SYMPOSIUM ON LONG-TERM PROJECTIONS OF SUPPLY AND DEMAND IN AGRICULTURE*

OPENING REMARKS BY THE CHAIRMAN—DR. S. R. SEN

LADIES AND GENTLEMEN:

I AM particularly happy to be here today. There are several reasons for this. Firstly, this gives me an opportunity to wish you all a happy New Year, and secondly, the question under discussion is of particular interest to me. I will only refer to the basic importance of long-term economic projections, whether it be in *laissez-faire* economy or planned economy or mixed economy. As you are aware, even in a *laissez-faire* economy, the projections are very useful; short-term projections are useful to businessmen and to various other people who take interest in day-to-day developments in the economic field, while long-term projections are of particular interest to economic policy makers. But it is only when it comes to planning that long-term projections assume special importance. They are in fact basic to planned economic development. As the techniques of planning advance, one has to undertake many kinds of exercises. One has to take stock of all the trends in the past as also the present situation, especially the interrelation of different sectors. In the light of these, the short-term, medium-term and long-term plans are prepared. It is in the formulation of these plans that the projections of demand and supply assume great importance.

When one is taking a long-term view, a perspective view, one has to deal with so many facts and figures. Certain facts are given, certain facts are assumed, while some others are not given at all. One has to co-relate all these various aspects. The process that one has to follow is one of successive approximation and iteration. In this process, one may start with certain basic assumptions, proceed to test them against facts and on this basis modify the ideas on the

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various points. It is mainly through a process of successive approximation and iteration that we arrive at the targets under the Plan.

Long-term projections—whether industrial or agricultural—have considerable use, whether it be in a *laissez-faire* economy or in a fully planned economy, or in a mixed economy. But the type of economy has some relevance to the nature of projections. Certain changes, which are assumed in the techniques of long-term projections, are valid in *laissez-faire* economy, at least in the first approximation, if these are the results of endogenous forces. Future trends can then be built up on the basis of past trends. But there may also be certain exogenous forces, which may lead to deviations from the trend line to some other direction for which one has to make certain allowances. In a *laissez-faire* economy, these exogenous forces are not determined by the State although one may make a guess about them. One may try to influence them, but one cannot always determine them with any degree of certainty. In planned economies, however, certain decisions regarding these endogenous and exogenous forces need to be taken. Changes will come from outside as a result of these decisions which are largely determined by the Government or the Planning authority. Some of the investments in planned economy are lumpy in nature and these consequently alter the trend line. Even then, it is obvious that the techniques of projection will become simpler in a planned and semi-planned economy than in a *laissez-faire* economy, because in the former there are certain parameters, which are determined. I would not go into this question in greater detail just now because we have a number of experts who have kindly agreed to speak to you on these and other related aspects of long-term supply and demand projections.

Closing Remarks

I think, we had a very useful discussion on the various aspects of long-term projections of supply and demand in agriculture. We are all aware that we have asked more questions than found answers for them. It is the formulation of correct questions, which is the basis of a scientific enquiry. In this symposium, we started with three questions put forward by Dr. Krishnaswamy, other speakers put other questions also, and finally we entered into this problem of changing parameters. Technology goes on changing—technology not only in the field or the factory, but also in regard to the methods of analysis adopted. But if our planning process or policy-making process is such that it gives ourselves periodical opportunities of re-examining all the old assumptions and making new assumptions, there one has a certain safeguard. For, we are not then making projections for all time to come. The process that is followed in any intelligent planning exercise or in any wise policy formulation in the economic field is that today one may make a certain long-term projection but one also changes it after five years or so. There is again the technique of successive approximation and iteration by which one passes on from one stage of imperfect knowledge to another of somewhat less imperfect knowledge, and in this way one goes on from one step to another and makes reasonable progress.

In conclusion, I would be reflecting your feelings when I say that we are very grateful to the Indian Society of Agricultural Statistics for giving us this opportunity to meet here and discuss this subject of great topical importance.

SHRI K. S. KRISHNASWAMY[1]: **Long-term Demand and Supply Projection of Agricultural Commodities**

In view of the limitations of time and my own competence, I shall confine my observations on long-term demand and supply projections to the elucidation of certain general points to be borne in mind in all such exercises. I take it that we are interested in long-term projections as instruments in planning; they become relevant in the context of defining the perspective with reference to which changes —actual or planned—occurring in a relatively shorter period may be assessed. The logic here is that in the case of long-term projections we would be able to focus attention on the possibility of variations in some of the elements which would be taken as data in the short run. For instance, while we might assume constancy in regard to rate of population change or rate of technological progress or consumers' tastes in the short period, we will have to treat them as variables in projections covering a long period of years. This has both advantages and disadvantages. The advantage lies in the fact that many of the elements which constitute constraints on short-term policy or planning can themselves be viewed as variable and therefore susceptible to policy influences. As a consequence, what would appear in the short term as a source of conflict in objectives can be handled in such a way that the problem is reduced to one of ordering the objectives along a time-scale. Clearly, this facilitates a more rational assessment of

[1] Planning Commission, New Delhi.

possibilities and of the suitability of policy instruments. However, it is also true that as the time period is lengthened for projection purposes, some of the uncertainties which could be left out of account in the short period will have to be explicitly worked into the projections covering a longer span. It is essentially this aspect which will have to be given weight in the technique adopted for deriving long-term projections on the supply or the demand side.

2. Given the increasing possibility of variability in individual elements as well as in the structure of relationships between them when we look further ahead into the future, it is obvious that any exercise in long-term projections of supply and demand has to be something more than an extrapolation of trends derived entirely from past data. To put it differently, we shall have to introduce certain normative judgement in the projections. Most certainly, care will have to be taken to see that these judgements are minimal in number and not inconsistent with one another. What these normative judgements ought to be will depend inevitably on the particular context in which the projections are to be made. But no matter what the system that we are dealing with is, the need for importation of certain normative values into the projections will remain. In practice, it will not be possible to fulfil the objective of long-term projections in the context of planning—which, I would assume will be the indication of the spectrum of possibilities that could be associated with *feasible* changes in policy parameters or structural coefficients—if we tie ourselves entirely to the pattern or rate of change that might be evidenced from past trends in the magnitudes concerned.

3. Admittedly, the anticipations in regard to possible changes in policy parameters or structural coefficients cannot be entirely arbitrary. They have to be related to:

(i) the time horizon for the projections;

(ii) the values of target variables at the initial position;

(iii) the extent of disaggregation involved; and

(iv) the relative importance of technological and behaviouristic elements in the functional relationships.

Secondly, inasmuch as the required projections involve common independent variables or parameters, the set of assumptions regarding policy constraints and exogenous factors on which such projections are based has to be clearly defined. These considerations have a bearing on the nature and scope for imposed judgements. What I have in mind may be illustrated in broad terms by the work done on "Agricultural Commodities Projection, 1970" by the F.A.O. In these projections, the procedure adopted has been one of combining historical trends with a judgement on possible changes in these trends over the projection period. In the case of both population and *per capita* income, an upper and a lower limit for the end-point are envisaged; and the values for target variables are derived in terms of ranges rather than definitive single-point magnitudes. The projections also involve the further judgement that, as *per capita* incomes increase, the operation of Engel's Law becomes more significant. It is not for me to say whether these are the only or the most correct assumptions to make in projecting the demand for agricultural commodities. My intention in referring to that study is that in all long-term projections which seek to assist policy, judgements regarding likely values of some of the variables or parameters have to be imposed and that it is best to recognise this explicitly.

4. Turning now from these generalities to the main topic of the Symposium—namely, long-term demand and supply projections of agricultural commodities—I would only raise a few questions for consideration. When one looks at the problem of demand projections, it is obvious that the changes in both income and prices over the projection period will have to be integrated. A projection based only on the likely trend in *per capita* income can be no more than a first approximation; for greater precision, we have to allow for changes in the pattern of income distribution, which cannot be assumed to be uniquely related to the level of *per capita* income. Secondly, we have to recognise the fact of changes in relative prices and their repercussions on the measurement of "real income" of which demand can be conceived as a function. And thirdly, we have to take into account the effects of both changes in income and in relative prices on the demand for related commodities. To illustrate, in projecting the demand for foodgrains, we have to recognise the possibility of a change in the demand for say wheat, resulting from a change in the supply and price position of rice or jowar. How strong such cross-elasticities are likely to be, and at what levels and time, are matters which have to be evaluated in the process of demand projections.

5. These are well-known problems and the difficulty is largely a practical one. It is arguable that in the context of long-term projections, changes in relative prices are not amongst the most important factors to worry about. This is perhaps true if the sights are set only

on the terminal point. But, when intermediate positions have to be defined—and this is important for operational purposes—the weight to be assigned to the relative price factor cannot be considered as negligible, especially in an underdeveloped country like India and especially in the case of agricultural commodities whose prices influence the distribution of total income between the low-income-earners and the high-income-earners.

6. As regards long-term projections on the supply side, the scope for firmer projections is probably larger. In respect of both the supply of inputs and changes in productivity, it should be possible to work out reasonable assumptions. The uncertain element here is basically one of envisaging the policy frame-work that would be conducive to rapid increases in productivity per man or per acre. In principle, the price question would also arise in this context; this is because, in the conditions such as we have, the extent to which agricultural production may be considered to be price-elastic has to be determined. But in practice, this may have to be subsumed under the general assumption regarding the policy frame-work with reference to which the projection is made. A more important analytical question which may have to be answered here is whether the projections should be for individual commodities or for groups of commodities which compete for the same supplies of factors of production or for the satisfaction of the same demand. I am aware of having done no more than list a set of problems which appear worthy of consideration; and if I have not hazarded to give any suggestions about the techniques that will help resolve these questions, it is not for lack of time. I hope that the distinguished speakers in this symposium will throw light on the manner in which these problems can be dealt with in developing long-term projections of supply and demand.

SHRI J. SATYANARAYANA[2]: **Some Aspects of Long-Term Demand Projections for Agricultural Commodities**

Introduction

The demand of an individual for a commodity depends upon his disposable income, price of the commodity, prices of the substitutes and complements (relative prices), and his tastes and preferences. Theoretically, therefore, all these factors must be taken into account while projecting demand for a commodity at the individual level. The

[2] National Council of Applied Economic Research, New Delhi.

usual approach is to establish a relationship between quantity consumel (dependent variable) and the various factors (independent variable) making use of the available data and to project it into the future. The task of the demand analyst is to decide whether the past relationhip will hold good for the future or it would change, and if so in what direction and to what extent.

The elasticity of demand for a commodity is defined, *ceteris paribus*, as a percentage change in quantity demanded relative to a one per cent. change in the independent variable where the independent variables stand for income, price and relative price(s).

Thus,

$$y = \frac{\%\text{ change in quantity demanded}}{\%\text{ change in independent variable}}$$

where,

y = Elasticity of demand.

Thus, income, price and cross-elasticities of demand refer to the change in quantity demanded with respect to change in disposable income, own price of the commodity and relative price (s) respectively.

The effect on demand of the variable taste cannot be quantified as the effect of the other variables, but if a trend were exhibited in the past, it can be extrapolated for future. However, it should be recognised that a trend projection to predict consumer behaviour is subject to many limitations and cannot be justified in all situations.

The Fundamental Assumptions

There are two sets of assumptions implicit in the technique of demand projection and the first set, in a sense, is germane to all economic projections. This set assumes that over the projected period the economy operates under normal conditions—free from political upheavals, natural calamities, wars and devastations, etc. The technique of projection cannot work if these fundamental assumptions cannot be guaranteed and therefore, the analyst is justified, by and large, in making assumptions about continuance of such conditions.

The second set of assumptions is of a different nature and subgroup (1) relates to changes in the direction and magnitude of the determining variables, Assumptions of subgroup (2) refer to the changes in the elasticities of demand, the quantitative relationships between the commodity demanded and its determining variables.

The demand analyst has to take into account all the relevant factors in estimating future demand for a commodity, assign importance to each factor on the basis of some anticipated developments and then only determine the order of magnitude. Usually, the analyst assumes that all factors except one will vary, determine the effect of that factor on demand. The ingenuity and technical skill of the analyst lies in relaxing the assumptions step by step, accommodating for the interplay of all factors and ultimately arriving at the final order of demand.

The Derivation of Elasticity

The sources of data for the derivation of elasticities of demand are the time series and cross-section, single or repeated. The former provides a basis for estimation of income, price and cross-elasticities of demand, if data are available for a sufficiently long period. The demand models which can be postulated for derivation of elasticities can be of several forms which cannot be discussed here. The difficulties, involved in finding a uniform time series which permits the application of rigorous statistical techniques to estimate the parameters are many and complex. Usually, the models which provide the most efficient estimates of the elasticities (standard errors being the smallest) are adopted for the measurement of elasticities.

