MAKERERE UNIVERSITY COLLEGE

Faculty of Agriculture

ON QUANTIFYING THE MALTHUSIAN DILEMMA

By

Thomas T. Poleman

Visiting Professor in Agricultural Economics

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Back in 1798 the English cleric and economist, Thomas Malthus, first propounded the theory which, though it differed in detail from one edition to the next, holds that man has the capability of increasing more rapidly than his food supply and that in the absence of checks on population growth he will eventually be unable to feed himself (6).

For most of the ensuing 170 years, events seemed to deny this thesis. Though the world's population more than doubled between the early 1800's and the onset of the Second World War, production of foodstuffs more than expanded apace. Vast new areas were opened to cultivation in western North America, Australasia, and temperate South America; and a variety of technological innovations revolutionized temperate-zone agriculture. There can be little doubt that diets among a large protion of the world's people improved.

More recently the dilemma posed by Malthus has returned to haunt us. The "population explosion" of the years since 1945 has made prewar population projections seem ludicrous. The population of the world now stands at about 3.3 billion persons, over half again the figure of 30 years ago. Unless population trends change markedly in the next 35 years, there will be six billion people on earth by the year 2000. The bulk of them will live in what are now the less developed countries.

Whether world agriculture has proved equal to this sudden new challenge and whether it is likely to do so in the future are much debated questions, and ones that have given rise to a substantial literature. Depending on where we choose to look, we can find an "authority" to support the contention that the world has never been so well fed, or conversely, that if things are bad now they are sure to grow even worse. The fault, of course, lies in the quality of the statistical evidence. It is anything but impressive. For most areas, statistics are few, conflicting, and frequently erroneous in the extreme. Indeed, it is no exageration to say that there is not a single low-income country for which a reliable set of food production data exists.

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In support of the last statement I should like to cite three examples, the first from Mexico, a country which is widely presumed to have experienced rapid agricultural growth in recent years. The principal crop of Mexico is maize; it occupies over half of the cultivated area and contributes about 50 per cent of the total food calories. Table 1 presents the available evidence on Maxican maize production and trade from 1897/98 through 1960/61.

While the data pose a number of interesting problems, I will focus on the decade of the 1950's. Statistics for 1959/60, the most recent census year, indicate that maize production was then of the order of 5.6 - 5.7 million metric tons (7, p. 52; 9, pp. 244-50). In 1949/50, ten years earlier, the census reported production to be of the order of 4.5 million tons, whereas the Ministry of Agriculture maintained it was only 2.9 million tons(7, p. 52; 8, pp. 85, 88). Thus you can have it either way: depending on which figure is accepted, one can prove either that Mexican maize production more that doubled during the decade of the 1950's or did not keep pace with population growth.

Equally confusing is the situation in India, the home of one-seventh of mankind (and, sometimes unhappily, of more than one-seventh of our statisticians). There has existed since the early 1950's a major controversy among Indian agricultural economists as to the level of foodgrain output. This is shown graphically in Chart 1.

One set of estimates, that prepared by the Ministry of Agriculture and derived from acreage and crop-cutting figures, suggests that grain production is now normally of the order of 80 million long tons. Estimates based on extrapolations of consumption data, notably information collected during the nation-wide National Sample Surveys, indicate, on the other hand, that it must be closer to 90 or even 100 million tons. Analysis of the underlying evidence by one of my students has pointed to the 80 million ton figure as the more nearly correct one. But the same analysis also suggests that, given the statistics now available, it would be a grave mistake to draw any firm conclusion about the rate of agricultural progress in India. (5)

An even more chaotic situation obtains in Nigeria. Nigeria is Africa's most populous country, but by what margin is almost anybody's quess. The 1952/53 Census counted 30.4 million persons, and on the assumption that the rate of growth was 1.86 per cent per annum, the population in mid 1962 was officially put at 36.5 million (10, p. 25). A speical census in November of the following year returned a figure of 55.7 million. Politics are involved, and the debate as to where the true figure lies continues: workers at the University of Ibadan say in the neighbourhood of 45 million (11).

