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AGRICULTURAL STATISTICS IN RELATION TO PLANNING*

MR. PRESIDENT, MINISTER OF FOOD AND AGRICULTURE, EXECUTIVE PRESIDENT OF THE SOCIETY, AND FRIENDS,

I AM particularly happy to be here today. When I got the invitation, I immediately accepted it. My own introduction to agricultural statistics came about through the Imperial, now the Indian Council of Agricultural Research. I think it was 1930 or 1931 when Mr. Burt, at that time the Agricultural Commissioner of the Indian Council of Agricultural Research, came to Calcutta and enquired whether I would like to have a little grant from the Indian Council of Agricultural Research for work in the design of experiments in agriculture. This is how a good deal of my work began in a subject which is of basic importance for our country. Some of my earlier work in statistics was done in connection with Indian Council of Agricultural Research schemes, at first mostly in the design of experiments and field trials; and also giving some statistical training to agricultural officers. A little later I believe in 1936 or just about 20 years ago, I started thinking on the possibility of a sample survey of the jute crop in response to an enquiry from the Indian Council of Agricultural Research. The scheme for the sample survey of the jute crop was, however, actually initiated by the Indian Central Jute Committee in 1937 immediately after its establishment. This is how I first came into contact with some of the basic problems of India. Work in the field of agricultural statistics led me, I should say forced me, to go out into the villages. I have spent days and nights in villages among the crops which gave me most valuable experience. For all these reasons I am particularly happy to be here.

The subject which I had suggested for my talk tonight is "Agricultural Statistics in Relation to Planning". I have drifted from one subject to another physics, meteorology, and statistics; and just now I have some connection with planning. It may be, therefore, appropriate if I make some observations on agricultural statistics from the point of view of planning.

Planning in India means what? It means solving the problem of poverty, that is, increasing the level of living; and the basic element

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in the level of living is food. We want more food, adequate food of better quality; and of course, many other things like housing, clothing, education, health, and cultural amenities; but above everything else more food and food of better quality. Here certain problems immediately arise. More food in our country usually means cereals. But this is not adequate from the point of view of nutrition.

I should like today to place before you certain problems which may be of interest to the members of your Society and may supply fruitful subjects for research. One basic problem is integrating nutrition requirements and food planning. The nutritionists have been making many recommendations about the need not only of calories but also high quality food, fats, proteins, vitamins and so on. These needs have to be linked in some way with the planning of food production. I see a big gap between what we can do and what we require according to the nutritionists. If we had enough resources, of course, there would be no difficulty. But we have not got enough resources to produce an adequate supply immediately. We shall have to do this over a period of 15, 20 or 30 years.

I may consider a second problem. When income increases—national income as well as personal income and income *per capita*—obviously the preferences of different items of food would change. As income increases, how would the expected demand change for different types of food? Fortunately, this is amenable to some kind of a rough solution on lines which I may briefly explain. The National Sample Survey is collecting extensive information twice a year from several hundreds of villages and urban areas about the pattern of consumption of households. The data can be tabulated by *per capita* or 'per household' expenditure. Classifying persons or households by levels of living one can find out the actual consumption of cereals, milk products, sugar, or other items of food for different levels of living.

There is a gap in our statistical knowledge again at this stage. How should we measure, assess, or rank different levels of living? We really do not know. *Per capita* expenditure may be one way of doing this. Presumably a person spending on an average Rs. 50 per month would be far better off than a person spending Rs. 10 per month. Using '*per capita* expenditure' as yardstick one can find out the 'expenditure elasticity' at least as a first approximation.