The single cross-section data contains information on quantity (value) consumed and income (expenditure) of a family (household) at different levels of income (expenditure) while own price of the commodity and relative prices remain constant. The models used to derive income (expenditure) elasticities of demand from single cross-section data are mainly of four different types: The Arithmetic model; The Double Logarithmic model; Semi Logarithmic model; and the Reverse Semi Logarithmic model.

These models have different implications to the relationship between the quantity demanded and the independent variable. The arithmetic model suggests that an absolute change in quantity demanded is the result of an absolute change in the independent variable. The double log model implies that a percentage change in the quantity demanded is brought about as a result of the percentage change in the independent variable. The model implies that elasticity remains constant over all ranges of the determining variable. The semi long model envisages that an absolute change in quantity demanded is dependent upon a percentage change in the independent variable. The elasticity is assumed to decrease over the different ranges of the independent variable. In the case of the last model the reverse semi long model, it is assumed that a percentage change in quantity demanded is related to an absolute change in the independent variable. In other words, the elasticity is expected to increase as one moves up along the curve representing the relationship between the dependent and the independent variable.

For the derivation of elasticity with respect to income (and, in fact, with respect to price also) the models suggested here and as well some others, are usually adopted. The procedure is to accept the model which gives the estimated elasticity with the smallest standard error.

The analyst has to project the magnitudes of the determining variables also over the forecast period in order to evaluate the combined effect of the changes in elasticities and the levels of each one of the determining variables upon demand. The analyst may be content with accepting projections of these independent variables, if available, or he will have to project their magnitudes also.

The Basis of Projection

The technique of projection is based on the concept of elasticity which is derived as a percentage change in quanity demanded divided by percentage change in the independent variable. Thus, if income alone changes, as a first approximation, percentage increase in quantity demanded is nothing but the product of the percentage change in individual's disposable income and the income elasticity of demand.

Effect of Change in Income on Demand

The magnitude of income elasticity at the present time obviously relates to the current distributional pattern of income which is bound to change over the projected period. The direction in which the change is likely to take place is not difficult to predict since a more egalitarian distribution of income is implicit in the social philosophy underlining planning which implies that there will be less number of persons (households) in the low income brackets and more, perhaps, in the upper income brackets by the projected period. The income elasticity of demand used for purposes of projection is an average of income elasticities over different ranges of income. The magnitude of this average depends upon the number of persons (households) in each income bracket at any period of time except for the double logarithmic model where the coefficient of elasticity remains constant. The extent to which inequalities in income distribution will be reduced on which the change in the income elasticity partly depends over the projected period is hazardous to predict. The overall average of all ranges will vary with the change in the number of persons (households) in each range..

The projected income elasticity of demand for a commodity depends on a number of factors and often the judgement of the analyst alone gives the final answer. If it is reasonable to assume that by the projected period the average income of the household (individual) reaches a particular level, the elasticity applicable to that range as at the present moment (revealed through current household budget data) can be adopted for purposes of projection.

The income elasticities for certain goods can be predicted visualising the behaviour of the consumers towards consumption of those goods as their incomes tend to increase. For example, as incomes increase, those persons (households) which are in the very low income bracket are likely to spend a major portion of their increase in income on foodgrains because they have been on the margin of subsistence. This naturally suggests that a higher income elasticity in the case of very low income groups is a legitimate assumption as income increases. Following Engel's Law, it appears also true that as people move into high income brackets their *per capita* consumption of foodgrains reaches a saturation point beyond which the effect of change in income on demand will not be felt.

In a case like demand for cotton textiles (to derive demand for cotton) it may be appropriate to assume that income elasticity increases as standards of living of the people improve. This may be true over all ranges of income at least for some time to come in the context of the present consumption of cotton textile in India although it can be argued that a shift in demand from cotton to other textiles may take place.

The Effect of Change in Prices

The available time series and continuous cross-section data (although not available at the present moment in India) can be employed to derive the price and cross-elasticities of demand for a commodity. The change in the magnitude of price elasticity is difficult to predict while it is true that structural shifts in price elasticities usually take place only over long periods of time.

The technique of projection can be applied to determine the effect of change in own price of the commodity upon quantity demanded if change in the level of price be predicted and that all other factors remain unchanged. This method follows the basic approach to demand projection as in the case of income.

The Problem of Relative Prices

The problem of relative prices is relevent to demand projection in the sense that if the price of a commodity relative to its substitute(s) increases, there will be a shift in demand from that commodity to its substitute(s). The extent of the shift depends upon the magnitude of the cross-elasticity of demand and change in relative price(s) for the product under consideration.

The cross-elasticity of demand for a commodity can be measured through available time series and continuous cross-section data. The problem then is to project the level of change in relative price(s) and the change in the magnitude of cross-elasticity. Firstly, the changes that may take place over the projected period in relative prices are difficult to predict. Secondly, the relationship between quantity demanded of a commodity and the price(s) of its substitute(s) which may take place, is equally, if not more difficult to project.

If, however, the data are available, the relationship between quantity demanded of a commodity and relative prices and cross-elasticity measures can be expressed as in the case of income and price elasticity and the effect on demand measured.

The direction and magnitude of changes in relative price(s) are very difficult to predict and at best they can be based on guess work. It may, therefore, be desirable to work with a much simpler assumption that relative price will not alter over the projected period; the loss of information is perhaps, not serious compared to the alternative of making untenable guesses. The income projection is generally made in constant prices which partly takes care of the effect on quantity demanded of the change in relative prices. The demand projections for these reasons are usually based on the assumption that relative price will not change over the projected period.

The Effect of Change in Taste on Demand

The discovery of synthetic fabrics has brought about a shift in demand from cotton and silk to synthetic fabrics. Many other examples of a similar nature can be drawn to illustrate the effect of changing patterns of demand. This inducement to change in tastes is the result of technological developments, demonstration effect and what is known as *consumption dynamics.*

The quantification of effect of change in taste variable on demand which implies, in the main, that some X per cent. of change in demand can be explained by a change in taste alone over the projected period, is not a simple problem for obvious reasons. The trend observed in the past in some cases can be extrapolated into the future on the assumption that it will continue. Secondly, the changes that have been taking place in consumer tastes in other countries may also provide an indication as to what can happen in a particular country undergoing similar experiences. Opinions of commodity experts are found extremely helpful in predicting the changes in demand caused by changing preferences and tastes.

Effect of all Factors on Demand

It is more easy to demonstrate the effect of change in the levels of determining variables and the corresponding parameters (elasticities and trends) on demand if a double logarithmic model is used for purposes of illustration. The limitations in adopting such a model should be fully recognized.

$$q_t = q_0\left(1 + \frac{y_t - y_0}{y_0}\right)^{\eta_y} \left(1 + \frac{p_t - p_0}{p_0}\right)^{\eta_p} \left(1 + \frac{p_t^s - p_0^s}{p_0^s}\right)^{\eta_{p^s}} \exp. t$$

OR

$$q_t = K \, . \, y_t^{\eta_y} \, . \, p_t^{\eta_p} \, . \, ps_t^{\eta_{ps}} \, . \exp. t$$

where

q_t is projected *per capita* demand at time t

q_0 *per capita* consumption at time t_0 (base period)

y_t projected *per capita* income at time t

y_0 *per capita* income at time t_0

p_t projected price (own price of the commodity) level at time t

p_0 price (own price of commodity) level at time t_0

p_t^s relative price level at time t

p_o^s relative price level at time t_o

η_y income elasticity of demand

η_p price elasticity of demand

η_p^s cross-elasticity of demand

exp. t trend factor.

The adoption of such a statistical technique lends content to economic thinking in more rigorous and quantitative terms than otherwise possible.

Alternative Projections

The projected demand for a commodity is a compound of the effect of the change in the levels of the determining variables, namely, individual's disposable real income, price of the commodity, relative price(s) and tastes and preferences and change in the parameters, namely, income, price and gross elasticities and trend factor. There are four determining variables and four measures of the parameters to limit the number only to these, despite the fact that there can be several others. Theoretically, therefore, there can exist 16 combinations but some of these can be ruled out on the basis of economic and other considerations.

The projected demand at the *per capita* level can be raised to the aggregate through the process of multiplication of *per capita* demand by the estimated population. Here again there is scope for different projections of population based on different growth rates which are conditioned by different sets of net births and death rates. Secondly, if the age composition of the population is expected to change over the projected period, the adult equivalent of the population must be estimated. It is desirable and useful in a demand projection to work out range of projections with alternative sets of assumptions with respect to the levels of the determining variables and magnitudes of elasticities.

The alternative projection of demand for selected agricultural commodities as worked by the NCAER over the period 1960–61 to 1975–76 are presented in table below.

Commodity		Unit	1965-66	1970-71	1975-76
Foodgrains					
Projection	I	Million tons	94·81	111·92	131·54
,,	II	,,	95·44	112·81	132·10
,,	III	,,	95·81	114·56	137·09
,,	IV	,,	95·44	113·05	133·44
Oilseeds					
Projection	I	,,	7·48	9·63	12·42
,,	II	,,	7·62	9·85	12·54
,,	III	,,	7·63	9·94	13·00
,,	IV	,,	7·62	9·91	12·90
Cotton					
Projection	I	Million bales	6·47	7·91	9·65
,,	II	,,	6·58	8·13	10·10
,,	III	,,	6·59	8·17	10·19
,,	IV	,,	6·58	8·10	10·00
Tobacco					
Projection	I	Thousand tons	331	398	478
,,	II	,,	335	406	493
,,	III	,,	336	410	504
,,	IV	,,	335	406	493

Note.—Projection I refers to alternative *per capita* income projections. Projection II refers to alternative income elasticities. Projection III refers to alternative population estimates. Projection IV refers to the one which the NCAER considers the most probable.

Finally, there is no substitute for judgement which plays a vital role in determining the order of magnitude of demand for a commodity. This judgement does not mean some guess work but it should be based on a careful analysis of the data available, etc.

SHRI S. RAGHAVACHARI[3]: **Problems Involved in Making Long-Term Projection of Population**

In the context of demand projections which form an essential feature of national plans for economic development there arises a great need for a reasonably correct assessment of the dynamics of population growth. Whether this assessment is reasonably correct or not depends on the accuracy of information regarding:

(i) the present level of population size and its characteristics, namely, age and sex composition, levels of fertility, mortality and migration;

[3] Central Statistical Organisation, New Delhi.

(ii) the past trends in fertility, mortality and migration; and

(iii) the most likely future course of the various population components.

Given some firm data under these three heads the mechanics of the projection as such is a simple affair, since the "component method" that we normally use centres round the well-known additive equation

$$P_{t+1} = P_t + B(t, t+1) - D(t, t+1) + M(t, t+1)$$

where P_t = population at time 't', $B(t, t+1)$, $D(t, t+1)$ and $M(t, t+1)$ are respectively the births, deaths and net migration during the interval $(t, t+1)$. The 1959 official projections on the eve of the preparation of the Third Plan as well as its revision in 1961 soon after the release of the "1961 census provisional population totals" were calculated by the component method. However a look at the spate of population projections that was there round about that time highlights the various problems involved in projecting the population even for as short a period as a decade. Most of these projections made use of the "component method" but the end results were widely divergent; the lowest estimate for 1961 all-India population was 404 millions while the highest was 431 millions. A scrutiny of these projections indicates that there were differences even in the current levels assumed, with regard to some of the components of population growth. For example, the general fertility ratio, *i.e.*, the ratio of the number of births to female population in the reproductive ages 15–44 assumed for 1951 varied between 0·177 and 0·189 with the corresponding birth rates ranging between 40 and 43. There were also conflicting views regarding the life tables for the base year so that one demographer went to the extent of constructing alternative life tables for the census year 1951. The age distribution of the population for the base year which is fundamental in population projection is again subject to a number of smoothing procedures since the census age data is proverbially defective due to under-enumeration, age bias, digit preference, etc., at various ages. A lot of subjectivity is also therefore introduced into the base year age distribution depending on the type of smoothing procedure adopted and to that extent the projections further vary from one another.

Regarding the past trends of fertility, mortality, etc., there exist till now very meagre data. Till very recently the demographic surveys have been on a very small scale and conducted in localised areas so that the agreement with regard to the trends in the components of population growth for the country as a whole has been of a qualitative nature and hence there occurs a divergence of views, while quantifying them for computational purposes. For example, as has already been indicated though fertility is accepted generally to be at a sustained high level for a long time, when it comes to the question of assessing its current level all that could be said was that it was probably somewhere around 40.

