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**Seminar on**  
**DEMAND AND SUPPLY**  
**PROJECTIONS FOR**  
**AGRICULTURAL**  
**COMMODITIES**

GIANNINI FOUNDATION OF  
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**ECONOMICS, BOMBAY**

Seminar on  
DEMAND AND SUPPLY  
PROJECTIONS  
FOR AGRICULTURAL  
COMMODITIES



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NEEDED: AN ALL-INDIA COORDINATED DEMAND  
AND SUPPLY PROJECTION RESEARCH PROGRAMME

William E. Hendrix\*

Introduction

Supply and demand, as economic concepts, embrace the totality of what agricultural economics and the whole field of agricultural development is about. Hence it would be presumptuous for me to attempt in this paper to do more than to touch upon a few select problems and needs that we face in supply and demand projections applicable to the agriculture of a nation as large, diverse and complex as India and on whose supply and demand conditions and problems so little is known. It will take the work of many economists collaborating closely with scientists in other social disciplines and the physical sciences to build models that will yield reasonably satisfactory supply and demand and agricultural production projections in this as yet largely unmapped agricultural economy. The convening of this Seminar is an implicit recognition of such a need.

I am interested in supply and demand projections as operations in making projections of agricultural production and related input, resource development and policy needs. I am glad, however, that the Indian Society of Agricultural Economics has called this a "supply and demand projections" instead of a short or "long-range agricultural adjustment analyses" seminar. For, from an economic point of view, agricultural production can be defined as the intersect

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\* Chief, Agricultural Economics Division, USAID/  
India and Agricultural Economist, Economic Research  
Service, U.S. Department of Agriculture.

of two curves or schedules, one a demand and the other a supply schedule. In turn, changes in production can be defined as changes in the intersect of these two curves resulting from shifts in one or both of them.

Moreover, the fact that each of these schedules is one of quantity-price relationships means that the agricultural production problem is an economic as well as a physical or technical problem. This stands in contrast to the notion implicit in some development literature and planning models that a nation's agricultural production, instead of being importantly affected by prices, is only a function of its physical supplies of agricultural land, labour and capital goods and of the technologies applicable to their uses.

The depiction of agricultural production as a function of supply and demand relationships, however, can be a deceptive over-simplification of the agricultural problem unless one understands that supply and demand are merely short-hand or broad general organizing terms, each used by economists to embrace a larger complex of factors, some readily amenable to change, some changeable only over long periods of time and by large investments of capital in human and physical resource development, and some fixed or constant or subject to rates of change that for all practical purposes are not amenable to policy.

While supply and demand are in a measure functionally inter-related in a developing economy, for analytical purposes they necessarily have to be treated initially as separate or independent components of the agricultural production problem, as recognised by the organizers of this conference in their reference to it as a "supply and demand projection seminar."



Some Facets of the Demand Problem

The theory of demand relates to the behaviour of consumer units in the allocation of their income and wealth as between available supplies of consumption goods and services and savings and investment opportunities. Each consumer unit's demand for a particular agricultural commodity is, therefore, a function of the size of its income and of its basic needs and preferences for this commodity relative to its needs and preference for other goods and services, taking account of their relative supply prices in consumer markets. Total demand for any particular commodity or group of commodities produced by any particular nation or region is a summation of the demand of all of its own consumer units plus that of consumer units in other nations or regions (with which it trades) for the output of its producers.

Abstracting for the moment from international or inter-regional trade sources of demand, in analyses of demand for India as a whole (or for one of its States or regions) it is a common practice to treat growth in demand for any particular commodity or group of commodities as a function of growth in population (or number of consumers), and of per capita income and of consumer preferences as measured by income and price elasticities of demand.

The worth of such aggregative estimates of growth of demand for predicting a nation's aggregative growth in agricultural output, however, could conceivably vary widely depending upon how its growth in demand is distributed geographically and therefore upon how these geographic differences in centres of growth affect the demand schedules

against which farmers differing widely in their proximity and accessibility to the centres of demand growth plan their farming operations.

It is well known, for example, that much more of India's growth in demand and markets for farm products has occurred in some States than in others. It would seem to follow, therefore, that shifts in the demand schedules against which cultivators plan their farming operations have also been larger in some States than in others. This probably stands out most sharply in the case of growth in the demand for highly perishable and bulky commodities like milk and certain fresh fruits and vegetables which cannot be economically hauled over long distances under Indian transport conditions. But in these respects, differences between such perishables and other products are ones of degree.

