to other ownerships in a district, and then in all the districts throughout the industry. An informed management cadre, constantly in touch with others through their various points of professional and social contacts, and lines of communication running through district, State, and Central planting associations, help greatly in the process.

Various studies have been made by the United Planters' Association of Southern India (UPASI) to understand industry-wide trends in the growth and use of capital, employment, output, yield, and the relationship of one to the other. From the data collected for these studies, it was possible to relate specific facts of operational and organisational reforms and capital changes to output.

In inter-estate comparisons, the three basic tests of efficiency generally applied are the rate of increase of output per worker per annum, the rise in yield per unit of bearing area, and the output per rupee of capital employed. Industry-wide studies do not always reveal the gaps between the performance of the leaders and the laggards, and to what extent, and for what duration,

changes tend to narrow or widen the gap. The distance between the leaders and the laggards in productive efficiency is quite wide in planting, and the units falling into either category do not conform to any size, elevation, location, or ownership pattern. Although, as a general rule, a large unit offers the most favourable condition to raise productivity by being able to develop, and support, the essential institutional apparatus of production, it is the management's qualitative status which makes the most significant difference between one unit and another. Perhaps, this is true of all industrial undertakings, but it is emphatically true of farming of any kind, particularly of plantations.

Planting operations can be broadly divided into four groups, viz., those concerned with field operations other than harvesting, crop gathering, processing, grading and packing, and ancillary services connected with supervision, transport, records, accounts, etc. Of the total working force, approximately 35 per cent falls into the first group, 55 per cent into the second, eight per cent into the third, and two per cent into the fourth group. Crop-harvesting and field-work account for 90 per cent of the man-days worked, and processing and connected work engage six per cent of the man-days. These figures relate to tea and rubber plantations, but not quite as much to coffee where a major part of the processing, grading, and packing is done at curing works outside the plantations.

Efforts have been made in all these crops, with varying degrees of intensity and success, for the elimination of certain types of operations, mechanisation of some, and the simplification of others. In rubber, for instance, weeding and manuring absorbed 7.01 per cent of the total man-days worked in 1950, but these operations took 12.04 per cent man-days worked in 1961. On the other hand, spraying and dusting for pest and disease prevention took 20.08 per cent of the man-days worked in 1950, but only 11.99 per cent in 1961. Research had proved that improved weeding and manuring were required in rubber fields, but spraying machines both from the ground and the air reduced the extent of labour utilisation in these operations. These changes in rubber plantations are illustrative of changes generally in estates.

The output per worker is normally worked out on the annual results, as the

I. Annual Output in Tea (in kilograms)

Year	Per worker	Per hectare of bearing area
1959	393.2	1164.2
1960	433.3	1279.5
1961	425.4	1258.2
1962	459.6	1424.1
1963	474.8	1555.1
1964	422.0	1406.6

II. Annual Output in Rubber (in kilograms)

1959	506.9	479.2
1960	592.8	571.3
1961	589.3	556.8
1962	605.4	606.6
1963	625.5	645.3
1964	608.5	691.7

III. Annual Output in Coffee (in kilograms)

1959	335.1	644.4
1960	544.8	1000.9
1961	469.1	770.8
1962	382.5	634.5
1963	532.8	830.1
1964	444.7	663.0

seasonal variations of operations and crops make other comparisons misleading. A favourable crop year tends to put up the output per worker figures high, as a lean year does to depress the figure. Yet, the annual output per worker shows a rising tendency over the six-year period for which data have been collected from South Indian estates.

The capital structure in plantations is interesting and gives a clue to the inter-relationship between land and labour, and output variations, and the distortion to which productivity indices are subject in this industry. A breakdown of fixed assets of 10 South Indian tea plantation companies showed that land and development accounted for 48.2 per cent, and machinery and equipment 20.9 per cent. In rubber, land and development accounted for 78.3 per cent, and machinery and equipment 6.7 per cent. In coffee, the respective figures were 51.1 per cent and 12.3 per cent.

UPASI studies have also been making comparisons of the propensity of growth of capital to labour. In tea, the capital employed per worker in 1950 was Rs. 1,530, as against Rs. 2,676 in 1960. The output value per worker, though not a wholly reliable indication, increased during the same period from Rs. 1,273 to Rs. 1,949. But to most managements in the industry the true indicator of operational efficiency lies in a comparison of the product value per rupee of capital employed. It was Re. 0.77 in 1950 and Re. 0.73 in 1959—the latest years for which the figures are available. An examination of the figures of 10 leading companies growing rubber showed a different picture, the product value per rupee of capital employed rising from Re. 0.296 to Re. 0.404 in 1960. As regards coffee industry, the relevant figures were Re. 0.36 and Re. 0.47 for the respective years.

Plantations have, as their origin, the system of supplying the Western markets with tropical produce from colonies. Cheap labour was abundant, and the unit cost of the produce was kept low to promote and maintain mass consumer markets in the West. With substitute and alternate beverages, and synthetic rubber, the unit cost must be maintained at competitive levels, despite the fact that labour wages cannot be held down to the level of the colonial days. The obvious course open to the producer of plantation crops is to exploit, to the maximum, the yield propensity of the plants, and to reduce and eliminate traditional field operations which are redundant, and improve the output per worker, his tools and living standards.

The planting industry is in the throes of changes in the evolution of disease-resisting, higher-yielding planting material, new systems of field operations and processing, and better labour utilisation. No industry-wide productivity movement is being heralded, but below the surface plantation management is in ferment, traditional methods are being questioned, and new machinery and equipment are being invested, tested, and adapted.

INTER-FIRM COMPARISON

Productivity (Vol. V, No. 3) contains a number of articles on Inter-Firm Comparison by Indian and foreign experts. Rupees Three Only. Copies can be had from the National Productivity Council, 38 Golf Links, New Delhi 3.

DS SAWHNY

Systems of Management for Cultivators

Here are more suggestions to give agricultural productivity the desired fillip. The author makes a plea for the removal of such impediments as vacillating land policies and cumbersome procedures for the assessment of agricultural income-tax, which are a source of harassment to the bonafide farmer. Confidence in government's policies should be created among agriculturists, and different systems of farm management evolved for the various categories of cultivators. The truly progressive farmers should be associated with extension work, and improved practices demonstrated on their farms. Further, tax rebates should be given wherever increase in productivity has been established.

JAMMU & KASHMIR STATE was perhaps the first in India to introduce the Big Landed Estates Abolition Act through which a ceiling of 182 Kanals (22.66 acres) was enforced, and the landlords were expropriated from the area in excess of this unit. No compensation was paid, and the rights of ownership were conferred on the tiller. Every acre was reckoned to be uniform in terms of productivity, in spite of the difference of land-type, such as, **kandi, karewa, khuskhi, maliari,** and **aabi**. This created a new class of landowners which possessed the rights of ownership of land, but was without resources to meet the requirements of seed, fertiliser, irrigation, implements, cattle, and sustenance for the family till the next harvest. Besides, the actual implementation of the land reforms was very slow, and consolidation of holdings did not receive the attention it deserved. Such vacillating land policies and the discrimination shown by the State Land Alienation Act debarring non-agriculturists from taking to cultivation may be considered as Enemy No. One of Agricultural Productivity.

On recommendation of the Taxation Inquiry Commission, the Union Government decided that an Agricultural Income-Tax should be imposed by the State Governments. The cumbersome procedures laid down for assessment are a source of harassment to the farmer. The

return to the agriculturist should be determined by the quantum of yield per acre, and the price he can secure for his marketable surplus. Though this community itself is the single largest consumer in the country, and the cost of living index has materially affected its economy, it has hardly any control over the price of its own produce. This has discouraged many a farmer from going all out to invest all available resources for increasing productivity. This factor may be reckoned as Enemy No. Two of Agricultural Productivity.