One faces the most difficult problem with regard to projecting the population into the future while stipulating the assumptions regarding future trends in fertility, mortality and migration. The demographic experience of other countries indicate that the past course of the various components of population growth however accurate the data may be, cannot be projected into the future without any serious misgivings. The "theory of demographic transition" which aims at predicting the course of population growth in a closed population bases itself mainly on the past trends experienced in the population of advanced countries. However as recent evidence show that there are too many exceptions to the rule that no generalisations could be made based on this 'theory'. To explain, the transition theory stipulates that a closed population grows slowly initially due to balance of births and deaths in what may be called the pre-industrial period. Then while the country is industrialising death rate starts falling followed by the birth rate after a time lag when there will be an enormous increase in population growth. Ultimately the growth of population settles down to a low level once again due to balance of births and deaths. And according to this theory the phenomenon is supposed to start in high urban centres and reach the agrarian population ultimately. It is enough to give just one example here to show that there are many exceptions to the rule. In the 1930's the birth rate of the agrarian population of France was as low as those of its urban and industrial population. And the industrial and urban north displayed a higher birth rate than the predominantly rural south. Further even the rate of fall in the death rate experienced by the developing countries like India which are benefiting from low cost Public Health measures and medicine is phenomenal compared to what was experienced by the new advanced countries where the average rise in e_0^0 since 1900 up to 1930 amounted only to 0·4 years. In contrast in Ceylon e_0^0 rose by 2 years within a period of one year, *i.e.*, 1947–48, by over a year in 1949 and by 0·7 years during 1949–53. Hence no such theory could be blindly applied to the Indian Population in projecting it to the future.

The most intractable of all the population components besides migration is fertility. Information available on Indian fertility as mentioned before is derived largely from a limited number of localised surveys conducted in the country during the course of the last fifteen years or so. The results of these surveys would permit only certain broad generalisations for the country as a whole regarding the levels, differentials and trends in Indian fertility. Some of these surveys do indicate that a decline in birth rate might have begun to manifest itself in some of the highly urban areas. Since the bulk of the population is rural it is to be expected that for the country as a whole institutional and cultural factors will play a predominant part in shaping the levels and trends of fertility.

According to available data the current age at marriage for women is around 15 years and analysis shows that unless it is raised well above at least 18 years its dampening effect on fertility is not going to be much. And such remarkable increase in age at marriage may take quite some time to achieve. Since widow remarriage is not considered to be common in India, the increase in average age at widowhood due to improvements in mortality may, if at all, tend to increase fertility at least in the short run. Further the Indian Government is committed to a programme of family planning and increasing budget allotments have been made in the Five-Year Plans. Very few localised studies have so far been conducted in the country to assess the attitude of the people to family limitation. Though these studies do indicate that the people at large are favourably disposed to the idea of family limitation and the desire for small family is spreading, such motivation is still weak to make them take positive action. These are all qualitative features which pose a difficult problem while quantifying them for projection purposes.

In view of the large amount of arbitrariness that necessarily enters into the assumptions, the demographers generally resort to the expediency of providing alternative sets of projections placing the onus on the users to adopt whichever set of figures they may please. Even so one should agree with the Expert Committee under whose guidance the 1961 official population projections were calculated that the projections are tentative even for a decade and are even more so beyond that period.

In the end it may be mentioned that in projecting the All-India population one is spared the ordeal of having to tackle the migration component which assumes unmanageable proportions when the Statewise break up of the all-India figures is desired. Though normally the "ratio method" is adopted to circumvent this difficulty as was done in the 1959 projection the method often leads to figures totally unrelated to reality especially for small areas because of too much of "pro-rating" involved.

SHRI RAM DAYAL[4]: Problems in Demand Projections

A distinction has to be made between demand prediction and demand projection. Prediction means arriving at a specific figure of demand in a particular future time period, while projections relate to estimating demand levels or changes in demand under given assumptions about one or more of demand determinants. Demand projections are concerned not so much with what the demand would be but with what the demand would tend to be if one or more of causal factors changed in a particular fashion. Techniques of demand projections consist mostly of techniques of determining parameters (*i.e.*, elasticities or coefficients) which measure the effects of causal factors on demand. Given these parameters, a wide range of questions important for public policy and planning can be answered and the effects of Government policies can be anticipated in quantitative terms before these policies are brought into force. Demand projections are therefore not only useful for estimating the demand in a future year so as to have sound planning and to balance production with anticipated demand, but are more helpful in deciding on appropriate every-day policies. In this wider use of demand projections, it is necessary to know not only the effect of income but also of other factors. For this purpose, it is generally, though not inevitably, necessary to use time series data. The fact is that the use of both time series data and cross-section data is fraught with a number of problems and in actual practice, it is desirable to utilise both types of data for making dependable demand projections.

An important problem involved in demand projections from time series data relates to mutual dependence of variables and the consequent least squares bias. In any particular period, demand for a commodity is dependent on its price and other factors and the price of that commodity is in turn dependent on the demand for that commodity and other factors. This is a case of mututal dependence of demand and price, each one determining the other. Commonsense suggests that in such a situation of mutual dependence, one cannot estimate the effect of price on demand by writing down an equation

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wherein demand is dependent variable and price is one of the pre-determined, *i.e.*, independent variables, and estimating that equation by least squares. In statistical terms, one pre-condition for estimating a stochastic relationship by least squares is that the error term should be independent of the explanatory variables. It can be shown that this would not be so in the case of mutual dependence, and the least squares regression would give biased estimates of parameters, not only of the mutually dependent variables but also of other explanatory variables in the equation. Often, the amount of this bias is much larger, or even many times larger than the estimate of coefficient. This shows how dangerous it is to estimate parameters by least squares on the basis of a single equation in the case of mutual dependence. Where foodgrains as a whole are taken, even income may be mutually dependent with the value of quantity demanded.

It needs to be clarified that although the estimate of parameters would be biased under the circumstances just explained, the demand projections need not necessarily be so. Suppose in regressing the quantity demanded on price, we use the data for the past many years as determined by free market forces, and the new price level against which we want to project the demand is also determined by the free market forces. Then the demand projections would be unbiased even though the estimate of the parameter is biased. But suppose we want to find an answer to the question: What would be the demand if Government fixed the price at a particular level? These questions are more common in actual policy than the kind of one posed earlier. In this case, the biased estimate of the parameter would also give a biased demand projection. The reason is that the price fixed by Government is not mutually determined with quantity demanded by free market forces.

In many cases the extent of mutual dependence may be too small to be taken serious notice of. Karl Fox, who has done extensive empirical work on demand analysis in U.S.A., found that the quantity demanded was very highly correlated with production. As production was taken as a pre-determined variable (since it was dependent on price not in the same period but in the previous period), he could take quantity demanded also as the pre-determined variable and formulate a single equation demand model. He made his estimate by both the single equation and multiple equation approaches and did not find any significant difference in the two results in many cases. Where, however, the difference was important, the results based on multiple equation model had to be preferred. Econometricians agree that in cases of doubt, it is safer to formulate a multiple equation model.

The problem of mutual dependence and least squares bias is attempted to be solved by writing down the full equation system, consisting of as many equations as the number of mutually determined variables, each equation having one of such variables as the dependent variable. There are then various methods of estimating such an equation system.

If the equation system is just identified, the estimation procedure is relatively easy. The just identified system, in rather simplified terms, is one in which the number of variables in the complete system minus the number of variables in an equation is equal to the total number of equations minus one. When this condition is met, the equation system has to be converted to what is called "the reduced form", by multiplying the whole system by the inverse of the matrix of coefficients of mutually dependent variables. This gives a new equation system in which each equation has only one mutually dependent variable with a non-zero coefficient. The various equations of this reduced form system can be estimated by the ordinary least squares method. From this estimated "reduced form" system, it is easy to estimate the original equations.

There is, perhaps, still not complete unanimity among the leading econometricians about the interpretation and use of the coefficients of the "reduced form" system and of the original equations system for demand projections.

In many cases, the model of a mutually dependent system may take the form of a "recursive model" of which the well-known "cobweb model" is a special case. The chief characteristic of this model is that each equation has either a single "endogenous" variable (*i.e.*, variable determined within the system, or the mutually determined variable) or if it has more than one endogenous variable (s), the additional endogenous variable (s) has occurred as dependent variable (s) in the previous equation (s). The matrix of coefficients of the mutually dependent variables in such a system is a triangular matrix. The general mathematical condition for the use of the recursive method is that the Jacobian of the transformation connecting the disturbances with endogenous variables be triangular and equal to one. Estimation of this model is also not very difficult. The first equation has only one endogenous variable and so it can be estimated by least squares method. The second equation may contain an additional endogenous variable, apart from the one on the left-hand side of the equation (*i.e.*, dependent variable). This additional endogenous variable would, by the very definition of the model, be the one that occurred as dependent variable in the first equation. Its estimated values from the first equation, rather than the original values, are used in estimating the second equation. The logic behind this step is that the dependent variable in the second equation is mutually determined with the additional endogenous variable as it stood originally but not with its estimated values. By using the 'estimated' and not the original values of this additional endogenous variable, there is no mutual dependence left in the second equation and so it can be estimated by ordinary least squares. By adopting this method, all the equations can be estimated by the least squares method.

A more generally applicable method is that of two-stage least squares, originally developed by Theil and Bassman. This method is applicable to models which are just identified or over-identified. At the first stage, each endogenous variable is expressed as a function of all the exogenous or pre-determined variables (*i.e.*, variables determined independently of other variables in the system). In this way, estimated values of the endogenous variables are obtained by the ordinary least squares method. At the second stage, the original equations of the model are estimated by taking estimated values (those estimated in the first-stage) of the endogenous variables on the right-hand side of the equations. These equations also can be estimated by the ordinary least squares, as by the use of estimated values rather than original values the mutual dependence of variables is no longer there. The estimated values of the variables are as good as exogenous or pre-determined variables.

The other methods are those devised by the Cowls Commission of U.S.A. These are the "maximum likelihood full information" method and "maximum likelihood limited information method". Under the M.L.F.I. method, the likelihood function of the error terms in all the equations in the model is set up and is then transformed in terms of the variables in the entire system. This likelihood function is maximised with respect to different parameters and suitably "concentrated" so as to make it easy to estimate. The estimates of the various parameters which are arrived at altogether in this way, are such that make the probability of occurrence of the values of the different variables in the sample the maximum. This method gives the best results of all the available methods but it is a very laborious method and, for that reason, is seldom used.

In the maximum likelihood limited information method, a sub-set of equations which are of immediate interest are estimated. In doing so, only the information contained in the sub-set of equations is utilised and the restrictions embodied in the remaining equations are ignored. For the rest, the likelihood functions is set up as in the case of the full information method, suitably 'concentrated' and put in a relatively easy form for the purpose of estimation. Another explanation of the principle underlying this method is analogous to the least variance of the residuals in the least squares theory. What is required is to minimize the ratio of the variance of the error terms in the sub-set of equations to the total variance of the error terms in the entire system. This means that the improvement in the efficiency of the estimates of the sub-set of equations would be the minimum when the restrictions contained in the remaining equations were also utilized. This ensures that the difference between the limited information estimates and full information estimates would be the minimum.

The limited information method has been extensively used in the United States Department of Agriculture and universities in U.S.A.

Perhaps a more serious problem of demand analysis from time series data in India is that we do not have aggregate data on quantity demanded. In a country like U.S.A., estimates of quantity demanded are available through data on sales at different stores in the country. But in India what we have is quantity available for consumption as derived from production. In line with Karl Fox's argument mentioned earlier, quantity available for consumption can be taken as a pre-determined variable and price as the dependent variable in the demand function. This will give "price flexibility", *i.e.*, the effect of quantity on price. By algebraically transposing the estimated function, we can get demand elasticity, *i.e.*, the effect of price on quantity. But this transposition is permissible if the partial correlation between quantity and price is perfect, which never is the case. I know of many cases, where the demand elasticity worked out by taking price as the dependent variable and that worked out by taking quantity as the dependent variable differed by more than 100%. This is about price clasticity of demand.

The estimation of cross-elasticities, representing the effect of changes in prices of substitutes, etc., on the demand for a commodity, is conceptually not difficult, but the lack of data on quantity demanded makes it a serious practical problem. Even in U.S.A., very few estimates of cross-elasticities are available. Attempts have been made to estimate them indirectly. A full matrix of available income elasticities is written down and the gaps in this matrix (usually relating to unknown cross-elasticities) are filled up by making use of the following relationships derived from the Pareto's theory of preference fields:

1. The sum of the direct and cross price elasticities and the income elasticity is zero, assuming that consumer preferences are constant.