Some interesting results immediately emerge. There is a definite pattern in the change of demand with increasing expenditure. We have made some rough calculations. For example, during the Second Five-Year Plan, from 1956 to 1961, our target is to increase the national

income at the rate of 5% per year which in five years (at compound interest rate) will come to about 27%. That is the target. Let us assume we can reach it and that there will be an increase in the national income of about 27% at the end of the Second Five-Year Plan. Here another question arises, namely, the distribution of income by size of income. Would it remain just as it is now or can we achieve a little more egalitarian distribution, that is, can we bring about that the poorer people would have an increase of not 27% but, let us say, 30% or 40% more income and the richer people somewhat less than 27%? We may make suitable assumptions about the changed pattern of the distribution of income and then we can make rough calculations. We find that for food-grains the increase in demand would be 15 or 20%; for pulses a little more, and for edible oils about 25%; and for milk and milk products over 45% more than what it is now. Clearly as we have a little more income there will be proportionately a good deal more demand for milk and milk products. The demand for fish, meat and eggs may increase by perhaps 30%, but the increase in the case of milk and milk products would be appreciably higher. In the case of fruits it may go up so high as 50%. Demand for sugar may increase by 30%. In this way we can make some kind of tentative estimates of the increase in demand; and on this basis of such estimates plan for an increased production.

This is possible; but the expected demand is not the same as requirements from the nutrition point of view. Also, there is bound to be a still bigger gap between requirements and what can be in fact supplied. I hope either the members of the Society or Indian Council of Agricultural Research, or the Ministry of Food and Agriculture would give some attention to this big gap in planning for food production, and examine what would be the best compromise from the point of view of nutrition. This, I think, calls for a certain amount of quantitative thinking in the concrete, not merely of what is desirable, but of what is feasible, say during the next five or ten or twenty years in India.

In this connexion I may consider one particular product ghee as an example to point out the inequality of distribution. The consumption is extremely uneven; about 60% of the population (who I may mention, spend less than Rs. 20 per month) consume only one-sixth of the total quantity of ghee; while 10% of the population consume about 40% of the total quantity of ghee. This only means that ghee is a luxury item; and if the income increases, most people would like to consume more ghee.

Now the changing pattern of demand, of course, must be given proper consideration in planning. However, we cannot possibly increase the supply of ghee to meet the demand which would arise over the next ten or even fifteen years. So there is need to think of long range planning. In the short run we must, of course, meet the increasing demand for cereals. We should be able to do it. I think there is a good chance of our achieving the targets for food-grains, but what about other food articles say like ghee? What would be our planning in such cases? The demand will be so great that we cannot hope to meet it immediately. What would be the compromises? I should like very much to know from the agricultural point of view, keeping in mind the needs of nutrition, what should be the targets of production. There would be a big gap in the short range. But what should be the pattern of production over twenty or thirty years? This I think is a very important problem which may be reasonably considered to come within the sphere of interest of agricultural statistics. The problem resolves itself ultimately in the most effective utilisation of land and other resources so that over a long period of years we may plan our crop production or improvement of dairy products to supply more food of better quality to satisfy our needs.

I may now say a few words about some other aspects of agricultural statistics. The subject is very very vast; and you have already, Sir, in your Inaugural Address referred to some very important problems; so has the Minister of Food and Agriculture. I shall not try to give a general review but let us see what is the scope of agricultural statistics. One important aspect is, of course, finding out the crop acreage, the yield per acre, the out-turn not only of crops but of milk and other agricultural products of forests and fish and so on. This is the estimating side which has to be done either through censuses or through sample surveys, on which there has been enough discussions and to which I do not think it necessary today to make any special reference. I think this subject is fairly advanced in India. Our knowledge is increasing as the Minister of Food and Agriculture has pointed out; and I think in India both our tools and our coverage are improving. If not fully satisfactorily, I think we have enough information for purposes of current planning.

I shall now consider a second aspect, a big field which I may perhaps call statistical techniques relating mostly to production. This, of course, is the special sphere of work of the Indian Council of Agricultural Research, and covers the design of experiments, field trials, nutrition experiments, etc., which require an entirely different approach

from the estimating surveys and the collection of data on crops and yields. This is a second big field for advanced studies and research about which I shall say a few words.

But first let me finish demarcating the whole subject. There is a third big group of studies relating to agricultural economy of which I have given one or two examples. Such studies would be particularly useful in connexion with planning to which, Sir, in your Inaugural Address you have made many references. Work in that field would be essential for the progress of planning in India.