Fixing of Targets

To give Agricultural Productivity the desired fillip, it is imperative that its above-mentioned two psychological enemies are exterminated by inspiring confidence among agriculturists regarding Government policies. Targets should be fixed for the implementation of these policies. such as the consolidation of holdings.

Different systems of management should be evolved for the various categories of cultivators. There are three distinct types of cultivators: (1) Owner-tillers whose productivity is good; (2) Owner-tillers whose productivity is poor; and (3) Landlords who have leased out cultivation rights. For all the three categories, the basic pre-requisites could be enumerated as improved varieties of seed, fertilisers and manures, improved implements, better cattle, better irrigation facilities, storage or warehousing, and credit facilities.

In the case of owner-tillers whose productivity is good, private individual ownership system should be accepted and encouraged.

For owner-tillers whose productivity is poor, cooperative farming societies should be encouraged and developed. The acreage under each society should be an economic unit, and management should be in the hands of qualified, trained, paid farm managers. Each farmer should subscribe his land to the Society, and be paid for the labour days contributed by him.

For landlords who have leased out cultivation rights, the corporate system of management may be better, whereby well-organised economic units could be developed, and the resources of landlords dovetailed with the interests of the cultivator to maximise productivity.

In each village, block, tehsil, taluqa or district, there exists a farmer who is considered to be the most progressive in his area in the cultivation of a certain crop, such as wheat, paddy, bajra, jowar, maize, cash crops, and rearing of dairy animals. He should be picked out, and associated with extension work. All improved practices recommended by the specialists, and adopted by the Extension Service, should be demonstrated on the farm of this farm leader. Being already acknowledged as the leader in his line, the acceptance of these improved practices by him would go a long way in convincing the other farmers in the area to adopt them. These farm leaders should also be associated with all activities pertaining to agriculture, particularly the cooperative banks, cooperative societies, etc., and should be sent on study tours in the country and abroad.

Wherever increase in productivity has been established, special development rebates in Agriculture Income-Tax should be granted. Vesting responsibility with one single Government Department (Revenue Authority) to ensure availability of resources to the farmer in every village at the right time, so as to suit his agricultural operations, is also bound to be very effective. To enable the farmer to get an economic price for his produce, regulated markets should be established in every zone.



NEW HORIZONS
IN FARMING :

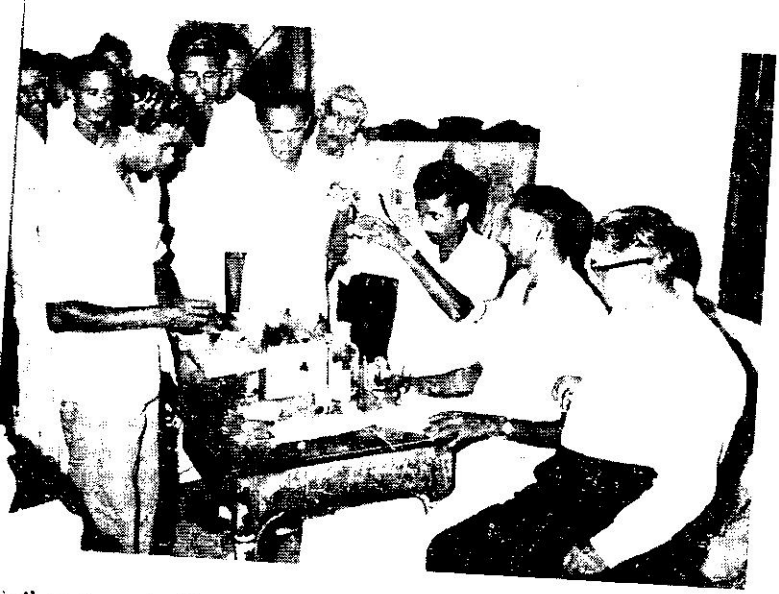
Anti-Locust Operations

Crop protection has been one of the main occupations of Indian agricultural services. Unless effective steps are taken to protect crops from locusts, etc., it would be rather difficult to raise the levels of agricultural productivity in the country. During early morning and late evening hours, locusts on the ground become inactive, and retire in thick clusters in bushes and wild grasses. ABOVE : A typical villager trying out a hand-dusting machine. BOTTOM (Left) : A demonstration in how locusts congregated on tall trees may be destroyed by throwing flames on those trees. (Right) : Aerial spraying plays an important part in anti-locust operations. A Super Piper-Gul spraying insecticide over infested area.





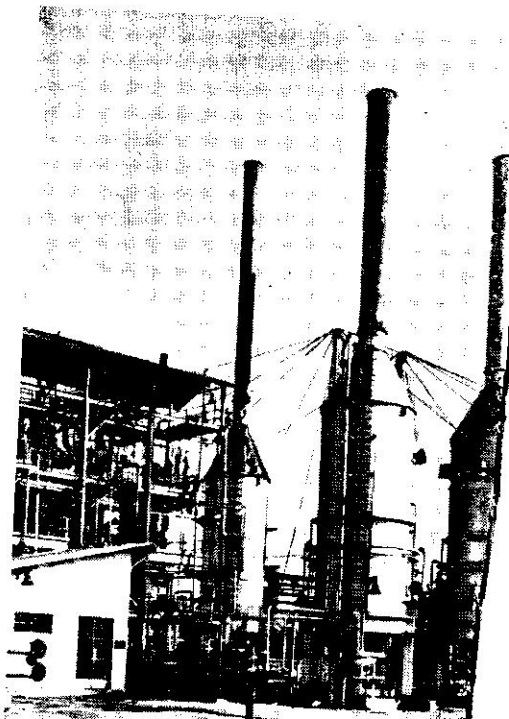




FERTILISER NUTRIENTS

Fertilisers play a vital role in increasin food production. The magical transfor mation that use of fertiliser bring about in food production is, however not yet fully realised by a majority o farmers. India is consuming per hec tare not more than 2.23 kg of all ferti liser nutrients, as against 142 kg in the UK, and 226 kg in Japan.

LEFT: An agronomist conducting a study class on use of fertiliser



Soil-testing facilities will have to improve considerably, if the fertiliser market is to expand. ABOVE: On-the-spot soil analysis by agronomists. RIGHT: FACT's oil gasification plant, the first of its kind in India. For some years now, FACT has been working on a plan for increased use of fertilisers by farmers.

RESEARCH . . .