2. The ratio of the cross elasticity 'W' in which the quantity of, say, wheat is dependent on the price of say, rice to the cross-elasticity 'R' in which the quantity of rice is dependent on the price of wheat is approximately equal to the ratio of the expenditure on rice to the expenditure on wheat.

3. The weighted sum of the cross-elasticities of different commodities with respect to the price of, say, wheat is the negative of the proportion of wheat expenditure to total expenditure on all commodities.

4. The weighted sum of the income elasticities of all commodities is unity.

Another problem in the case of foodgrains is created by the fact that a major part of food production is consumed by the producers themselves. This makes estimation of parameters difficult. Take the case of price elasticity of demand. An increase in the price of foodgrains decreases the quantity consumed by non-producers through both the income effect and the substitution effect. But the same increase in price means more income for the producers from the sale of their produce and consequently may lead to higher consumption if, as is generally assumed, the income effect is stronger than the substitution effect. Moreover, the effect of price increase on farmers' consumption through increased income takes place with much greater time-lag than the direct effect on urban consumption. This makes it difficult to construct a suitable demand function.

Another important problem in demand projections from time series data arises from multi-collinearity. In a demand function, real income and relative price are generally taken as explanatory variables. There may be a high degree of inter-correlation between them, which will make it difficult to isolate the effect of each on demand; the standard errors of the coefficients would also be very high. In the extreme cases, this inter-correlation among the explanatory variables may be close to or even higher than the gross correlation of the whole equation; there would in that case be a tendency towards indeterminacy of the best fitting plane. The problem of multi-collinearity arises in both the single equation and simultaneous equations approaches. Sometimes, the use of ratio variables overcomes the problem of multi-collinearity.

Aggregation presents still another problem. As is well known, according to the individual person's demand function as derived from Pareto's theory of preference fields, the quantity demanded depends on relative prices and real income. This demand function for an individual can be linear, parabolic, logarithmic, etc. If the individual demand function is linear and so is the aggregate demand function of the community, no problem of aggregation is involved, because the sum of first powers of a variable is the first power of the sum. But if the individual demand function is, say, parabolic, then a new problem is involved, because the sum of the second powers of a variable is not the second power of the sum. For instance, the sum of the squared income of numerous individuals in a community is equal to the square of the average income of the community *plus* the variance of income distribution about the *per capita* average. This gives a new factor which should be incorporated in estimating the community's demand function. There are also problems of aggregating commodities in demand analysis, or the problems when individual demand functions are of some other types.

Demand Projections from Cross-Section Data

In view of the various problems connected with analysis of time series data, demand projections on the basis of analysis of cross-section data has become almost indispensable. A significant advantage of the cross-section data is that price variables and other market variables except income are effectively held constant and the relationship between income and quantity demanded can be studied without involving the problem of multi-collinearity or of mutual relationship and least squares bias. However, there are still a number of variables which are not held constant in cross-section samples. These variables include number of persons in the family, their age, the strenuousness of their work, social tastes, etc., which have independent effects on food consumption. The omission of these variables, which are generally called "nuisance variables", and regressing quantity demanded on income alone leads to what is sometimes callled 'specification bias' in the estimates of income elasticity.

This problems can be overcome. In the case of food consumption, for instance, the most important nuisance variable is family size as it shows the effect of economics of scale on consumption. In simulating a controlled experiment, it is possible to classify a sample into different groups according to the family size and to examine the expenditure-income relationship in each group. Then, the data can be so arranged as to estimate the effect of income and nuisance variables on consumption through multiple regression method.

The most common functional form in studying the income-consumption relationship from cross-section data is the double-log linear function, which gives constant income elasticity of consumption at all levels of income. But more recently the use of log-normal distribution in estimating income-consumption relationship, at least for necessities like food, is being preferred. According to this, the functional relationship between consumption and income is assumed to follow the log-normal distribution. Log-normal distribution is the one in which logarithms of the variate are normally distributed. As is well known, the logarithmic scale "compresses" the distribution of income at higher levels and "stretches" the distribution at lower levels. This fits in with the belief that at higher income levels, larger variations in incomes are needed to bring about a given change in consumption, while at lower income levels, much smaller variations in income would result in the same changes in consumption.

In actual procedure, consumption of each income group is transfomred into relative frequency or probability by expressing consumption as a ratio of maximum possible level of consumption or what is called "saturation level" of consumption. This is essential to give consumption the character of a statistical distribution, in which the probability or relative frequency varies between 0 and 1. Then the task is to find out the unknown parameters, namely saturation level and mean and variance of the distribution, after which the cumulative log-normal function can be written down giving consumption as a function of income. The saturation level can be determined by an iterative process, trying different plausible values such that income and the ratio of consumption to saturation level of consumption plotted on a logarithmic probability paper give a straight line. Once saturation level is found out, the mean and variance of the distribution are not difficult to calculate.

The three famous Tornqvist functions for necessities, semi-luxuries and luxuries which also assume different income-elasticities of demand at different income levels were also found better than the constant elasticity function by Wold. For instance, the Tornqvist function for necessities assumes a decline in the income-elasticity as income increases. These functions are not difficult to estimate and can be used with advantage in demand projections from cross-section data. Some variations in these functions can be made to suit the data.

Some workers in this field have tried to pool together the time series and cross-section samples. The most significant way in which pooling has taken place is that income elasticity or coefficient is determined from cross-section data and is substituted into the demand function, to be estimated from time series data, with a view to determine the price-elasticity of demand. This, of course, assumes that the income-elasticity determined from cross-section data would be the same as could have been found out from time series data. However, some econometricians hold that cross-section data yields long-term elasticity and time series data yield short-term elasticity. It is also felt that if micro-economic cross-section coefficient is to be used in macro-economic time series analysis, a separate variable for variance of income distribution becomes necessary to include in time series analysis. Further, it becomes all the more necessary to take account of at least one or two important nuisance variables in estimating income-elasticity from cross-section data. These requirements are, of course, a part from the sampling difference of time series and cross-section income-elasticity.

A recent development is the combining of cross-section data collected in successive time periods. These combined cross-section and time series data can yield both income and price coefficients. Of course, it is desirable that the cross-section sample should remain fixed over time. This type of combination has been adopted recently in estimating Cobb-Douglas production functions. Similar procedure can be used in estimating demand functions from a combination of cross-section data over time.

A third type of data usable in demand projection is the consumer panel data. The collection of consumer panel data has been taken up in the United States in recent years. Data from a continuing sample of households is collected on the quantity and value of different consumer goods used by them, particularly food, as also household income, on weekly or monthly basis. The fixed households in the sample fill up a proforma each time, or these proformas can be filled up by a group of enumerators. These data are potentially more reliable and useful in demand analysis than the market data or cross-section data. In fact, these data provide both the time series and cross-section statistics and enables measurement of responses to changes in income, own price, prices of substitutes and other factors.

The difference between consumer panel data and the present N.S.S. rounds is that in India in the former the sample remains fixed in successive periods and the data is collected more frequently rather than collecting it for one week in a year and blowing it up to get annual consumption estimates.

Another aspect tending to become as controversial as the least squares bias is the distinction between long-term and short-term elasticities and their use in long-term projections. One of the prevailing ideas has been that weekly or monthly data yield short-term parameters while annual data yield long-term parameters. This conclusion is, however, believed by many of the empirical results in U.S.A. which showed that the parameters estimated from annual data were even lower than those estimated from annual data. In my view, the use of weekly or annual data does not change the nature of the parameter, but when time lag is involved and quantity in period 't' is related with income or price in period "$t - 1$", then weekly data would give short-run and annual data long-run parameters.

Some writers have recently held that relating quantity demanded with price or income in the same period gives neither short-run nor long-run parameters but some mixture of the two. To find out truly short-term and long-term parameters, the use of distributed lags is suggested. The demand function may be estimated by relating quantity demanded not only to price and income in the same period but also in several preceding periods. The coefficient of, say, the price variable in the same period would give the short-term effect while the sum of coefficients of the price variables in all the periods would give the long-term effect. This type of analysis fits very well in estimating the short-term and long-run responses of production to price. But in demand analysis, the influence of prices and income on quantity demanded is not of once-in-a-year type but a continuous one. If weekly or monthly data are used, too many price variables for the previous periods may have to be included. If, annual data are used, it is not clear if it would be justifiable to include price in the previous years as separate variables and thereby assume that prices in the previous few years influenced quantity demanded, today.

Most distributed lag models have avoided taking too many separate variables for successively preceding periods. By an algebraic manipulation, under certain assumption, the model is so transformed that quantity demanded in period 't' is a function of price, income, etc. in period 't' and quantity demanded in period '$t-1$.' Thus the lagged value of the dependent variable becomes one of the explanatory variables. In this equation, the coefficient of the current period price or income represents the short-run effect and the coefficient of the lagged value of the dependent variable represents what is called "coefficient of adjustment", giving a multiple by which the short-term coefficient should be inflated to give long-term effect.

In actually working with this distributed lag model, several weaknesses of the model have come to light. First, this model gives the same "coefficient of adjustment" for price, income and other explanatory variables included in the model. This is highly unsatisfactory. Further, the coefficient of adjustment is very sensitive to specification error. That is, adding or taking away of a variable or changing the form of relationship results in a substantial change in the coefficient of adjustment. Aggregation of weekly or monthly data to annual data also causes a bias in the estimation of adjustment coefficient. It has also been shown by some workers that the use of lagged value of the dependent variable as one of the explanatory variables does mostly the same thing as would be done by including a separate "trend" variable. When this distributed lag model was originally used, it was claimed that it did away with the problem of autocorrelation which defies good estimation. But some econometricians feel that this is mainly because the use of lagged value of the dependent variable picks up trend.

As for estimates from cross-section data, it is generally assumed that these estimates give long-term coefficients or elasticities. But this presupposes that the income data relate to those families who have been in a particular income group for a sufficiently long time to acquire the consumption habits appropriate to that income class. But in actual data, the selection of families is not based on this criterion. Perhaps, the consumer panel data would be more appropriate than other types of data in separate estimation of long-term and short-run parameters.

Several workers have recently suspected that elasticities are not reversible. The response of demand to an increase in income is different from the response to a decrease in income. If this is so then the elasticity calculated from actual data relating to periods of income increase as well as periods of income decrease is a sort of average of the two different orders of response. We cannot use this elasticity to know the effect on demand of say, a 25% increase in income. For this, we should use the elasticity pertinent to periods of rising income. I am not aware of any econometrician having successfully calculated separate responses in the upward and downward directions from time series data. Income-elasticity of demand worked out from cross-section data would relate to the response of demand to an increase in income.

SHRI J. S. SARMA[5]: **Long-Term Projections of Agricultural Supply**

In a country where planning has been accepted as a tool of economic development and perspective planning as a technique, the importance of making reliable projections of supplies needs no emphasis. Agricultural supply projections are considered necessary for commercial agriculture even under *laissez faire* economy or under-mixed economy by farmers, traders and policy makers alike. The techniques and methodology of projections are much more complex in the case of projection of agricultural supplies, than of other goods, not only in view of the fact that there are millions of farmers on whose decisions and actions production depends, but also of the uncertainties of the weather. There is also the impact of technological innovations and of structural changes in agriculture which cannot always be measured and predicted. The effects of planned agricultural policies and programmes including price policies on the rate of change of production are also considerable. Among the other interrelated factors that merit consideration are the interdependence of outputs using common inputs, aggregate supplies of production inputs, rates of investment in different factors of production, regional specialization and competition. Last of all the non-availability of statistical data is a serious handicap to the application of sophisticated techniques of agricultural supply projections.

SECTION I

In the further discussion of the problem, production may be taken as equivalent to domestic supplies ignoring changes in stocks. Production is a function of land, labour, capital and enterpreneurship. The functional relationship may be expressed in the form:

$$y = f(a, l, c, e)$$

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where

y = yield per acre,
a = area (size of holding),
l = labour (number of man-days),
c = capital (irrigation, fertilisers, manures, improved seeds, pesticides, etc.),
e = entrepreneurship.

Conclusive evidence is not available on the relationship, if any, between the size of holding and yield per acre, in India. Although, supply of labour, in general, is plentiful, at the present stage of development, there are shortages in certain areas and at certain times, and the qualitative aspects of labour, *e.g.*, skills require further improvement. Yet, the two most important factors that influence production are capital and entrepreneurship. The former covers such inputs as irrigation, fertilisers, manures, improved seeds, pesticides, etc., while the latter includes farmer's attitudes and ability to adopt new techniques of development. The other factors that influence production directly or indirectly relate to institutional measures such as legislation affecting land reforms, availability of credit facilities, adequacy of marketing agencies for inputs and outputs.