I do not mean to imply that a high rate of growth in India's domestic demand for agricultural products will not cause shifts in the demand schedules facing farmers in all except the most inaccessible areas. But I am suggesting as an hypothesis that (because of differences among States and regions in the proximity and accessibility of their farmers to the centres of growth in demand and market) the shift in the demand schedule resulting from any given increase in total national demand will differ enough among States or regions to make an important difference from the demand side of the production equation in the nation's rate of agricultural output growth.

Without further labouring this point, it seems to me that on both theoretical and factual grounds, there are good reasons to believe that in our analyses of the demand side of the agricultural production problem, instead of treating



## DEMAND AND SUPPLY PROJECTIONS

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India as one large homogeneous nation in respect to the demand schedule facing farmers, we need to break it down into several fairly distinct agricultural product demand regions. Prices paid to farmers for agricultural products in Orissa or Assam suggest that in such a delineation, these States would not be in a demand or consumption regions also embracing Maharashtra or Punjab, Haryana and the Union Territory of Delhi.

Interestingly, in production adjustment analyses for the United States, Heady and his associates have delineated the nation into 31 demand regions and into 144 producing or supply regions. This suggests that in Heady's view demand and supply regions do not necessarily coincide. If they did, then in estimating demand growth applicable to each region one would need to take account of only its own internal rates of population and per capita income growth, ignoring the influence of trade with other regions on the demand schedules applicable to its farmers. The fact that this is not the case suggests that instead of treating demand growth in each State or region, or for that matter in India as a whole, as a function of only its own internal rates of population and per capita income growth, account must be taken also of the markets provided to its farmers by consumers in other States and regions and by other nations, that is, if our analyses are to be used in developing the demand side of the agricultural production projection equation. In demand projections made for a State or a smaller area trading with others, its own self-sufficiency needs provide at best only a first rough approximation of the size of markets open to its farmers. Using such a basis for projecting the demand or markets for milk produced by farmers in Rajasthan would be

to grossly under-estimate the size of markets that they do in fact have. Similarly for other commodities in many of India's other producing regions.

Complexities of demand analyses made for use in agricultural production projections suggest the need for a considerable amount of fairly basic research at both national and local levels and for close co-ordination of effort as between national and local levels or as between macro and micro levels of analyses.

Before leaving the demand problem, may I suggest that increases in demand for agricultural commodities affects their production only as they affect the quantity-price demand schedules facing farmers. The practical importance of this fact has been frequently overlooked in the development plans and price policies of developing countries, with the result that rates of growth in agricultural production have fallen short of their output growth potentials. India has not been wholly an exception in this respect. For example, emphasis was given in its First Five-Year Plan Report to stabilizing the terms of trade as between agriculture and rest of its economy. India achieved a high degree of success in respect of this objective during its first three Five-Year Plan periods. But this was done through heavy reliance upon concessional imports. Hence, India's growth in demand for agricultural commodities had little effect upon the demand schedules facing its farmers. Increases in agricultural product prices might not have been a sufficient condition for achieving a higher rate of growth in agricultural production. Yet without advances in cost reducing technologies and/or reductions in the prices of inputs, it would

have been a necessary condition. In fact, under these limitations, it would have been the only way in which India could have induced free and economically rational farmers to have increased their production at a faster rate. Stabilizing terms of trade is a worthy objective but under the agricultural supply conditions prevailing in India from 1950 to 1965, it appears to have had its costs for achieving the more important objective of a higher rate of growth in its farmers' demands for fertilizers, water and other inputs and thereby in its agricultural production.

In the views of many economists, India's zonal system and foodgrains procurement and distribution practices have been and still are, additional factors adversely affecting growth in its agricultural production through their effects upon the demand or quantity-price schedules against which its cultivators plan their resource uses and investments. In any case, no policies and programmes which importantly affect prices paid to farmers or the size of their markets for agricultural products, or, for that matter, farm production costs, can be ignored in any realistic analyses of the effects of growth in demand upon growth in agricultural production.

#### Some Facets of the Supply Problem

Conceptually, the supply projection side of the agricultural production problem is more complex than is the demand projection side in terms of the number of variables and the relationships involved. Its empirical development is vastly more difficult in terms of both (a) the amount and complexity of the work that needs to be done and (b) the number of disciplines upon which we have to draw.

In theory, production is often briefly defined as a function of utilized supplies of agricultural land, water, labour and capital goods and of the technologies and production coefficient applicable to their uses. The amounts of such inputs used and hence what we call the supply responses to a given set of farm product prices, however, turn also upon the supply prices and elasticities applicable to these inputs.