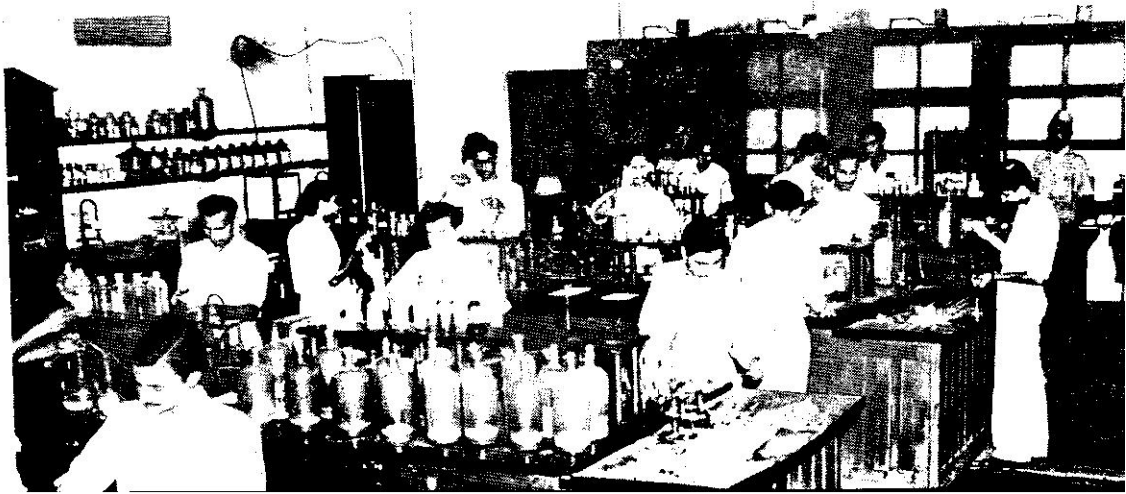


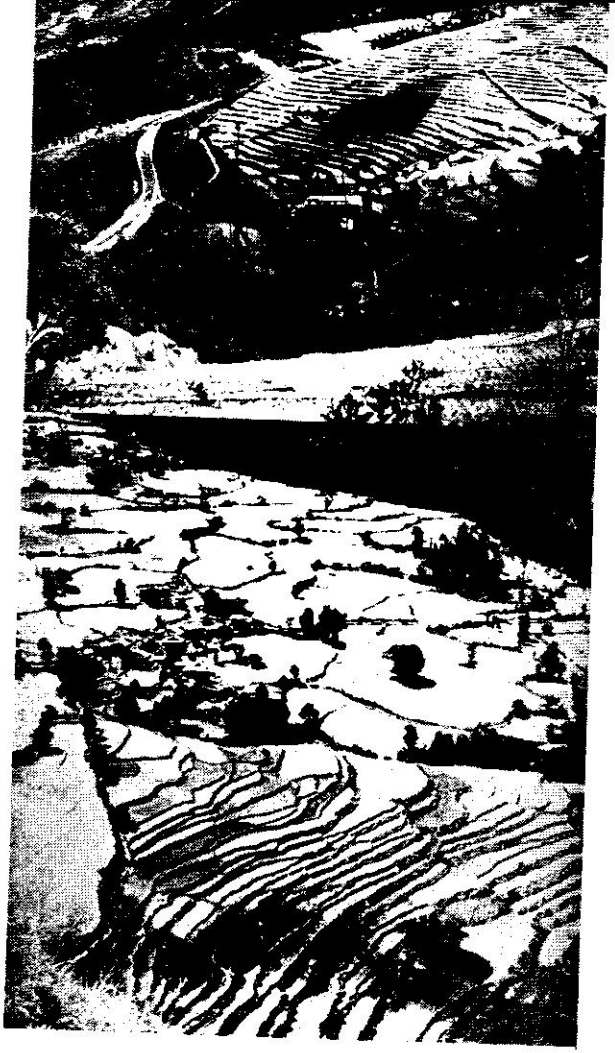
(From Top to Bottom)
Trainers receiving practical lessons in the application of manure mixtures

Experimental field of Japonica and Indica varieties of rice at a farm attached to the Central Rice Research Institute, Cuttack, showing research workers studying crossed plants in the field



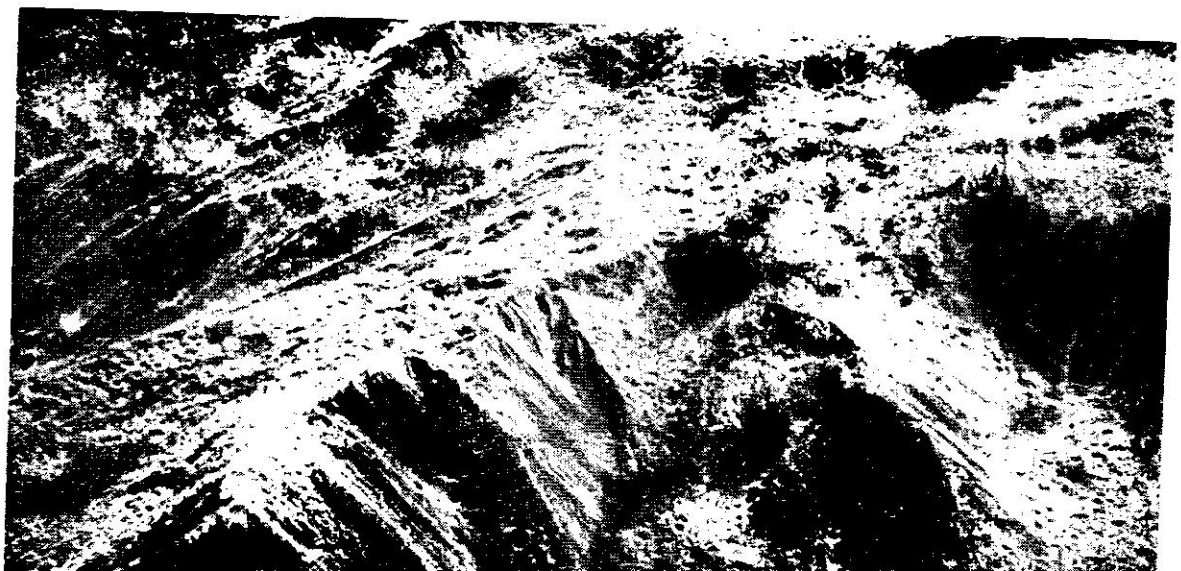
Experiments on improvement of soil fertility have been going on at the Indian Agricultural Research Institute, New Pusa, for over three decades. Students of soil chemistry at work in the Institute's laboratory





"Creeping Death"

Few are aware of the havoc wrought, and the toll that nature is taking, through the advance of "creeping death"—soil erosion. The rain beats down on the exposed areas, and literally washes off the top soil, which is the really precious part of our land resources. Our lands, therefore, are fast becoming sub-marginal. It has been estimated that over one-third of our agricultural lands are subjected to erosion, and that millions of acres have been lost. PHOTOS SHOW: LEFT (Top): Government soil conservation work at Kheti on the way to Ootacamund in Madras State. (Bottom): Village fields in Kulu terraced to prevent erosion. Controlled grazing of cattle is allowed in the forest in the background. BELOW: Typical Gullying, the last of the four stages of soil erosion (the other three are Natural, Sheet, and Rill), in Bijapur District