In some respects, the competitive theory of the firm is unrealistic in agriculture because of the relative immobility of land and labour and under certain circumstances even of capital within agriculture and particularly between agriculture and the rest of the economy. Most of agricultural land has no alternative uses aside from agriculture. Mobility of labour is low; the bulk of family labour is also unpaid. Farm capital equipment has few alternative uses. Yet, over the long run, resources do move into and out of agriculture. As a basis of long-term appraisal, it seems reasonable to assume that resources used in agriculture will vary in response to changes both in demand and in innovations. The innovations, although difficult to measure, may result in the long run in substantial shifts in the use and combination of different factors of production and may consequently modify production functions. Further, inputs of fertilisers and pesticides are responsive to prospective changes in agricultural prices and incomes. The problem is, therefore, one of appraising the probable uses of resources in agriculture and possible innovations that affect the output per unit of input.

Ultimately, the projection of agricultural production virtually depends upon estimating the acreage and the yield per acre for each crop. From the point of view of development programmes, the various measures taken can be broadly classified into:

(i) those for expansion of area under cultivation or under particular crops, and

(ii) those for intensification of the yield per acre.

These measures can be further classified into:

(*a*) Provision of material inputs, *e.g.*, irrigation, seeds, fertilisers and manures,

(*b*) measures for improving the efficiency of the use of labour and other inputs,

(*c*) provision of economic incentives, and

(*d*) institutional and organisational reforms.

The types of problems involved in estimating the effect of these measures on area and yield per acre depend upon the general assumptions regarding:

(i) subsistence agriculture in *laissez faire* economy,

(ii) commercial agriculture in *laissez faire* economy,

(iii) planned economy, and

(iv) mixed economy.

In this paper, attention is devoted to a discussion, mainly of the problems involved in the planned economy under Indian conditions, in Section II.

The problems involved in production projections also depend upon the period covered by them. From this point of view, three distinct periods may be distinguished:

(i) annual, usually for the next year,

(ii) quinquennial, *i.e.*, at the end of the Five-Year Plan, and

(iii) perspective, *i.e.*, at the end of say 15 to 20 years.

In the first type of projections, the weather which influences the production in any particular year is the most important variable and also uncertain factor. Particularly in India where less than one-fifth of the area has assured irrigation supplies, the effect of weather may over-shadow the entire development effort, in any particular year. Quinquennial projections are relatively more easy and assume normal weather at the end of the Five-Year Period. The whole group of factors connoted by the term "technological changes" may be considered to be fixed or given and structural changes may also be deemed not to have taken place but for the extent planned. The third group of projection of the perspective is often rendered difficult by the assumptions regarding technological and structural changes, both planned and otherwise. Some of the considerations relevant to this group are assumptions regarding overall economic stability over the period, despite short-term fluctuations, extent of mechanisation, variation in population dependent on agriculture, percentage of irrigated area, double-cropped area and area under food crops, and assumptions regarding relative prices, war or peace, etc.

Supply (production) projections may be done for individual agricultural commodities or for agricultural production as a whole. The former are much more difficult because they involve questions regarding substitution, etc. These projections may be done at the micro level or macro level, or for the country as a whole or for different regions. These different types of projections raise problems of aggregation and disaggregation.

The types of data used for supply projections can be either time series data or cross-section data. In India, comparable series of data over time are available, even with regard to production, from the beginning of the First Five-Year Plan only, figures for earlier years being rendered non-comparable due to changes in political boundaries, methods of estimation, coverage of the data, etc. Although, some studies are being undertaken which provide cross-section data on production and consumption, their coverage is not wide or extensive.

The most commonly adopted methods of production projections are based on analysis of time-series data and determination of the long-term trend, the regression and study of interrelationships among the various factors. Thus, past time-series data regarding area, yield per acre or both are projected into the future. In such projections, one of the first assumptions to be made will be regarding the relative contribution of area and yield per acre to increased production. In the Agricultural Commodities Projections for 1970, by the F.A.O., it has been generally assumed that during the sixties, area would continue to remain constant in high income countries while some increase was assumed in low income countries. This has been based on the experience of the fifties when in the high income countries, the increase in agricultural production was almost entirely due to higher yields while in most low income countries, the greater part of the rise was due to expansion in cultivated area. The F.A.O. worked out the projections on two alternative assumptions, a lower one corresponding to an extrapolation of recent trends and a higher one based on an acceleration of these trends in line with national plans.

The technique of time-series analysis based on long-term trends or regression analysis suffers from certain drawbacks. The assumption of unchanging technology may be valid at a point of time or over a relatively short period and may give first approximation to reality; but for long periods of time, this assumption will not hold good. Regression analysis of time-series data is an imperfect tool, if structural changes occur during the time period under study. Thus, regression models based on time-series data reflect historic relationships and at best describe present relationship and cannot be used for predictions, for, they can take into account the effects of changes in the values of strictly shift variables but cannot take into account the effects of changes in structural variables, such as changes in technology, managerial ability, institutions, etc. A further limitation of time-series analysis as the basis of prediction arises in planned or semi-planned economics. In these economies, some of the investments are lumpy in nature, affecting the trend lines, considerably. Traditional supply projections have thus greater applicability in *laissez faire* economies.

Conceptually, production functions derived from cross-section physical data can be used for estimating supply response through the application of prices and costs provided the production structure is not expected to change during the period for which predictions are being made and provided the usual optimising assumption is acceptable. Deriving production function from the cross-section data eliminates the main drawback of time-series regression analysis, *viz.*, the problem of changes in production structure during the time period for which data are drawn. It has, however, its problems that the data from individual farms in the cross-section may represent points on different production functions. However, neither the short-term forecast nor the long-term projection hinges on any single statistical method or technique. An endeavour is made to use all the available knowledge. Reliance has also to be placed on the experience and judgment of agronomists, farm management specialists and agricultural economists, besides statisticians.

SECTION II

In a planned economy, the fixation of targets of production whether it be for the next year, or the end of the Plan period or the perspective, may be deemed to be analogous to the determination of projection of production. In India, targets of production were being fixed in respect of foodgrains ever since the inception of the Grow-More-Food Programme in 1943, and subsequently under the successive Plans both in respect of foodgrains and commercial crops. The approach followed is basically one of determining the production potential created by the various development programmes, designed to increase production. Targets are set forth for each of these programmes expressed in terms of additional area to be benefited by irrigation facilities, additional quantities of fertilisers, manures and improved seeds to be distributed and the areas to be covered by them, the areas to be benefited by other improved agricultural practices such as plant protection, dry farming, etc., the acreages to be brought under cultivation through reclamation, double-cropping and finally the areas to be covered by land development measures such as contour bunding, etc. These targets in terms of physical quantities, are based on a review and assessment of the progress so far made in the respective spheres and the potentiality for development during the proposed period, taking into account the organisational, financial and other technical resources that exist or can be made available. Once these physical inputs are determined, then the additional production potential to be created by these additional inputs is estimated on the basis of the 'yardstick' which gives the additional production anticipated to be achieved from a given unit of input. The additional production potential added to the base level production gives the target at the end of the Plan.

To illustrate this yardstick approach, if a masonry well is constructed, it is expected to irrigate 5 acres and each acre when it receives irrigation, is expected to give additional yield of 0·2 tons of foodgrains, other things being the same. Thus, the construction of a well will result in the creation of production potential of 1 ton; and if 1,000 wells are constructed, 1,000 tons of foodgrains will be produced. Similarly, one ton of ammonium sulphate applied to about 22 acres (dosage of 100 lb. per acre) is expected to increase the production by two tons of foodgrains; and if 100,000 tons of fertilisers (in terms of ammonium sulphate) are distributed, the production potential would go up by 200,000 tons. The estimated production potential created by the different programmes is then added up, to give the total target.

In a way, these yardsticks are the simplest forms of production functions, for each input. This approach is defective, because, firstly there is the implied assumption that the benefits from the different measures are additive. No conclusive evidence is yet available on the validity of this assumption. This defect can be remedied only by working out composite yardsticks. Secondly, the yardsticks which are based on past data or at best on current cross-section data may not be valid for a future period, during which they may undergo variation. Thirdly, the yardsticks have to be formulated for sufficiently homogeneous regions, *i.e.*, not only at the State level but also at district and block levels. Fourthly, the yardsticks are based on the assumption of normal weather. In spite of these defects, the production potential approach gives a simple and handy tool for fixation of targets for relatively shorter periods and for a current assessment of the progress of different schemes.

As an alternative to the yardstick approach, in some countries, the targets are fixed in terms of the yield per acre either for the entire area under the crop or separately for irrigated and unirrigated areas. After fixing the targets in terms of yield per acre, efforts are made to translate the increase thus envisaged in terms of the material and other inputs necesssry to achieve the targets. These two approaches, the unit yield approach and the production potential approach are essentially the same (*see* note below).

Another approach which is an improvement on the 'yardstick' approach is that based on balance sheets and composite yardsticks.

Note.—Let A_0 and A_1 be the area under the crops, suffix 0 denoting the base level and suffix 1 the end of the Plan or the Perspective period.

Y_0 and Y_1 be the yield per acre.

P_0 and P_1 be the outturn.

Then target of production $P_1 = A_1 \times Y_1$.

Target of additional production over the base level $= P_1 - P_0$.

Let the physical targets in respect of important development measures be—

I, for area under irrigation

F, for quantity of fertilisers

M, for quantity of manures.

S, for area under improved seeds and so on and let the respective yardsticks of additional production be Y_i, Y_f, Y_m, Y_s and so on.

Let $A_1 - A_0$ represent the additional area brought under cultivation as a result of reclamation, double-cropping, diversion, etc.

Then the additional production potential created by these programme equals:

$$(A_1 - A_0) \times Y_0 + (I_1 - I_0) \times Y_i + (F_1 - F_0) \times Y_f + (M_1 - M_0) \times Y_m + (S_1 - S_0) \times Y_s + \text{etc.}$$

This is equal to $P_1 - P_0 = A_1Y_1 - A_0Y_0$.

Under this, land use balance sheets are first drawn up for the country as a whole, or for the State or for different regions thereof. Within this pattern of land use, separate balance sheets are drawn up crop-wise, for gross area sown and gross area irrigated, areas under fertilisers, manures and improved seeds, etc., which are consistent with the potentialities in the respective fields. Having drawn up these balance sheets, a broad classification of the area under each crop is attempted as under:

1. *Irrigated*:
   - 1.1. with improved seeds, fertilisers and manures.
   - 1.2. with improved seeds and manures.
   - 1.3. with ordinary seeds.
2. *Un-irrigated*:
   - 2.1. with improved seeds and manures.
   - 2.2. with ordinary seeds.

Once the yield rates for each of these categories of land are determined, the production of each category of land at the end of each Plan period may be worked out and aggregated to give the total production of that commodity, after making allowances, if necessary, for plant protection measures, etc. The application of the method also requires data on investments envisaged on irrigation, fertilisers and other production programmes, the physical targets for these programmes consistent with these investments and also with arrangements for credit, extension and education, for the different time periods.

The increase in the net area sown is determined on the basis of the known programmes of land reclamation, the net withdrawals from fallow lands and other development schemes. The gross area sown is estimated by taking into account the possibilities for double-cropping primarily through irrigation. The projected additional acreage is allotted to different crops considering the projected demand and the base period production, the monetary returns from the crop, etc. Where facilities for computation exist, the cropping patterns in different regions can be worked out using linear programming techniques.

The increase in irrigated area can be determined on the basis of projected investments on irrigation, major & medium and minor and anticipated capital costs of irrigation. The additional acreage under irrigation can be distributed under different crops, taking into account the gap between the projected demand and the base period supply underlying the importance of the crop, the response coefficient of irrigation for the crop and cost of irrigating the crop. With regard to fertilisers, the requirements of nitrogen (N), phosphorus (P) and potassium (K) for each crop taking into account irrigated and assured rainfall areas and unirrigated areas and the optimum dosages in each region are worked out initially. The total availability of fertilisers of each type is determined on the basis of scope for internal production and likely imports and the scope for expansion in consumption. These quantities are allocated to different crops on the basis of requirements worked out earlier. The areas to be fertilised under each crop are then worked out with the help of given dosages. The total area to be manured can be estimated on the basis of the quantities of manures that could be produced within the country, and the optimum dosage to be applied for each crop. An assumption can then be made that priority would be given to the irrigated areas and areas with assured rainfall in the application of the manures. Estimates will have to be made separately for rural compost, urban compost green manures, sludge, sewage and sullage and other organic manures. The area under improved seeds at the end of each Plan period depends upon the extent of availability of improved varieties of seeds evolved with a view to suiting the conditions of the area, the progress of establishment of seed farms, the rate of seed multiplication, etc.