Such prices include land rents and interest on credit for which supplies to some users and uses in some localities may be too inelastic for some farmers to acquire more of these "inputs" at prices or on terms within their means or which permit their profitable uses. While land tenure relationships are frequently viewed as only distribution problems, they affect agricultural production through their effects upon the prices and supply elasticities of land for particular uses and users, including especially those requiring long term development investments of labour and/or capital. This follows from the fact that the distribution of income from land is also an operation in the pricing of its services.

Most of the agricultural production projections that have been made on an all-India basis, including those we have made for USAID, have been predicted on the implicit assumption that India's land, labour and capital resources are highly homogeneous and that the prices of their services are about the same for all farmers and uses, the distinction between irrigated and non-irrigated land being the one notable exception. I would also add that from the demand side, such projections have been predicted on the assumption, at least implicitly, that all of India can be treated as a large one-price market.

If these were valid assumptions, the projection problem would be very simple indeed; so also would be the achievement of the projected rates of increase in agricultural production.

Instead of such homogeneity, however, India is a land of great diversity in its natural resource endowments, in its rural population density and size of farms, in the development of both its land and human resources and in its rural property and other institutions affecting both (a) its resource allocation and (b) its income distribution, or land and labour pricing patterns. Still more critical for the projection problem is the fact that we have only the crudest of information on the nature and extent of many of these important attributes.

In the case of land under irrigation, we have good statistics on the size of the area irrigated, but no person in India at this stage knows how much of this land has an assured year-round supply of water, how much has only enough water in the kharif season merely to prevent crop failure, and how much has enough water to meet the needs of the new high-yielding varieties of wheat, rice and other cereals. Plan reports have repeatedly emphasized the fact that emphasis in the use of India's irrigation resources has been put upon preventing crop failures caused by drought rather than upon irrigation as a means of greatly increasing production. Does it follow from this that a large part of its irrigation works can now provide the command area they serve little more than enough water for such insurance purposes instead of enough to meet requirements of the new high-yielding cereal varieties? Projections and Plan targets

seem to assume at least implicitly that a large part of India's irrigated land has enough water to meet needs of high-yielding varieties.

An additional problem on much of India's currently irrigated land, (also on it much of its rainfed rice land) is that of water control during monsoon seasons. Good water control is now believed to be crucial to the success of IR-8 and other exotic rice varieties upon which 1 to 2 years ago we were pinning our hopes for a foodgrain output growth rate of 5 per cent or more per year through the Fourth Five-Year Plan period. Currently, we have no very reliable estimates on this important aspect of India's agricultural production problem. Moreover, relatively little work has been done on the cost-benefit relationships of water control measures.

Fuller development and use of India's underground water resources is regarded as an important means of further increasing its agricultural production. Here again, however, little has been done to inventory its underground water resources and to assess their agricultural development potentials.

But even if we knew how much irrigated and non-irrigated crop area the nation has and if every acre of crop land in each of these categories were identical in quality, the amount of crop land available for the application of modern farming technologies requiring large amounts of purchased inputs might still be only a fraction of this total area. One of the most important reasons why this may be so in India is that of the size of its farms.

Most economists correctly hold that there are no significant economies of scale in the use of seeds of high-yielding crop varieties, fertilizers, pesticide, water and other yield increasing inputs. The fact remains, however, that the ability of a cultivator regularly to produce a sizable market surplus over the subsistence needs of his family and of the labourers and village workers to whom he pays a share of his output is a first essential pre-requisite to the economic modernization of his farming operations. The farms operated by millions of India's cultivators are simply too small even if their yields could be doubled for consistent year to year production of large enough market surpluses to buy the inputs needed for their use of improved technologies. Many of these small farm cultivators are also tenants who are additionally handicapped in that they have to pay a sizable share of their output as rent.

The size of farm required for enough economic viability to sustain continuing year to year use of modern inputs varies markedly from one part of India to another. It is much larger in rocky hill-land areas and in semi-arid regions dependent wholly on rainfall, than in better land or irrigated farming areas. Generally, most of Punjab and Haryana, because of their larger size of farms, have had a large advantage over eastern Uttar Pradesh, Bihar and West Bengal in their capacity to adopt new high-yielding cereal varieties and to buy the fairly large amounts of fertilizers, water, pesticides and other inputs required by these varieties. The point I would emphasize is that projections made without taking account of the size of farms on which crop land area physically suitable for adoption of the new technologies is located could easily lead to an over-estimation of India's agricultural output growth potentials.



Finally, both the current and the long-run supply functions applicable to India's farms of viable economic sizes vary appreciably among States and within States, among their districts and blocks. These differences could have an important effect upon the agricultural output growth potentials of the nation as a whole. Besides, they are of large practical importance for the efficient inter-regional allocation of the nation's agricultural inputs and investments for resource development, without which India's agricultural output growth will fail to match its potentials.