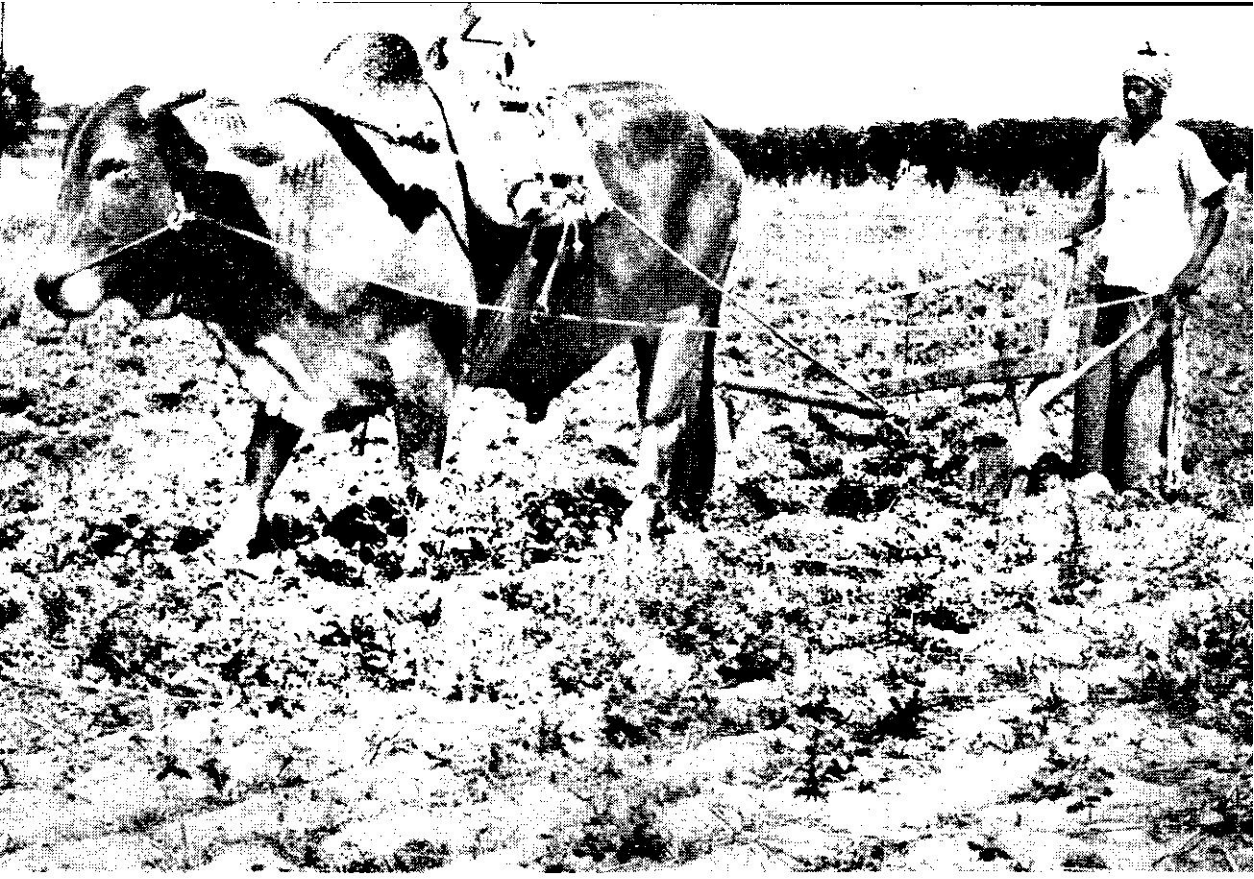


Farm Implements

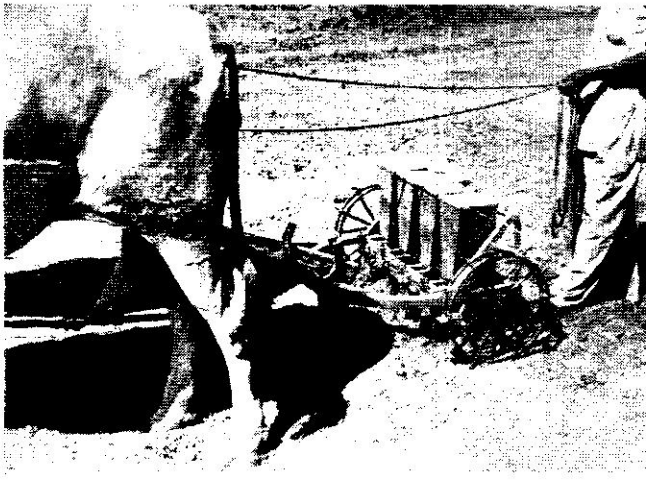
To maximise food production, timeliness and quickness in operation are essential; it cannot be achieved with time-honoured implements. Mechanical seed drills, for instance, give four times more area, and saves valuable seeds. Indian farm conditions, in fact, offer large scope for designing indigenous machines for use on the farm. Presented on this and the following pages are some farm tools (old and new) in use in India.

The Desi plough (Right) alone is, perhaps, the best insignia of backwardness of Indian agriculture. BOTTOM: Mould-board plough—an improved variety designed by IARI. Thirty million ploughs of this kind are immediately needed to replace the Desi plough, as a first step towards increasing agricultural production









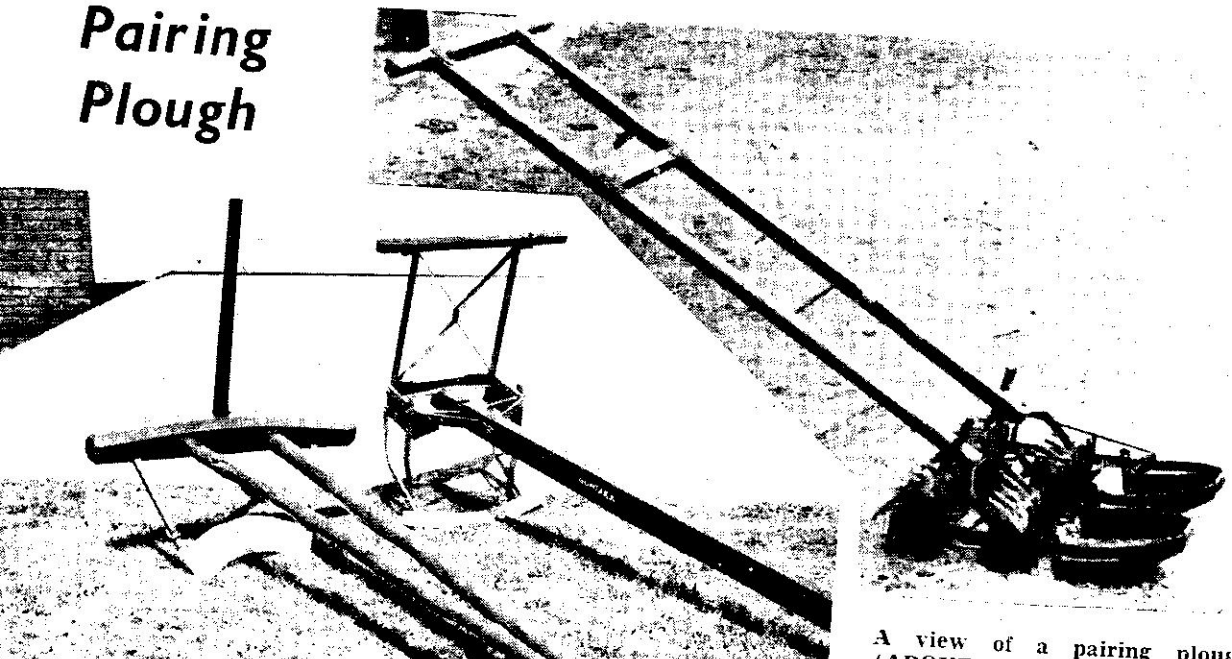
TOP : Japanese type Single Bullock Yoke. A single bullock can give as much as 0.8 times the power of a pair of bullocks using the conventional indigenous two-bullock yoke. If such yokes are used, in place of the existing ones, the power available on the Indian farm may increase as much as 60 per cent, besides ensuring increased manoeuvrability. BOTTOM (Left) : Indigenous Ragi Seed Spout Drill. This implement is used in certain parts of India as an inexpensive substitute for a seed drill. (Right) : Four-row Multi-grain Seed Drill. This implement, developed by IARI recently, has adjustments for varying the seed rate.

quality seeds for making selection for so

Bottom picture shows a three-row S
cum-Fertiliser Drill. This helps to imp
cultivation methods as it enables row placeme
seed and fertiliser placement in proper relation
of seed.