In working out these balance sheets and yardsticks, there is need for several forward and backward adjustments. This method may, therefore, appropriately be called one of successive iterations and approximations. Certain assumptions are made, the estimates are made and these are checked up for consistency and if necessary, the assumptions are altered, till a set of mutually consistent estimates is made available. One of the basic assumptions made is regarding prices and demand. If production patterns change and demand does not change, prices change and with the change in prices, production also changes and thus bringing chain reaction.

This raises the question of relationship between supply and prices and the measurement of price-elasticity of supply. In planned economies, maintenance of stable price-levels and also of relative prices between different commodities, is one of the basic objectives and hence this aspect of price-elasticity of supply is not always considered, in supply projections. However, where it is considered necessary to take into account prices also, suitable econometric models can be built, using time-series data or cross-section data. It may be noted that in agricultural supply projections, the supply depends on the previous year's prices.

The paper may be concluded with a broad projection of agricultural production made in the Ministry of Food & Agriculture.

Year	Index of agricultural production	Production of foodgrains (million tons)
1949–50	100	58
1955–56	115	66
1960–61	140	80
1965–66	175	100
1970–71	225	125
1975–76	300	140

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SHRI V. N. AMBLE[6]: **Demand and Supply Projections for Livestock Products**

Comparatively little attention has been given to studies on demand and supply projections for livestock products. Perhaps one reason

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for this is the relatively high cost of producing livestock products. From the results of farm management surveys sponsored by the Research Programmes Committee of the Planning Commission and the Cost of Production studies conducted by the I.A.R.S., I have roughly estimated that a rupee spent in raising pulses provides about 1,000 grams of proteins and 14,000 calories. On the other hand, a rupee spent in producing cow milk would provide 60 grams of protein and 1,200 calories of energy. Spent on buffalo milk, it would fetch 125 grams of protein and 2,500 calories. A rupee spent on producing mutton of sheep would provide about 150 to 200 grams of protein and 2,000 calories. Even allowing for the fact that the vegetable protein provided by pulses have a biological value of half the amount of animal protein, it is clear that products of animal origin are expensive to produce. Nevertheless, as is stressed by nutritionists all over the world, it is essential to provide for a certain amount of animal protein in the diet for the purposes of tissue building and replacement. It is estimated from the balance sheet method adopted by Dr. Panse that the average *per capita* availability of animal proteins amounts to 6·4 grams per day and of vegetable proteins to 45·3 grams per day. As against this it is estimated that the corresponding average values for the world as a whole are 20 grams and 40 grams respectively. The minimum *per capita* per day requirement of animal protein for an average Indian has been estimated by Dr. P. V. Sukhatme to be 10 grams per day with about 46 grams of vegetable proteins. It is clear that it is essential to look into the problems of supply and demand projections of livestock products for meeting the needs of proper growth and maintenance of health of the Indian population.

In the studies carried out in agricultural commodities by the Planning Commission and the I.S.I., some studies have been made on the demand projections on groups of livestock products such as milk and milk products, and meat, fish and eggs put together. In the exhaustive paper by Dr. P. V. Sukhatme on 'Food and Nutrition Situation in India', recently published in the *Indian Journal of Agricultural Economics* meat, fish, eggs and milk have been considered along with other products of vegetable origin. It is understood that National Council of Applied Economic Research has also conducted studies on a limited scale on milk and milk products. This enumeration possibly exhausts the studies made on the subject. More studies are evidently needed to secure sufficiently detailed and accurate projections of demand and supply as these are essential prerequisites to sound planning.

Considering first the demand problem, there are broadly two approaches: the first is based on nutritional requirements of human beings and the second is based on consumer preference. The first approach has been thoroughly dealt with by Dr. P. V. Sukhatme in the paper on "Food and Nutrition Situation in India". Based on the authoritative views of nutritional experts,—in this case the Nutritional Advisory Committee of India and the F.A.O. Committee on nutritional requirements,—the *per capita* requirements are set down in terms of (*a*) calories, (*b*) total proteins and (*c*) animal proteins. The *per capita* quantities of various items of food in an average diet needed to secure these targets are then determined. The problem can have numerous solutions. Following the well-known Linear Programming Technique, the quantities of the items are so determined as to result in the least cost to the consumer on the whole. Even so since the items of food are more numerous than the three specific targets laid down, it is possible to impose additional conditions in determining the quantities required to make up the diet. These conditions make the solution which finally emerges realistic from the nutritional, economic and production points of view. While these conditions are undoubtedly somewhat arbitrarily laid down, they permit a diet having a reasonably adequate level of nutrition to be worked out. It is estimated by Dr. Sukhatme that in order to meet the minimum requirements of animal proteins, it will be necessary to provide 200 grams of milk per head per day furnishing 7·5 grams of animal protein and 170 calories of energy.

Once the *per capita* requirements are available, it is a simple matter to estimate the total requirement for each item of food by multiplying the *per capita* figure by the estimated population figure in a future year. Taking a figure of 492 millions as the projected population for 1966 as against 438 millions for 1961, it is estimated that in order to meet minimum requirements of animal proteins for the average Indian the amount of milk required per year will increase from 32·1 million tons to 36·1 million tons.

The consumer preference approach uses the methods of demand analysis. The Planning Commission and the I.S.I. as also the N.C.A.E.R. have carried out projections based on this approach. Ideally this would require a series of demand or income surveys over a period of years from which one could build up an expression for the change with time in the relationship of demand with income. Such income surveys, not to speak of a time series of them, are practically non-existent. And income or demand surveys is not easy to undertake and is full of pitfalls. As the only alternative we have to depend on consumer expenditure surveys. Having worked out the expenditure elasticity of demand for a particular item, it is multiplied with an assumed figure of income elasticity of total expenditure in order to arrive at the income elasticity of demand. Next the income projection figures are used to work out from the relationship of demand and income the *per capita* demand projection. Finally, this is multiplied by the population projection to secure the projection of aggregate demand in a future year. Even as regards the relationship of demand for a particular item with the total expenditure, the time series data available in this country being inadequate and of limited comparability and accuracy, we have to fall back on the cross-sectional approach and use data sorted out into groups according to the level of total expenditure from consumer expenditure surveys such as those of the National Sample Survey. In this connection, it may be pointed out that although the N.S.S. schedules had provided for separate collection of data on important types of livestock products, the published figures give the results for meat, fish, poultry and eggs together which takes away the usefulness of the results for estimating the expenditure elasticities for distinct types of livestock products.

The difference in the two approaches may be pointed out. The approach based on the nutritional requirements does not explicitly take into account consumer preference for individual commodities but the technique used for converting the nutritional targets into the quantities of different items of food takes care that the suggested changes in food consumption do not show any radical deviation from the consumption pattern and are practicable from the economic and production points of view. Similarly the method based on demand analysis does not take into account nutritional requirements although it is likely that in practice the consumer may show preference for items of food which are nutritionally desirable. It is necessary to work out demand projections by both these approaches in order to gauge the situation from the technical as well as economic angle and decide on the appropriate target level to aim at.

It would not be too rash to say that hardly any integrated study has been made of supply projections for livestock products. The approach followed so far seems to be to consider the allocations to items of livestock development such as key village scheme, fodder improvement programme, mixed farming, poultry extension work, etc., individually on *ad hoc* basis. Whereas for some items such as wool or poultry, estimates of likely production by the end of the plan are mentioned, for others not even *ad hoc* estimates of the likely outturn are given. For short-term planning, it would suffice to assume the existing level of production as remaining unchanged and merely multiply the present *per capita* animal production by the projected animal population figure. From the surveys on milk estimation and cost of milk production conducted by the I.A.R.S., it is estimated that the average yield per day per breeding cow is 1·04 and per breeding buffalo 2·96. From this it can be estimated that the total milk production (ignoring the small contribution of goats) would be 18·3 million tons in 1961 and 20·4 million tons in 1966. This would mean a short fall of 13·3 million tons in 1961 and 15·1 million tons in 1966 from the estimated minimum requirements mentioned earlier.

The necessity of securing objective and reliable estimates of production of livestock products for enabling satisfactory projections to be made needs no emphasis. Till now the only estimates on livestock production were those given by the Directorate of Marketing and Inspection and these are known to be subjective. Random sample survey techniques are now available for such estimations and it is necessary that appropriate machinery is set up in the States to take up this work so that proper estimates of livestock production are available at least for the fourth and future plans.

When long-term planning is discussed it is but appropriate to consider the improvement in outturn per animal in addition to the mere increase in livestock numbers. For doing so it is necessary to build up technical production functions indicating the relation of response of yield to measures of improvement. A number of such studies have been made in the field of response of crop yields to fertilizers. Similar studies in the animal nutritional field would be useful. For this purpose the available experimental as well as survey data could be utilised and further investigations planned where necessary.

For both demand and supply projections, the studies so far made have been carried out at the all-India level. This country is really a sub-continent with wide variations in agro-economic conditions, availability of agricultural and livestock produce and consumer preferences. It seems more efficient to work out the projections separately for the major regions into which the country could be divided for the purpose and then build up the aggregate demand or supply projection. It seems also necessary to make detailed examination of the situation for different items of livestock products such as goat, meat, mutton, pork, etc., so that competing and complementary requirements could be appropriately met. In carrying out such studies it would be preferable to consider all the important livestock products together in an integrated activity analysis so that the available resources are best utilised in developing production of various commodities in the most efficient and economic manner.

To sum up the following studies are called for:

(1) Regional studies on demand and supply projections;

(2) Studies of projections of important individual livestock commodities in an integrated manner;

(3) Studies in technical production functions relating to response in livestock production to feeding and other improvement measures;

(4) Random sample surveys at periodic intervals in all the States for securing objective and reliable estimates of livestock production;

(5) Investigation into the trends of change in livestock population.

SHRI K. R. NAIR[7, 8]: **Methodological Problems involved in the Various Aspects of Long-term Projections of Demand and Supply of Timber**

Long-term projections of demand and supply of timber are essential particularly for a rapidly changing economy because trees take a long time to grow and unlike other materials cannot be manufactured rapidly as and when required to meet increased demand. Projections of future demand of this commodity cannot be based on historical trends alone for several reasons. To mention a few, different needs are met by different wood categories; as the economy progresses, different needs grow at different rates; and adequate data on consumption of timber in the past are not available. Therefore, a reasonable appraisal of future requirements has to be based on an assessment of the needs of each consuming sector separately. The process of building up the projections through this component method necessarily involves the examination of the pattern as well as the scale of consumption of forest products and also the making of a number of assumptions.

Studies already conducted on the subject have brought out that the methodological problems involved in making long-term projections arise primarily out of the inadequacy of the existing data relating to resources, production and consumption and consequently on the uncertain nature of behaviour of the several sets of assumptions on the basis of which such projections are worked out. Projections of demand and supply of timber for 1960 have been made by the Food

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[8] Paper prepared jointly with Shri B. L. Rawat.

and Agriculture Organisation (F.A.O.) for Europe on the basis of data up to 1950, and for Asia-Pacific region for the years 1965 and 1975 based on data upto 1955 in two comprehensive studies.

A. Inadequacy of Data

The inadequate nature of available data has been emphasised in both the studies. Some of the important points brought out in them are discussed below:

Europe

(1) Only a few countries have organised regular or periodic forest inventories in line with modern statistical methods. All others supply information on the basis of land cadasters and by making estimates of forest resources and annual growth. These are not sufficiently detailed and their results are subject to large margins of error. Moreover, in many countries, a deliberately conservative approach in making the estimates has introduced a systematic statistical error involving widespread underestimation of the extent of the forest resources and their annual yield. This reduces figures of annual fellings below net growth.

(2) The quality of forestry statistics leaves much to be desired and constitutes a serious obstacle, not only to analyses of trends in wood supply but even to adequate wood production. Estimates of growth and annual cut are unreliable. In general, they tend to be too low.

(3) Statistics for the total round wood cut, and particularly for that part of it which is used as fuel wood are also unreliable. Even where figures exist, they usually relate only to public forests; and the cut in private forests, and specially on the wood-lots of farmers, is either omitted or estimated by methods whose results are admitted to be highly uncertain. The quality of production statistics for wood products (pulp, wall boards, plywood, veneers, sawn timber, etc.) varies considerably.