But I should like today to make somewhat more detailed references to the second group of technical studies concerned with the use of design of experiments in agriculture and related problems. In the first section of agricultural statistics we are concerned primarily with the collection of basic information on land utilization and out-turn of crops and agricultural products. In the third section we are concerned with the economic aspects of production, interrelationship between income and demand, or the advantages of consolidation of holdings, for example, another very important subject for study. In the second group we are concerned with the biological, in its broad sense, or may be even physico-chemical techniques which we can use to produce a bigger supply of better quality of agricultural products. This, I think is the central aim of the second group of studies.

In this second group there are big problems to be solved. I may perhaps give some examples. Let us consider fertilizers. What are our national needs ? We have got one factory at Sindri, manufacturing 70,000 tons of nitrogen. We are thinking of establishing two or three more factories of the same capacity. Last year I had myself pressed that instead of two or three we should establish five or six more factories like Sindri. I personally feel that fertilizer factories like Sindri (but not only for nitrogen but also for phosphates and potash) should be given a very high priority subject to only one consideration which I shall briefly explain. It was because of this consideration that I did not press for fertilizers more strongly. A more basic approach would be to develop our heavy machine building industry very quickly; and remain content with installing only two or three fertilizer factories with imported machinery during the next five years, while we are increasing our capacity to manufacture fertilizer plants and machinery in India. We have plenty of iron ore. We have more iron ore than any other country; and three times more than the U.S.A. Once we have the means to produce fertilizer plants in India, there is no reason why we should not be able to set up one or two Sindri type factories every year

But do we want them, and if so how many do we want? What should be the pattern of fertilizer manufacture not merely during the next five years when our resources would be meagre, and we know that we cannot set up more than two, three or four factories, but what should be the long term plan about fertilizer production? To answer this question it is obviously necessary to make a broad survey of our fertilizer needs on a large-scale covering the whole of the country. Suppose we have enough resources,—and planning becomes meaningless if we do not have increasing resources as the only purpose of planning is to increase resources—suppose we have enough resources, then what should be the fertilizer targets?

A second question. Until we have an adequate supply of fertilizers what would be the best way of using the available supply? I do not know the answer. Our lands are of very different quality; and we may classify them as some of very good quality which normally give a good deal more than the average yield, some of average quality with average yield, and others of poorer quality. Now if we apply the same amount of fertilizer to these three types of land, which would give the biggest dividend in the form of say an additional yield of food-grains? That is a kind of question which would continually arise and must be answered from the national point of view and not merely in a market economy. So long as our resources are meagre and we have an inadequate supply of fertilizers to meet total needs how can we, from the national point of view, make the best use of what we have? This is the kind of information for which experiments have to be conducted on a national scale, and estimates have to be prepared of national requirements of fertilizers of different kinds, and how best to use them.

Let me refer to another problem, namely, water requirements of crops which have been the subject of a good deal of debate and even heated discussions. We are in urgent need of information on what additional yield of crops we may reasonably expect when irrigation is extended by a given amount either through major irrigation schemes like barrages and canals or through the excavation of tanks, tube wells, etc. This offers a very important field for careful investigations by statisticians.

I myself had to give some thought to this problem about 20 years ago in connexion with what used to be called, the Burdwan Hooghly Horwah Irrigation Scheme, and which has been now transformed into the great Damodar Valley Project. If we put up certain barrages and irrigation works in the Damodar Valley then we should get so much additional water for irrigation and the question arose what would be

the additional yield of paddy in the irrigated area? Would it be so much as to make the scheme worth while? At that time there was no question of power development. Leaving power aside, the problem was to decide whether the return in the form of additional yield of paddy would justify incurring the capital cost of the proposed irrigation works. This is a type of problem which is continually arising. It is no doubt a rather complicated and difficult problem in which many different factors are involved. However, it seems to me that the modern statistical theory of design of experiments is well suited to disentangle the effect of many of the factors which are at work at the same time. This problem should be capable of being studied through properly designed observations and controlled experiments. If we take rice, for example, it should be possible to find out what would be the effect on yield of an additional supply of water at different times and under different conditions of cultivation. It would have to be a kind of complex experiment of a rather complicated kind. But I am convinced that the results of such experiments would be of very great help in agricultural planning.