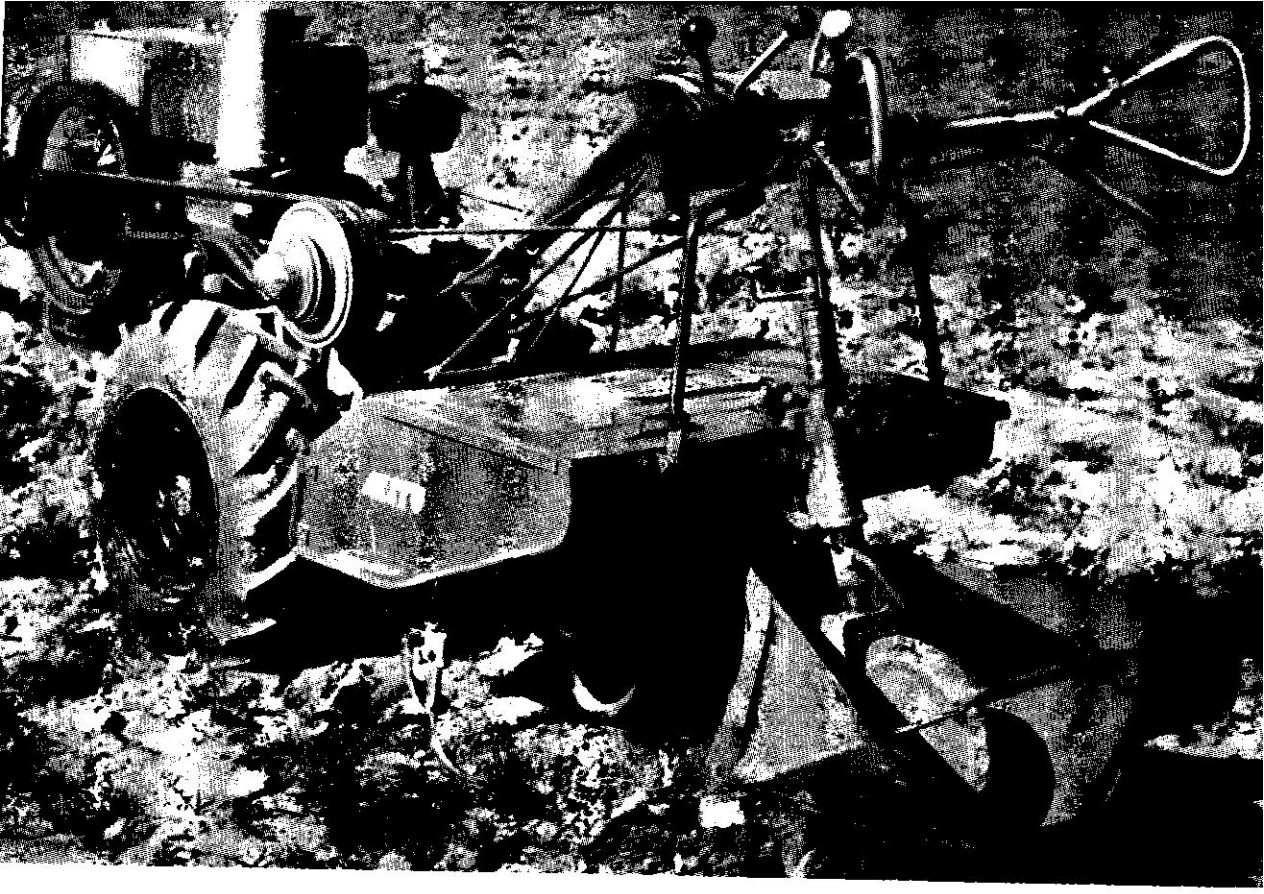


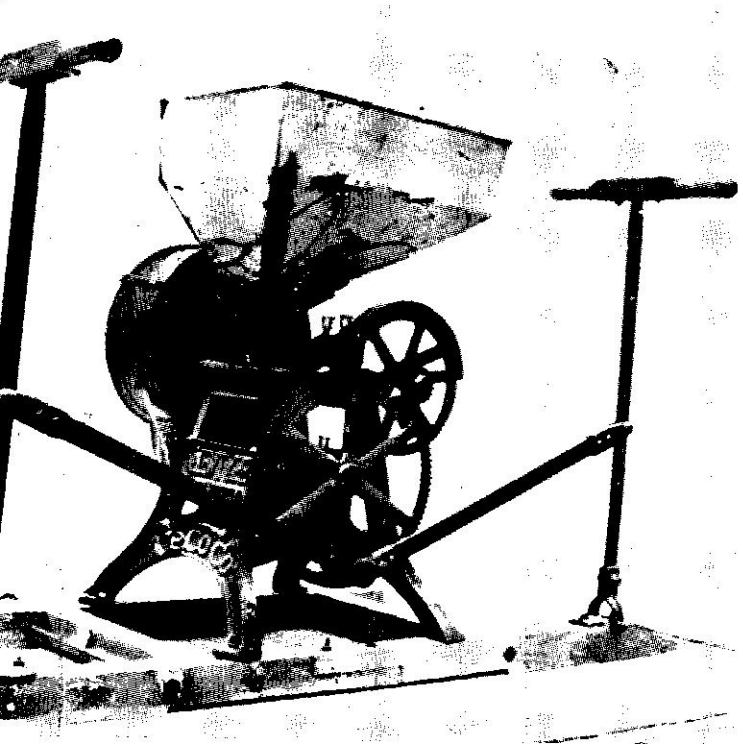
Pairing Plough



A view of a pairing ploug
(ABOVE) which helps in t
destruction of weeds. LEFT
Two-row Japanese-type Pad
Weeder—an efficient manual
operated wetland paddy inte
culturing equipment.

The only type of power tiller indigenously manufactured





PADDY HULLER : This is an indigenously manufactured machine, and can be operated by two men. Agro-industries, such as hulling, must rapidly increase at the village level. The by-products of such process can be utilised on the farm, and profits ploughed back into primary production.

Agricultural Productivity is Pakistan's Pressing Need

Thanks to the US Department of Agriculture (Economic Research Service), we now have some reliable information on agricultural productivity in Pakistan. A pamphlet, "Agriculture in Pakistan," says:

"In general, cultivation and harvesting methods are quite primitive. A wooden plough and a simple wooden drag are used, both drawn by oxen or camels. Most seed is broadcast by hand; seed planters, if used at all, are generally primitive. Harvesting is by hand, hand-sickles being used in cutting grain and oilseed crops. Threshing is done by placing the grain stalks on the ground or floor, and walking cattle over them. Grain is separated from the chaff by tossing it into the air for the wind to blow the chaff away. The average Pakistani farmer does not have either capital or know-how for modern farm machinery, and the fragmentation of the average farm makes the use of power equipment uneconomic. Also, a large labour force that is both underemployed and unemployed limits the amount of powered equipment that would be used.

For the time being, technology is largely confined to expanding irrigation, using more fertilisers and improved seeds, plant protection, and improved hand tools. The use of chemical fertilisers was practically unknown in Pakistan 15 years ago, except for small quantities used on the tea estates in East Pakistan. A little progress has been made since then; according to a recent calculation, an average of only three pounds of chemical fertilisers per acre were consumed.

An increase in agricultural productivity, both on a per man and per acre basis, is one of the most pressing needs of the country. During the 27-year period 1937-64, the annual compound rate of increase in agricultural production was about 0.7 per cent, while population increased at a compound rate of 1.7 per cent. Agricultural performance for a shorter and more recent period shows that Pakistan's agricultural output has outpaced the growth in population. Over the 10-year period 1953–63, the compound rate of growth for agricultural output was 3.0 per cent, while the average annual rate of growth for the population was 2.3 per cent.

Pakistan has a substantial livestock population, mainly bovines. In general, the quality of most animals is rather low. Nevertheless, the country is noted for the outstanding qualities of some of its animals, particularly certain breeds of cattle and horses. Limited availability, low incomes, and religious and other taboos restrict consumption of livestock products.

The outlook over the next decade is for a fairly rapid rate of economic growth in Pakistan. Nevertheless, farm output is unlikely to expand at a sufficiently rapid rate to achieve the goal of self-sufficiency in foods, particularly in view of the explosive rate of population growth. Pakistan's import needs for food grains—on concessional terms—will probably continue to grow over the next several years."

Of Mice and Men

A great deal of damage is caused to crops, in all countries, by harmful and destructive pests. The waste caused by rodents alone is alarming. But what does a farmer do under such circumstances? He either takes drastic steps to get rid of them when the occasion warrants it, or lets things slide and watches his crop, and his effort on the land, run to waste.

"On my own farm," writes the farming correspondent of a leading English daily, "I have never had to take recourse to shooting, though I do know of farmers who have found it necessary to destroy wild life —from elephants to jackals and porcupine—when they have started pillaging crops. Even though many in India do not hold with the ethics of killing, as a farmer, it sometimes becomes very necessary to employ such drastic measures.