(4) The greatest single weakness is undoubtedly the practical non-existence of direct consumption statistics. Data on wood consumption are therefore usually derived indirectly from the statistics of production and trade which need to be corrected for stock changes. But very few countries publish any statistical information about stock changes for wood and its products, and wherever available, it is partial,

(5) For compiling trade and production statistics certain standard conversion factors are adopted, *e.g.*, yield of sawn wood from round wood. As averages, these are reasonably satisfactory but for more detailed work their use may result in error.

(6) Except for new housing, the statistical material available is extremely deficient. European statistics of wood use in non-residential construction are far from satisfactory. Very few countries publish figures covering the whole field; some publish figures covering a part of it; but, for most, little or no statistical information of any kind is available.

(7) Most of the wood used on farms is cut by the farmer himself on his own land, and is neither bought nor sold. The direct statistics which exist only in very few countries either of the farmer's total cut for his own use or of the quantities which he uses as fuel wood are based on inadequate sampling methods and are subject to appreciable margins of error. No direct statistics exist of the quantities of processed wood which the farmers buy in the market.

(8) From a statistical point of view, the plywood industry is particularly difficult to analyse; first because national statistics do not distinguish between saw logs and veneer logs, and second because the term "plywood" covers such a great variety of products, some of which are really composite products made by combining veneers or plywood with sawn timber (block boards, etc.) and sometimes even with metals and plastics.

(9) These statistical difficulties have greatly complicated the task of depicting the present situation and weaken the basis on which forecasts of the future can be made.

Asia-Pacific Region

(1) The problem of inadequate data is formidable. Few countries have as yet carried out national forest inventories, and the available data are not necessarily comparable because they are not based on uniform methods and definitions. The available statistics throw little light on whether fellings are high or low in relation to forest resources. Precise statistical data are scarce and values of some of the principal parameters such as prices, industrial output, agricultural output, etc., are known only within broad limits.

(2) Adequate statistics on past consumption trends are not available. Very little definite data are available on the distribution of types of houses and on the quantity of sawn wood and wood used in the round per house of each type.

(3) Sufficiently reliable data on the relative changes in the urban and rural population of the region are difficult to obtain.

(4) Statistics of consumption of wood for rural uses, usually inadequate even in highly developed countries, are often virtually non-existent in the region.

B. ASSUMPTIONS MADE IN THE PROJECTIONS

Due to inadequacy of data a large number of assumptions have been made in preparing the long-term projections for timber for Europe and the Asia-Pacific region. Some of the assumptions are discussed below:

Europe

(1) Since the demand for wood and its products is largely determined by the general level of economic activity, two contrasting rates of increase in gross output for Europe as a whole have been assumed for 1960 over 1950, *viz.*, 20% and 50%. Out of the 20% increase, one-fourth has been assumed to be in industries and one-tenth in agriculture. In the case of 50% increase, three-fifth has been assumed to be in industries and one-fifth in agriculture. Different rates of growth of gross output have been assumed for different countries, *e.g.*, highest in underdeveloped countries which are now being industrialised in Eastern and Central Europe and lowest in Southern Europe and the highly developed countries of Western Europe.

(2) Apart from the general level of economic activity, the demand for wood and its products is chiefly influenced by the relationship between the price of wood and those of competing materials. Two sets of projections of demand for timber have been made on the basis of the following two different assumptions about the relationship between the price of wood and those of competing materials:

(i) If relative prices of wood products revert to pre-Korean-war level;

(ii) If relative prices of wood rise considerably (Anything from a fifth to a third).

The demand for industrial wood has been estimated under these two basic assumptions separately for each end-use, *e.g.*, housing, non-residential construction, rural use, transport and communications, etc.

(3) It has also been assumed in general that European countries will have been able by 1960 to balance their international payments

without requiring to maintain abnormal restrictions on consumption, whether the gross product is 20% or 50% higher than in 1950.

(4) Taking the illustration of wood requirements for construction purposes, the projections have been based on assumptions about the rate of growth of population, number of dwelling units required, wood required in various forms for different uses per dwelling unit, influence of social changes on the intensity of wood use in houses, investment in industries and its construction component, wood content and replacement requirements of industrial buildings, etc., effect of technological developments and changes, effect of changes in the relative prices of timber and other building materials, and use of alternative and substitute materials.

(5) The basic assumptions made about the way in which wood is produced or consumed in Europe are that the forests should be managed and their production organised on the principle of "sustained yield" and forests should make a maximum contribution to the welfare of the people.

Asia-Pacific Region

(1) Estimates of future wood requirements were prepared after considering present consumption levels of forest products, the expected population rise, changes in national income and the probable shift toward urban living. Different rates of population growth have been assumed for the three parts of the region. It has been assumed that the urban population of Tropical Asia will grow at the rate of $4\frac{1}{2}\%$ per annum between 1955 and 1975, and the rate of growth of urban population in East-Asia and Oceania will be only slightly greater than that of the population as a whole. The income per head has been assumed to rise by 2% per annum in all countries except in Japan, Australia and New Zealand and a rise of 125% in national income has been assumed throughout the region.

(2) Estimates of requirements for fuel wood were dependent primarily on expected population increases and the availability of substitute fuels. It has been assumed that an economy of about 1% per annum in the use of fuel wood can be achieved.

(3) For urban areas the requirements of housing is based on assumptions of population growth, the lag of the present rate of house building behind the trend of requirements, the rate of replacement of old houses, etc., for the rural areas it has been assumed that demand for new houses and requirements for replacement will increase

by the same percentage as the rural population. It has been assumed that non-residential construction will increase at the same rate as investment and that the share of investments in the national income will remain the same as in the base period. For rural uses it has been assumed that demand for wood will increase at the same rate as agricultural production (1–1·5% per head per year). The demand for wooden sleepers for railways has been assumed to increase by 50% in Oceania, 30% in South Asia and 15% in other areas of the region. The demand for wood for other parts and transport and communications sector has been assumed to be 175% more than in the base period.

(4) *Paper and paper board.*—The basic assumption is that demand per head will follow changes in income per head (GNP) in accordance with the theoretical demand functions established for that category. The method followed in projecting demand for paper and paper board was as under. "In projecting demand for paper and board it is possible to proceed along somewhat more sophisticated lines than when dealing with other sectors of wood consumption. In the first place, the statistics are more accurate, more detailed and, in some cases, available for longer periods. In the second place, a good deal of experience has already been gained in relating paper and board consumption to various economic parameters.

For general purpose, medium-term projections, when consumption data are available only for broad categories of paper, it is sufficient to relate consumption to a simple independent variable: income. The introduction of other parameters (price, literacy, industrial output, personal disposable income, etc.), while it may in certain cases make possible a better 'fit' of the historical data, does not facilitate the task of projection. The first studies of the income consumption relationship based on data from a number of countries (cross-section analysis) assumed a straight-line logarithmic correlation between income and consumption. This method implied that paper consumption per head would increase at the same rate for a given income growth rate in all countries (constant income elasticity), whatever their income level (stage of economic development). This was in conflict with observed data, in particular with income elasticities calculated from time series available for individual countries at different income levels. Attempts were made to fit a curvi-linear (parabolic) regression line, but this approach gave rise to certain practical difficulties as well as failing to overcome certain theoretical objections. Finally, it was found that, by selecting as the demand function the log-normal distribution curve, not only was a better fit obtained but also the elasticity coefficients corresponding to this curve decreased with rising income in accordance with the results obtained from historical data in a number of countries. Thus, the sigmoid curve successfully reconciled the different results previously obtained from the cross-sectional and historical analyses.

The application of this function rests on the assumption that paper and board demand per head will gradually approach a "saturation" value as income per head increases, and that consumption will rise according to the sigmoid represented by the integral of the log-normal distribution:

$$y = S_a \int_{-a}^{t} \frac{1}{\sqrt{2\pi}} e^{-t^2/2}\, dt,$$

where

y is consumption, in kg. per head.

S is the assumed saturation value, in kg. per head,

and

$t = \frac{(\log x - a)}{b}$, where x is income (gross national product) per head, and a and b are constants.

Though the equation for the demand function looks rather complicated, its application is fairly simple, since the introduction of the new parameter, t, reduces the function to a linear relationship between this parameter and the logarithm of income. The value of the integral (y/S) is available in tabulated form for different values of t. The saturation value (S) is determined by consecutive adjustments from an original guess figure, a procedure which is facilitated by the use of a probability diagram. It should be noted that the saturation value is empirically selected to fit existing data. In this sense the value is a purely arbitrary one, carrying no implication that this is the point at which per caput consumption will, at some time in the future, cease to rise. The range of incomes over which projections are made are in all cases below those at which saturation value is approached.

The projection is made by determining the t value corresponding to the projected income from the linear relationship between t and the logarithm of income. The saturation "level" (s) at that income—expressed as a percentage of the saturation "value" (S)—is then read off from the tabulated Gauss integral. Multiplying the saturation "level" (s) by the saturation "value" (S) then gives projected demand expressed in kilograms per head.

Although the log-normal distribution gives a much better fit of existing data (historical and cross-sectional) than earlier demand curves employed, there are still one or two cases where the observed data do not exactly fit the "ideal" curve. Two important instances occur in the study region, where, on the basis of 1952–55 consumption and income data, Japan appears to be an "over-consumer" and Oceania an "under-consumer" of paper in relation to income, the former lying above the curve and the latter below. Japan has, therefore, been projected separately—parallel with the curve, the underlying assumption being that, for specific local reasons, Japan is a permanent over-consumer. Oceania, though, as noted earlier, a "normal" consumer of cultural paper as a group, is an under-consumer of industrial papers, probably, a consequence of import restrictions operating during the base period. In view of the rapidly rising domestic output of these papers in recent years an upward adjustment has, therefore, been made in projecting demand for industrial papers in this sub-region—the underlying assumption being that Oceania will gradually approach "normality".

Projections have been made for each of four categories of paper and board (newsprint; printing and writing paper; all other paper; paperboard) in each sub-region. The basic assumption is that demand per head for each of these categories will follow changes in income per head (gross national product) in accordance with the theoretical demand function established for that category. The changes in income per head assumed up to 1965 and 1975 are those applied in projecting demand for other sectors of wood consumption and referred to at the beginning of this part of the study. To the future per head consumption figures thus obtained are applied the population projections discussed earlier, in order to arrive at demand for each category of paper and board in 1965 and 1975.

C. Studies for India

To provide the material on India for the second FAO study (on the Asia-Pacific Region) the Inspector-General of Forests, Government of India, prepared a County Report on timber trends study for India in 1958. The statistical data contained in this county report were utilised by Dr. J. A. von Monroy, a FAO expert, in his Report to the Government of India on "Integration of Forests and Forest Products" in 1960. The former gives for the years 1960, 1970 and 1975 production estimates and two sets of demand projections (minimum or maximum) by end uses and by types of wood. The latter report furnishes estimates of future requirements for 1960, 1965, 1970 and 1975 by major groups of consumers.

The inadequacy and special features of the Indian data and the methods for projecting demand supply used in these two reports are summarised below:

(*a*) *Inadequacy of data*

(1) In India utilisation of forest products, commencing from the first stages of logging to the ultimate end uses, has developed largely in an unorganised way without any overall integrated planning. Nor has there been any correlation between production and end-uses. As a result, available data are extremely meagre and difficult to co-ordinate.

(2) Trend survey for timber utilisation in India is difficult because there is considerable diversity in the development of end-uses and past data are inadequate as a basis for indicating future trends in the context of development plans.

(3) Production figures are inadequate and incomplete. No direct data are available for unrecorded production.

(4) Reliable and complete data on consumption of timber are not available from direct sources. The gaps in information required for projections have been filled up from indirect sources and estimates, *e.g.*, a considerable portion of the data for consumption of sawn wood such as in housing, rural uses, etc., has been built up from limited sampling studies, from related information in the records and N.S.S. and assumption of suitable averages for different uses.

(*b*) *Assumptions*

(1) Two sets of projections have been made on the basis of two different assumptions about the maximum and minimum rates of increase over the averages for 1953–55 in population, national income, agricultural output and industrial output. For example, the minimum and maximum rates of increase in 1975 over 1953–55 average have been assumed respectively to be 28·21 and 31·21% for population, 106·5 and 162·8% for national income, 63 and 84% for agricultural output and 130 and 214% for industrial output.

(2) It has been assumed that in urban areas 60 cu.ft. of sawn wood is required per house, use of cement, concrete and steel will increase and sizes of individual houses may tend to be smaller. The demand for houses in rural areas may be influenced by the rise in

prices of timber and increasing popularity of timber substitutes. It has been assumed that the sawn wood consumption for non-residential construction will increase in the decade 1960–70 at the same rate as in the previous decade. The figures for consumption of wood for rural uses are expected to run parallel to increases in agricultural output.