Hence, even for estimating probable shifts in supply functions for the nation as a whole, there is a need in such assessment to break the nation down into each of several distinct producing regions, each having a high degree of homogeneity in respect of its natural resource endowments and other important supply factors.

The services of agricultural economists working at State and regional levels, such as those in India's agricultural universities and in agro-economic and farm management research centres are indispensable to the building up of reasonably good supply projections for the nation as a whole. To the extent that these economists are intimately familiar with the agriculture of the producing regions in which they work, they can at least introduce into their analyses reasonably good qualitative judgments about important resource attributes for which as yet we have little reliable quantitative information — certainly better judgments than can be made by most persons working at the all-India level of aggregation.

But in supply analyses, as well as in those relating to demand, there is need for both macro and micro studies

and for close co-operation and co-ordination of effort among regions and as between personnel working at national and at State and local levels. This is needed because, among other reasons, probable future supplies of inputs provided by non-farm sectors, including some technological advances, will turn heavily upon national as well as upon State and local policies and programmes; because input supply prices at local levels are influenced by the demand for such inputs in other States and regions.

Close co-ordination of effort in the development of appropriate methodologies is a first major requisite needed to increase worth of State or smaller areas analyses in assessment of the nation's production potentials and in the development of plans for such national policies and programmes as are needed to achieve the full growth potentials of each State or area and of the nation as a whole. Careful co-ordination of effort in the development of appropriate methodologies, drawing upon the nation's best expertise in this field (if not also upon highly competent expertise that might be obtainable from agricultural economic research centres in the United States, Japan and other countries) could also be of large value for strengthening the quality of work in the weaker collaborating agricultural economic research centres, i.e., weaker in respect to the competence of their personnel in the application of modern quantitative methods of economic analysis.

#### Concluding Comments

In the summer of 1967, I developed a very simple model for estimating on an all-India basis its probable 1967-68 foodgrain production and the inputs needed to sustain a growth rate of 5 per cent per year to 1970-71,

later published in ERS-USDA's FAER Report No.40, "Accelerating India's Foodgrain Production 1967-68 to 1970-71." With but minor adaptations this model was used by R.W.Cummings, Jr. in his report entitled Long Range Agricultural Adjustment Analysis completed in August 1969. With modifications to fit local conditions, it has been proposed for use in some parts of India by Schutjer and other U.S. agricultural economists.

The simplicity of this model is its principal merit. But as is often the case, simplicity is also its major weakness. For its simplicity is achieved by abstracting from some of the most important problems of Indian agricultural development. It treats all foodgrains as a single commodity. Instead of taking account of cost-price relations, it merely assumes that costs will be low enough and foodgrain prices high enough to achieve the projected increases in inputs and production. Instead of such a macro model, realistic analysis of India's agricultural production potentials will, I believe, require the disaggregation of India's agriculture by both commodities and region; careful consideration of cost-price relationships for all commodities and regions; and consideration of the effects of differences in farm size, farm tenure and other factors importantly affecting India's agricultural production potentials.

In this paper, I have not attempted to outline a systematic comprehensive methodology or model for demand and supply projection analyses and for their integration as required for production projection analyses. For I view the development of models adequate for the agricultural supply and demand and production projection problem of Indian agriculture as a task that will require the combined

efforts of specialists in each of several different branches of agricultural economics including some who are also highly adept in using modern quantitative techniques in conjunction with fairly elaborate conceptual models.

The need for much more systematic analyses of India's agricultural production potentials and related problems than have yet been undertaken is beyond question. For while the essentially macro projections that have been made in the past have been useful for some purposes, the degree to which subsequent performance of India's agricultural sector has matched the projections made leaves little room for complacency. Recent projections by both Indian planners and USAID officials indicate an agricultural output growth rate of 5 per cent per year during the Fourth Plan period. This is a larger rate of growth than any nation of comparable area size, or any nation with comparably complex social and economic problems, has ever made for so long a period of time. Already, many of India's own most astute observers, as well as economists in private foundations and international development agencies, have begun to wonder if the projection of a 5 per cent growth rate, instead of being soundly based, is not very largely a product of shooting in the dark in respect to India's agricultural production bases or, else, of much wishful thinking. I hope that these pessimists are wrong; but even if they are improvement in both the conceptual and the factual bases on which projections of supply, demand and production for planning purposes are made, will represent exceedingly valuable inputs for further development of the nation's agriculture and general economy-inputs matching in importance new crop varieties being produced by physical scientists.