I recently put down a crop of maize to discover after two or three days that germination in the fields was poor. The quality and source of the seed, the type and dosage of manure and fertiliser used, and the amount of rain were all unimpeachable. But an army of field mice were systematically going through the fields, digging up the fresh, soft, germinating seeds, and making a feast of it.

So I went along to the district farm authorities and procured some zinc phosphide from them. I treated a certain amount of maize grain with this poison, and spread the bait out over a fairly large area. The first morning we collected and buried about 350 dead field mice of different colours and sizes, and an assortment of dead squirrels, mynahs, and doves. The same day, we replanted the crop, filled vacancies in the fields and, late in the afternoon, spread the poison once again. The next morning, we picked up just over 200 field mice, three village pariah dogs, more squirrels and doves, and a couple of dead partridges.

The third day, it was evident that either the rats and squirrels had got wise to our tactics and had grown altogether more cautious, or their numbers were so depleted that they failed to cause any marked damage in the fields. At any rate, they stopped appearing and even the birds were very subdued in the trees. But in another day or two, everything seemed to return to normal, and the crop came up fresh and green and soon established itself fairly firmly in the soil. By then, however, we had long stopped spreading the poison, because I discovered that the system was not without its disadvantages... We had to spend a good deal of valuable time hunting and searching for our dead and burying them deep, partly because of the danger of the spread of disease, and partly because many tribals consider dead rats a delicacy...

Whether it is killing of kangaroos and emus in Australia, or the extermination of rodents and other pests in India, an exploding world population justifies drastic measures. In Britain, Australia, and other advanced agricultural countries, which were once confronted with the rabbit menace, the problem was countered by the introduction of myxomatosis. Surely something on these lines is indicated to check the alarming waste caused by rodents in India?"

DRU SRIVASTAVA

Indian Agricultural Research Institute, New Delhi

Impact of Different Types of Risks

Farmers are prone to consider all outcomes leading to losses, as risks. There are three types of risks: price risk, weather risk, and technical risk. In discussing their significance, and impact on productivity, Dru Srivastava says that the existence of risks governs the cost and flow of credit, which, in turn, governs the investment outlay. She points out that the existence of risks affecting productivity and farm incomes is one of the reasons for the migration of villagers to urban areas, and, therefore, favours the acceptance of Halperin's concept of Agrindus as a counteracting force.

THE WEATHER is an uncontrollable factor causing uncertainty. Some of the aspects of uncertainty caused by weather have been successfully controlled in the developed countries. Still, there are a number of factors which play their role in causing uncertainty. The impact of weather risk is still greater in the less developed countries. For instance, in India, floods alone cause a loss of Rs. 4,500 million worth of agricultural produce. Approximately one million tonnes of food grains—about 20 to 25 per cent of our annual food deficit—are lost on account of floods every year. Insect pest attack cuts agricultural output by four per cent annually. In addition, there are several other hazards like frost, drought, water-logging, and plant diseases. The annual loss to farm production due to waterlogging in Meerut district alone is over Rs. 10 million.

By and large, high risk is associated with innovation due to lack of research and testing. Besides, the penalty of error in

innovation is high due to the prevailing low levels of incomes. The farmers tend to look at a new technique with suspicion. The impact would differ from one farmer to another depending upon his resource position, environment, and psychological set-up. Therefore, the recommendations to the farmers should not be made on a blanket basis, but the use of any particular technique should be suggested with discrimination and modifications, keeping in mind the complete social and economic background of the farmer. Hasty and ill-conceived introduction of innovations increase the farmer's prejudice against them, and hamper the speedy growth of improved methods of production, thereby affecting the productivity in agriculture.

The above discussion explains, in brief, the significance of different types of risks, but the cumulative effect of all these risks expresses itself in investment decisions and cost of credit.

Investment here denotes the use of all possible inputs. The impact of risks on the investment pattern of the farmer should be viewed from two angles: (a) farmer's willingness to invest, and (b) farmer's ability to invest. According to Schultz, there exists for agriculture both external and internal capital rationing. Internal capital rationing is more or less self-imposed, and reflects on the farmer's unwillingness to invest. The external capital rationing implies that additional credit is not available at a reasonable rate of interest. While the farmer's response to the risk expresses itself in internal capital-rationing, the lender's response to the risk is expressed in external capital rationing. The effective investment is the result of the above two forces (willingness to invest and ability to invest) which might move in the same direction or in the opposite direction.

A rural house survey conducted by National Council of Applied Economic Research says that the positive savings of household started at a level of annual income between Rs. 721 and 900. Therefore, a farmer, having a large size of holding (say 30 acres to 40 acres) is likely to have a comparatively higher ability to invest, but the presence of risk would affect his willingness to invest. This is reflected in a rather thin spread of inputs on these farms, and exodus of youth from the villages. On the other hand, a farmer having a small size of holding (say, less than 5 acres) will try to get the maximum out of his holding. More so because of the absence of alternative opportunities for work. His only hope being his piece of land, his willingness to invest is likely to be high, but his ability to invest is limited. This, therefore, brings us to the question of agricultural credit.

Insufficient Capital

A great majority of farmers in our country have insufficient capital (both invested and working), low income, and poor farming knowledge. On the one hand, there is a general interest in giving credit at a reasonable rate of interest to the farmers, and on the other hand there is a lack of such credit facilities. Hence we face a striking contrast between the idea and the reality.

The existence of risks governs the cost and flow of credit, which, in turn, govern the investment outlay. The credit problem is most acute for small farmers working submarginal farms with little and/or poor land, who have neither the actual nor the potential capacity to repay a loan. In their case, subsidised agricultural credit act as a relief, and does not make any significant contribution to agricultural development. In this connexion, it may be mentioned that estimated outstandings from agricultural societies at the Central Bank level will be Rs. 338.28 crores, at the end of

Third Plan. One of the most effective ways to convert this static credit into dynamic credit could be by the reduction of the magnitude of risks of various types.

In view of the static aspect of credit, the diversion of funds for the price support policy may be considered. If the farmers are allowed to borrow at the natural rate of interest, the cost will get inflated. This could be taken care of by fixing specific producers' prices; and in order to protect the consumers' interest, reasonable consumers' prices may be fixed. It seems to me that such an approach will have a few distinct advantages viz.,

a) the natural rate of interest will tend to mobilise the rural savings;

b) it will tend to prevent misuse of agricultural credit;

c) it will tend to discourage hoarding of agricultural produce; and

d) a suitable policy of price discrimination can considerably influence the cropping pattern of individual farmers.

The existence of risks affecting productivity and farm incomes is a reason for the migration of village population to the urban areas. The population of the Indian Union during the decade 1951-61 increased by 21.5 per cent. The population of urban centres increased by 26.6 per cent, and of the rural areas by 20.6 per cent, which gives a good indication of the extent of migration from rural to urban areas. This, along with many complex problems, demands additional transfer of agricultural produce to the urban areas. Dr Halperin finds the answer to this migration in his concept of Agrindus. According to him Agrindus represents a town which covers a score or more of villages, and serves as an industrial centre with all those attributes which the villagers find attractive. These industrial towns may be developed by public or private enterprise, by the cooperative effort of the villages or may develop by the combination of these, the most fundamental principle of Agrindus being integration of agriculture, services and industries. This type of approach will greatly succeed in reducing the magnitude of technical risk by providing expert advice and required inputs within easy reach.

Do You Know...

Around 15 per cent of the total cultivated land is with operational holders having five acres or less; 40 per cent is with the five-to-20-acre holders; 39 per cent with the 20-to-100-acre holders, and six per cent is with the 100-acre-or-above group.

A serious threat to rice cultivation originates from insects, about 100 species of which are known to feed on rice plants in the field. The stem borers are the most destructive of these insects.