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SHRI J. P. BHATTACHARJEE[9]: **Changes in Technology, Consumer Preference and All That**

There are at least three courses open to any one asked, as I have been, to speak on methods of estimating the impact of changes in technology on the supply and in consumption pattern on the demand for farm products. The easiest way out is to start with a recapitulation of the standard assumption in economic theory about no-change in these two directions, and then somewhere along the way digress completely in the realm of metaphysical speculation with a take-off from the hackneyed and fatal Keynesian onslaught on the long run. I am afraid I do not have the flair of an essayist of this type. Another course is a more frustrating one of trying to explain how hazardous and uncertain such an exercise can be by describing all the qualifications and listing out all the problems and difficulties in the way, along with copious references to previous attempts in these fields. This should better be left to the writers of text-books. I am, therefore, inclined to take the third course of a bit of dangerous free-thinking without digression. Whether such a presentation will have more of positive substance is anybody's guess at this stage. For, to be quite frank, on these two sets of issues, nearly 90% of the discourse amount to nothing more than restatement of the gory details of the magnitude of the problems, followed by *ad hoc* advice. Faced with a task as difficult as this and painfully aware of the need to be brief, the best I can do is, without the overtones, to look forward and backward a little, which, after all, is what most exercises in long-range projection are—looking forward in the adjusted tail light.

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The longer the historical time series of past data, the greater in general, the scope for exercise in forecasting and projection. History always helps—the more of it the better. It gives us confidence in our knowledge of the adjustments that the population made in the past in production and consumption, and the time-lag involved in the process. In India, since the length of the historical information is abnormally short, we are at a disadvantage. For some commodities like milk, there is hardly any time series. Even for foodgrains for which we have the longest series, the past data offer very little guide. As one who has built up a series of production and consumption statistics of foodgrains going back to 1900, I am painfully aware of the inadequacies of such data for most types of multi-variate analysis. Besides, for nearly 40 of these years, the data reveal a generally stagnant level of production with any change in technology hardly perceptible. What guide lines can such data offer for the future? With only a decade of improvement in farm production and output in India, any long range projection going beyond ten years or so is bound to carry with it too many assumptions, the validity of which is subject to more than the acceptable measure of doubt. In any case, exercises in projection in India necessarily require anticipations, the framework of which can fortunately be derived from the course and objective of our plans. I can hardly go too far in emphasising the need for caution in such anticipations.

Changes in Technology.—The way in which technology affects both the level and the proportions of different inputs has recently been the subject of considerable discussion in the United States. The evidence establishes clearly that technical change does bring about changes in the factor proportions so as to reduce the input of the most scarce and expensive resources, subject generally to the constraint that returns to labour do not go down. This corresponds to the findings of the familiar models used in economic theory and analysis. This line of technical advance has, *pari passu,* brought about a steady increase in labour productivity in agriculture and other sectors in advanced countries. Recent studies have also shown a trend in the West toward a rising level of output per unit of total inputs. The lowering of the total input used per unit of output has come about through more efficient organisation as well as technical changes brought about through capital replacement. Is this what is likely to happen in Indian agriculture over the next ten or fifteen years? In America, let us not forget, the economy in the use of inputs probably came in the third stage, while in the second stage, the level of application of inputs reached a high degree of intensity. In the third stage, there has been over the years a reduction in the st of non-human inputs. And, as for labour, the economy in its qu tum per unit of output has probably been at a high rate than the rise in the rate of earnings. In India, the attempt so far has been to raise the level of intensity of inputs (fertiliser, irrigation, seeds, pesticides, etc.), including manpower. And, if the cost of the non-human inputs do not go up any more—we are yet far from the stage of cost reduction—the social desirability of raising wage rates and earnings of human labour—another assumption—is likely to lead to a situation in which the pattern of technological development in the next few planning periods may not be along the familiar Western (or American) lines. In any case, the prospect is uncertain for a steadily rising trend in the level of total output per unit of total input on farms.

This does not, however, put us in any difficulty; on the contrary, it makes the job easier for analysts. For, the computation of a composite measure or index of all inputs involves very difficult problems in aggregation and index number construction and seems to be ruled out for the present in India. In fact, even in the United States, a composite index of inputs has only recently been prepared; and even this is a rough approximation.

I have tried to engage in a bit of speculation about the future course of development of farm technology in India. This is necessary and has its implications on the method of estimation of the long-term supply prospects. In the view explained here, two assumptions seem to be justified. One is that there should be an allowance made for interactions of all improved inputs on the productivity per unit of land. The other is that productivity per unit of human labour has to rise to make it possible for earnings of labour to go up. These are the additional indicators that need to be used to make allowances for the effect of the technological variables. Now, output per unit of labour is one of the indicators sanctioned by long usage and may easily be tried in our country too. My suggestion, however, is to put at least two variables on the input side; these two variables may be land and labour. And, an indicator like output per man-acre seems worthwhile trying under our conditions.

While saying this, I assume that in long-range projection exercises, the plan framewrok will serve to provide some guide lines for the estimation of the quantity of individual inputs likely to be used in future. Adjustments in the use-efficiency will have to be made for the individual inputs separately as well as in their mutual interactions. The importance of interactions need to be re-emphasised in view of the fact that it has tended to be ignored in the yardstick approach to agricultural planning in India. At the back of all this discussion, there is the basic assumption that any long-range supply projection starts with the derivation of a production function, into the nature and methods of which I need not go here.

Changes in Consumer Preference.—Turning to changes in consumer preferences, the first point that comes to my mind is that their effect is much slower to work out than that of changes in technology. I have also a feeling that much of the discussion on this issue needs to be related to the reality in the country. In highly industrialised and urbanised societies, changes have occurred over time in consumption pattern through changes in tastes and preferences. But even in such societies the ultimate impact of these changes on the quantities consumed of different agricultural commodities is probably not as significant as on the processing, packaging and other so-called utilities that are added to these. I remember that in the course of discussion on this problem in an annual meeting of the American Farm Association, it was pointed out that the effect of changes in consumer preferences on the quantity of pea consumed in the United States has not been very significant. What has happened over the years, is a substitution of frozen peas for canned peas. In other words, the impact of changes in consumer preferences may not be as much on the quantity consumed as on the processing and other services added to the commodities. There are, however, cases of new commodities entering into production as well as consumption. The extent of their inroad depends on Government patronage, price support, research, industrial use and salesmanship. A good example is soya beans in the United States. In such cases, one cannot but rely on speculative forecasting.

I would like to make a broad distinction between two types of changes in consumer preference—autonomous and induced. A good example of the autonomous type of change is the introduction of new commodities to which I just referred. I think there will be agreement that these come about over periods longer than long-term. The induced changes are the ones built into the system and may be caused by changes in the price structure, the play of force of emulation and other social factors, the effect of prolonged scarcities in the case of particular commodities and changes in income. Such changes are incipient and going on slowly all the time. That is why any cross-sectional analysis of demand will tend to display significant variations in the consumption pattern among different groups. We are all aware of the tendency for the substitution of inferior by superior grains with increase in the level of income, and/or its redistribution. Such built in differences in consumption pattern among different groups are easier to project in future.

The methodological approaches that I may refer to in this connection are not different from those followed even in projections over shorter periods. In the first place, it would be better to use the quantity elasticity of demand (or consumption) in relation to income rather than value elasticity for particular products. I have emphasised in the past the fact that the use of quantity elasticity for groups of products like foodgrains, among items of which there is likely to be substitution, tends to take care of the problem of substitution to a much larger extent than value elasticity. Secondly, changes in the distribution of income is a factor that can hardly be ignored by long-range forecasters of demand. Since this is one of the imponderables, it is best to have projections for more than one level of income and one pattern of its distribution. Thirdly, in a diverse non-integrated economy like India's demand projections at the national level can only be meaningful to the extent it is agregated from separate and independent projections at the regional level. Lastly, the consumer preferences and tastes of the rural people display extreme rigidity in all countries; more so in India. Allowances for changes in tastes and preferences among the rural people will have to be made on a highly conservative basis and in any case should be done separately from those for the urban population. An important indicator on which the forecaster may do well to fix the gaze is the degree of monetization in the rural areas. Since both autonomous and induced changes in preferences are facilitated in a monetized economy, the extent of allowance to be made for these in long-range demand forecasts may be assessed from the projected change in the degree of monetization in the rural as well as urban economies.

SHRI B. R. KOHLI[10]: **Estimates of Demand for Foodgrains in India at the End of the Third and Fourth Five-Year Plans—State-wise Analysis**

The importance of demand projections in the context of planning for economic and social progress can hardly be exaggerated. Reliable estimates of demand for foodgrains at present and at a future date for All-India and State-wise are needed for various purposes such as import

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The views expressed in this paper are of the authors and not of the organisations to which the authors are employed.

and export policies, price support and inter-State grain movements. In this context, a study has been made to estimate the demand for foodgrains for All-India and State-wise by the end of the Third and Fourth Five-Year Plan periods.

Population Projection of All-India and State-wise

For estimating the demand for foodgrains for All-India and State-wise during 1961–71, the first pre-requisite is to have a reliable set of estimates of population beyond 1961. As the All-India and State-wise population Census figures for 1961 differ significantly from the estimates of population for 1961 prepared by the Expert Committee on Population Projections set up by the Planning Commission in 1959, it is necessary to attempt alternative sets of figures by States for periods later than 1961. The estimates* of total population of India by States for 1966 and 1971 have been worked out on the basis of the Final Population totals released recently by the Registrar-General of India. Since there is a priority reason to believe in the existence of marked rural-urban differentials in the pattern of consumption of foodgrains, it is but essential as a first step to have the rural-urban break-up of the total population in India by States. While estimating the rural-urban pattern, it has been assumed that the change in the proportion of urban *vis-a-vis* total population during the current decade would be similar to that experienced during the fifties, *i.e.*, 1951–61. Due care has been taken to exclude the spurious towns (which had been classified as urban in 1951 but have been de-classified as urban areas on the basis of a set of criteria for determining the urban nature of a place, adopted in 1961 Census).

Methods for Estimating Demand for Foodgrains for Human Consumption

The demand for foodgrains of a given population are estimated by the 'Statistical' or 'Normative' approach. The Statistical approach is based on the growth of population, *per capita* income and the corresponding income elasticities of demand for foodgrains. In the Normative approach, the daily caloric and nutritional requirements based on normal balanced diet for a 'Reference Man' are fixed and then applied to the total population. In this study, an attempt has been made to work out the All-India and State-wise demand for foodgrains by both the approaches. However, in the Normative approach, two different methods have been used.

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* The population projections for All-India and State-wise have been worked out by Modified Geometric Method with suitable assumptions.

Statistical Approach

Per capita effective demand for foodgrains in the Third and Fourth Plan periods may be estimated by inflating the figures of *per capita* availability of foodgrains at the end of Second Plan by an amount obtained by multiplying the estimated increase in the *per capita* income during this period over 1960–61 and the income elasticity coefficient of demand for foodgrains. This may be worked out separately for rural and urban areas respectively by assuming that the *per capita* consumption of foodgrains in urban areas would be 80% of that in rural areas in 1960–61.

For estimating the State-wise demand for foodgrains, the zonal *per capita* availability in 1960–61, the Zonal Income elasticity coefficients derived from the analysis of the National Sample Survey data collected in the 11th round (1956–57) and Zonal increases in *per capita* income in 1965–66 over 1960–61 from the estimates of the Indian Institute of Public Opinion can be utilized.

Normative Approach

For estimating the total demand for foodgrains, the consumption of 18 and 19 oz. of foodgrains, per day for a 'Reference Man' is taken as the basis. These consumption levels are regarded as the minimum, so long as other constituents of diet, *viz.*, vegetables, fruits, fats, etc., do not attain the norms laid down by the Nutrition Advisory Committee of the Indian Council of Medical Research. The All-India and State-wise demands can be estimated by adopting two further different procedures, firstly, by multiplying the consumption of 'Reference Man' equivalent to daily *per capita* consumption at 18 oz. of foodgrains by the projected population figures.

Secondly, the 'Reference Man' may be converted equivalent to one adult male unit. For this purpose, the whole population can be converted into adult male units. On the basis of the average intake at 19 oz. of foodgrains per adult per day (as revealed by the Survey conducted by the Indian Council of Medical Research during 1955–58) the total demand of foodgrains may be calculated.

Demand for Foodgrains for uses other than Human Consumption

For assessing the total demand for foodgrains, the requirements for seed, animal feed and wastage will also have to be taken into account. It has been officially estimated that the demand for non-human consumption would be about 14·3% of the demand for human consumption.