I may also briefly refer to a third problem, namely, the interaction between fertilizers and irrigation. This also is a most important question. If we do not have an adequate supply of water, we shall not get sufficient return from fertilizers. The question is, at what level of irrigation would the additional dose of fertilizer become truly effective? Now, these are problems which cannot be handled in a straightforward, routine manner. There is need of ingenuity in combining laboratory experiments, field trials, and other sources of information on the yield of crops in relation to rainfall and irrigation. Any advance would be of very great help.

Again I may mention the vast subject of improvements in methods of cultivation. For example, recently we have had much discussion on the advantages of the Japanese method of cultivation of rice. Here, again, the factual position still seems to be somewhat obscure. It is obvious that in the basic Japanese method if you put in a good deal of fertilizers and also a good deal of manual labour for cultivation, weeding, watering, etc., then the yield must be much larger. But what is really needed is somewhat more precise information on what would be the additional yield of rice for a given input of labour or a given input of fertilizer or of water supply. It is only when information of this kind becomes available that it would be possible to prepare realistic plans for the use of the Japanese method to increase the supply of rice.

I have in mind a much broader problem of cultivation, namely, the effect of consolidation of holdings. The question of ownership is,

of course, important; but just now I am looking at the problem from the point of view of production. Every one is agreed that consolidation of holdings would be of great help as it would facilitate the use of improved methods of cultivation. I am not thinking of highly mechanised production immediately, but it seems to me that we may with some confidence look forward to a certain increase in the supply of power, either in the form of electricity or through simple steam engines, in our villages. The pattern of production in India, as I have stressed in other lectures and articles, in my opinion, should be as highly dispersed as possible. If this is the correct view, then a good deal of production in household industries and handicrafts should in future be located in villages using the most modern machinery with the help of electricity or some other form of power. If we succeed increasingly to introduce power in the villages, as I hope we shall, then the question will arise to what extent we can use power in agriculture.

We cannot immediately have a large number of tractors operating in our villages. It is simply not possible. We cannot afford to have tractors on a large-scale until we start manufacturing them here in our own country. We cannot even repair and service them economically at present. I am not ruling out the possibilities of using tractors after many years; I do not know and I have no rigid views. It is simply not feasible in the near future. However, if power is increasingly introduced in the villages, the question will arise what would be the best way of utilizing such power either as electricity or in other forms for agricultural purposes. This seems to me to be also a subject to which some thought should be given. This again falls within the sphere of interest of the second group of statistical methods based on design of experiments. Here also controlled experiments would be extremely useful; and looking to the future, I think, might be of great help in planning at the national level.

I shall refer to only two other topics; improved seeds and crop protection. The use of Fisherian designs in varietal trials has been of crucial importance in the production of improved seeds. Statistical methods also supply a powerful tool for research in plant genetics. It seems to me that we are somewhat backward in such studies in India. Considering that this is a vast country where 45 or 50 per cent. of the national income comes from agriculture, I personally think that researches in plant genetics are much too meagre. I think that is a subject where the statisticians should press hard to get a good deal more done. Then, there is also the vast subject of crop protection. Here, I think, in

India we are doing a certain amount of useful work on the study of crop pests, but a good deal more requires to be done.

I have spoken at some length on the urgent need of more work in what I have called the second area of the application of statistical methods in agriculture which is based on the use of the design of experiments. I venture to think that is a very special responsibility of the Indian Council of Agricultural Research and your Society. I have tried to indicate the vast areas of ignorance which require urgent attention. These are subjects of basic importance for crop production and crop protection not only for the immediate future but for purposes of agricultural planning over a period of 15, 20 or 30 years or more. I have referred to five important topics, namely, the need of fertilizers, water requirements of crops, improved methods of cultivation, improved varieties, and methods of crop protection. Work in this field offers almost unlimited scope for scientific research using the basic methods of controlled experiments in which the theory of design of experiments would be a most important tool. This is a vast field which, in comparison with statistical surveys for purposes of estimation in agriculture, does not seem to have been fully cultivated in India. This is a thought which I should like to commend to you. I should also like to draw your attention to the need of hard and systematic work to build up the scientific foundations for crop planning for the next 30 years to change the whole pattern of living in India.