SATWANT SINGH

From Subsistence to Surplus Farming

The wide difference between consumer and producer prices of farm commodities acts as a "deadweight on production," says the author who pleads for legislation to set up regulated markets and warehouses within bullock-cart distance of groups of villages. If surplus production is to be achieved, the farmer should get an economic price for his produce, and he should be aware of sound agronomic practices. Suggestions have also been offered here on ways to attract talent to agriculture. The author indicates that a sound surplus agricultural production would provide the maximum opportunities for remunerative employment in the rural areas, and thus strengthen the rural base of the economy.

CONVERTING the large number of our farmers who devote all their effort to growing crops mainly for self-consumption into specialised surplus producers calls for an integrated solution of their economic and technical farm problems. To achieve surplus production, a farmer has to run his enterprise on business lines by an optimum co-ordination of his soil, plant material, human labour, and animal power. To help him in this, we must take to him sound agronomic practices, and create a congenial marketing climate, so that he would get an economic price for his produce.

In terms of farm efficiency, as well as productivity per acre, the canal colonies of the pre-Independence era achieved a very high level, and can even now hold their own against the best cultivated areas in countries like the USA, Australia, and the USSR. Special-purpose

tenancies were created in these colonies to develop pedigreed plants, horses, cattle, seed farms, fruit plantations, etc. Besides providing a most effective nucleus for agricultural propaganda, these special-purpose tenancies served as pilot projects for introduction of scientific farming techniques.

As regards ensuring an economic price to the farmer, the present farm legislation does not take cognizance of the price spread—the difference between the prices of agricultural commodities at the consumer level and the producer level—which is at least 10 per cent. This wide gap, which is acting as a dead-weight on production, has created a parasitic class of speculators in the distributive trade. Thus, there is a strong case for enacting legislation to set up regulated markets and warehouses within bullock-cart distance of a group of villages. Producer-controlled agro-industrial processing and farm supply concerns should be set up at primary assembly points to act as pace-setters in determining service charges of the existing monopolistic trade.

Regulated Markets

Thus, an integrated land colonisation plan in which the agro-industrial processing sector and regulated markets are located at focal points of producing areas would harness the best human material and farming skill in agriculture. In turn, these rural producing and processing sectors would magnetise a vast army of unskilled and semi-skilled workers and technicians at an increasing pace not realised so far.

Farmers possessing 5-10-25-100 acres should be dotted all over the country to provide leadership and farming experience. Traditional single cropping should be replaced by ley farming practices and crop rotations which include soil restorative crops. The farm credit needs of agriculture should normally be met by the scheduled banks. The bureaucratic machinery should be more concerned with the creation of facilities in terms of economic utilities like village-to-market roads, electricity, telephones, and regulated markets rather than exclusive teaching of the know-how of farming. The Indian farmer already possesses wisdom and experience accumulated over the centuries with regard to local agro-climatic factors; he needs to be adequately equipped with modern agricultural technology comprising machinery, insecticides, weedicides, and the requisite plant material to achieve his full productivity potential.

Talent for Agriculture

Agriculture needs both brain and brawn, and must be able to compete on equal terms with commerce, Government or liberal professions to attract the best talent.

To achieve this with the help of legislation, flooring and ceiling of white-collared jobs should be brought on a par with agricultural income. In Communist countries, the State controls the entire distribution and marketing sectors, and thus maintains a fair balance between agriculture and industry. The Western democracies by appropriate legislation divert a part of the profits of the trade, industry, and processing sectors to agriculture in the form of price support for farm production and distribution programmes, and supply of agricultural requisites at competitive prices. By increasing the monopolistic control of trade and agro-industrial undertakings, and multiplication of marginal and sub-marginal holdings, agriculture has become the victim of weaknesses of both the capitalist and the communist systems in India. It is high time that policy-makers adopted a rational approach. A uniform yardstick of taxation, ceilings on income,

and social and economic amenities should be adopted for agriculture, trade, and industry.

The legislative tool should be increasingly used to mop up the surplus wealth, unearned incomes from easy money-making professions, income bracket groups higher than the ceiling on agricultural income, profits from agro-industrial enterprises and trade, etc., and diverting the same to equip the farmers with agricultural machinery and farm requisites to increase their productivity.

Tackling of Hazards

Continuous exploitation of agriculture, and the tackling of the attendant hazards, both in the physical and economic sense, direct middle-class intelligentsia from farming to non-agricultural professions. By the creation of a social climate, and the adoption of suitable legislative measure, this tendency should be checked by making agricultural and non-agricultural professions interchangeable in the socio-economic field. The vacuum created by the driving out of farming skill from agriculture would upset the fast tempo of rural development plans, and encourage subsistence farming.

Only by having a strong agricultural background can the policy-maker really imbibe the basic concept, and bring forth policies which would maintain a proper equilibrium between agriculture and other professions in terms of allocation of physical and technological resources, diversion of income from utilisation for personal conveniences to economic production and regulatory provisions to ensure quality supplies at reasonable rates and fairness in exchange.

From the Editor's Scrapbook:

THE ONLY ANSWER

To say that productivity is the answer to all Problems, would certainly be an exaggeration, but it is the exaggeration of a vital truth. The mass of the people are overjoyed to find that the home-made Gnat has been more than a match for the Sabre Jet—that's the real substance of all the war news: what is it but superior productivity, the triumph of the ingenuity and the skill and the direction of the Indian engineers, the Indian pilots, and the Indian commanders on the field of battle. In spite of deficiencies in arms—both quantitatively and qualitatively—the Indian Army has triumphed over... that's the Army's Productivity... (In the context of the Emergency, the Editor was struggling with a special piece for this issue of the journal, for it was almost mandatory—both intellectually and emotionally—to refer to the Indian Army's proved superior productivity, when the news came that a cease-fire was being negotiated... The case is no longer one to be proved. What the People's Army—that's what is has proved to be—achieved in the field of battle, should now be reflected in the common life of man in India: its superior productivity in every walk of life, including the common man's subsistence to be derived from Agriculture, with which this special issue is very particularly concerned).



...In the past 18 years we have repeatedly promised to our people to make the country self-sufficient in food grains. But it is still a distant goal... A new momentum will have to be imparted to agricultural production... —DR S RADHAKRISHNAN (in broadcast on eve of Independence Day).

India is short of only five million tons of food. Today we produce 38 million tons of rice. If we can increase it by at least 10 per cent, we may be able to solve the food problem... —DR PARPIA, Director, Central Food Technological Research Institute, Mysore (at a Rice Symposium in Mysore).

...Science and industry, and outer space explorations may exercise men's minds and hold us all enthralled, but ultimately the common man must look to agriculture for his food, clothing, and shelter... —The Farming Correspondent in THE STATESMAN.

The Tirupati Devasthanam, one of the richest temple managements in the country, bought a radiogram, costing Rs. 2,561 in 1964, and has proved that music means more milk... Milking time music has resulted in the yield of cows' and buffaloes' milk rising to 26,291 lb compared to 16,871 lb in the previous year... —K BRAHMANANDA REDDI, Andhra Chief Minister (in the State Legislative Assembly).

...Camel's milk and donkey's milk are good for human consumption (The milk of cow and camel resemble very closely. The milk of the donkey is being widely used in Australia and New Zealand)...—Recommendation of the Central Committee for Food Standards, New Delhi.

...The dream of planning is the dream of plenty. One must not dream —unless one is willing to back the dreams with efforts. In any creative act, the mid-point is a situation of discomfort; we are at that mid-point... —ASOKA MEHTA, Vice-Chairman, Planning Commission (in AIR Symposium on Challenge and Achievement).

...The officials, because of the power vested in them, do not regard the citizen as some one who has to be helped, but as a petitioner to whom a favour has to be shown... —HVR IENGAR, former Chairman of NPC (report in the INDIAN EXPRESS).

...If Hindi is made the official language, the country will produce more engineers and doctors than ever... —MORARJI DESAI (quoted in THE STATESMAN).

...Exporters should not take a pessimistic view of the country's progress and terrorise the Government of India as a mother-in-law terrorises her daughter-in-law...—MANUBHAI SHAH, Union Commerce Minister (at Silver Jubilee Celebrations of the All-India Exporters' Chamber).

...There are some Patels (Village Officers) in Bhadrachalam taluq (Andhra Pradesh) who get a remuneration of only 12 Paise per annum... There are in the State 296 Patels who are not paid any remuneration at all... —RAMACHANDRA REDDI, Andhra Revenue Minister (in the State Legislative Assembly).

Here, The Advertisers

American Universal Electric (India) Ltd. .. 444
Bata 207 & 443
Bharat Pulverising Mills Pvt. Ltd. 441
Bombay Metal & Alloys Mfg. Co. Private Ltd. .. 268
Burn & Co. Ltd. .. 337
Coventry Spring & Engineering Co. (Private) Ltd. .. 201
Director of Information & Public Relations, Hyderabad .. 394
Directorate of Advertising & Visual Publicity 206 & 336
Dynacraft Machine Co. Pvt. Ltd. .. 267
Escorts Limited .. 390
Hindustan Insecticides Ltd. .. 440
Hindustan Lever Limited .. 269
India Foils Ltd. 338 & 448
Indian Engineering Company .. 396
Indian Oxygen Limited .. 202
Indian Standards Institution .. 442
Indian Telephone Industries Limited, Bangalore .. 270
Kamani Metals & Alloys Ltd. .. 334
Larsen & Toubro .. 393
Mahindra & Mahindra Ltd. .. 339
Metal Box .. 335
Pioneer Equipment Co. Private Ltd. .. 440
Precision Bearings India Ltd. .. 340
Punjab Public Relations .. 388
Ramkrishna Biscuit Co. .. 395
R. M. Engineering Works .. 396
Sree Saraswaty Press Ltd. .. 396
S. R. Samadder .. 440
Tata Steel .. 204
The Anil Starch Products Ltd. .. 265
The Aluminium Industries Ltd. .. 271
The Dharamsi Morarji Chemical Co. Ltd. .. 447
The Director of Information, Govt. of Gujarat .. 205
The E.I.D.-Parry Ltd. .. 203
The Fertilisers and Chemicals Travancore Ltd. .. 333
The Indian Iron & Steel Co. Ltd. .. 208
The Indian Institute of Public Administration .. 446
The Indian Standard Wagon Co. Ltd. .. 272
The Indian Tube Company Ltd. .. 391
The Materials-Management Journal of India .. 445
The National Ekco Radio & Engineering Co. Ltd. .. 266
Thermolab Glass Products Pvt. Ltd. .. 444
Universal Cables Limited .. 392

Ibcon Private Ltd. ... *back inner cover*
Calcutta Fan Works Pvt. Ltd. ... *back outer cover*

SPECIAL ISSUES OF

PRODUCTIVITY

(Quarterly Journal of NPC)

●

1. Preventive Maintenance (Vol. V, No. 4): A number of authoritative articles, by experts, on machine productivity and the importance of preventive maintenance. Modern machinery poses a challenging demand for a more progressive management and programme.

Rupees Three Only

2. Human Relations in Industry (Vol. VI, No. 1): Man is the important factor of production, and unless the supervisors use the techniques of human relations in supervision, they will not be able to achieve the desired results. Contains first-rate material by Indian specialists on Job Satisfaction, Personality Factors, the Manager as Change Agent, etc.

Rupees Three Only

●

Only a few more copies in stock

NATIONAL PRODUCTIVITY COUNCIL

38 GOLF LINKS, NEW DELHI 3

Next issue of

PRODUCTIVITY

will contain a

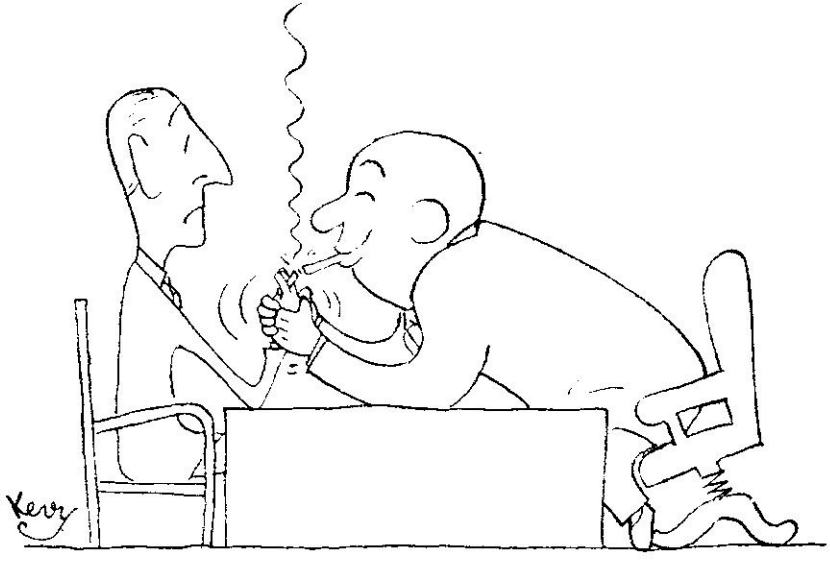
Special Section

on

FUEL EFFICIENCY

. . . Indeed it is well said that in every object
there is inexhaustible meaning:
the eye sees in it what the eye brings means
of seeing . . .

—Carlyle



"Now, let me explain to you Fuel Efficiency:"

Vol. VI, No. 4, Winter 1965-66

CONTENTS

		Page
	LIST OF ILLUSTRATIONS	488
	Editorial	
	Fuel Economy: Essential to High Growth Rate	489
	Part I—The Policy Perspective	
Leslie Hollinghurst	*Industrial Fuel & Efficiency of Its Use*	493
UK White Paper	*New Appraisal of UK's Fuel Policy*	496
Michael Posner	*Scope for Planning & Co-ordination*	506
DH Butani	*Need to Develop New Sources of Supply*	517
	Part II—Position in India	
Cecil AJ Plummer and Brinley R Addicott	*State of Fuel Efficiency in India*	519
JW Whitaker	*Elements of Combustion Control in Furnaces*	529
K Higginson	*How to Avoid Wastage of Fuel*	542
	Part III—In Coal Industry	
Darab C Driver	*Application of Fuel Efficiency to Indian Coal*	557
AB Gupta	*Productivity Problems of Coal Industry*	559

Part IV—In Thermal Power Stations

JB SINGH *Avenues of Improvement in Thermal Power Stations* 563

PR SRINIVASAN *Automatic Control of Boilers in Thermal Power Stations* 570

Part V—Boiler Efficiency

A BHATTACHARYA *Steps for Efficient Operation of Boilers* 577

RENE J BENDER *Fuel and Boiler Must Go Well Together* 581

M SEN AND SK DAS GUPTA *Utilisation of Fuel for Steam Generation* 585

HS DWARAKANATH *Cause, Effect & Cure of Fluctuating Steam Loads* 592

Part VI—In Steel Industry

H SAHAI *Fuel Factor in Steel Production* 613

H SAHAI *Work Organisation of Energy & Economy Department* 622

PD SUNAVALA *Fuel Economy as Affected by Steel-making Processes* 633

Part VII—Significant Details

BIRAZA B PAUL AND PARTHA P CHOWDHURY *Fuel Saving: Daurala Experiments* 677

LA NATESAN *Railway's Fuel Efficiency Problems* 686

Book Reviews 693

They Said So ... 696

Here, the Advertisers 701

COVER PAGE Shows the Ultimate in Fuel Efficiency

Hindi Edition

of

Business is People

(richly illustrated with cartoons in three colours)

Written in a simple, imaginative, and entertaining style, this book highlights the principles of good human relations, and their significance for the progress and prosperity of the nation

Publication Date: Sept. 1, 1966
Tentative Price: Rs. 5

Book your orders in advance

National Productivity Council

38 Golf Links, New Delhi 3