Estimates of Nigeria's cattle population diverge even further - - all the way from 4.3 million head to 15 million (2, p. 34).

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The neglect of the food sector in the statistical series of most underdeveloped countries mirrors the semi-subsistance character of this segment of the economy, the difficulties of agricultural data collection and, until recently, the lack of concern in official circles with food production and consumption. Colonial governments were assiduous data collectors, but commonly limited their activities to such enumerations as population censuses, cadastral surveys, and tallies of international trade and government revenue. The interest of a colonial administration in such matters is obvious. But the collection of information from many scattered agricultural units is difficult at best and hardly seemed worth the pains. Despite the myriad of impressively bound statistical bulletins, national income accounts, and the like now published, the situation persists: in virtually every underdeveloped acountry the reporting of crop yields, harvested acreage, home consumption, marketings, and similar features of the traditional agricultural sector is still woefully inadequate.

Such a situation cannot, of course, be allowed to continue indefinitely. To be sure, it really doesn't matter whether FAO and similar organizations base their propoganda on fact or fiction: no harm can come from efforts to stimulate food production. But if planning is to proceed on a rational basis in advanced as well as low-income countries it is urgent that individual food economies be quantified with some precision.

Ideally this would call for priority to be given throughout the tropical world to the establishment of effective statistical reporting systems. Such systems, however, are expensive in terms of both money and trained manpower: it would, I think, be unrealistic to expect much for many years to come.

This gloomy outlook need not, however, be occasion for despair among agricultural economists. Rather I think it should be taken as a challenge to utilize effectively such information as is available. There is a great deal of scattered and unorganized material which, while not primarily concerned with feoff production and consumption, can be brought to bear on such questions. Agricultural research results, cadastral survey records, reports of administrative officers, nutritional surveys, trade statistics, population data, household budget surveys, and sociological, anthropological, and geographical reports all contain information which can assist in establishing trustworthy food supply estimates. The problem is one of collecting and organizing this material in such a way that it can be analysed and used to build up a realiable picture of the food economy.

There are three major tools which can be used to this end. They are the compilation of regional or national food balance sheets, the employment of consumption surveys and other indicators of utilization to estimate aggregate consumption, and the use of nutritional yardsticks to test the consistency of the results. None are new approaches. All have been applied in the United States and Western Europe for a variety of purposes, including the retrospective construction of time series data (cf. 13) . In fact, the food balance sheet technique has been used extensively in attempts to quantify the food economics of underdeveloped countries - unfortunately with little discretion. Both the FAO and the United States Department of Agriculture have published balance sheets for most countries of the world (cf. 4, 12).

In a penetrating and devastating analysis of these publications, Helen C. Farnsworth has pointed out the dangers of hastily compiled national production and consumption estimates (1). If such exercises are to be at all valid, there is a critical need for painstaking scrutiny and description of the mass of underlying evidence, and for cross checks and corroboration from independent sources.

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The strategy of analysis I advance is outlined in Chart 2. It reflects the work of my students and myself over a number of years, during which time we have applied it to data from a number of countries: Mexico, India, China, Ghana, Ceylon, Malaysia, Nigeria, and Mauritius. We hope its validity is even broader, and I would welcome comments regarding its usefulness in the circumstances that prevail in East Africa.

The strategy is essentially a "circular" one: figures of unknown reliability are fed into an analytical framework wherein they can be distilled, refined, and tempered, to be discharged as, if not a precise, at least a definable statistical set. The approach in no way is a substitute for reliable and continuous data collection. But it does provide a legitimate summation of current evidence and starting point for future work.

A trinity denoted as the Demand Approach, the Supply Approach, and the Consolidated Account form the cornerstones of this interlocking scheme of analysis. The Demand Approach and the Supply Approach represent two independent methods of arriving at estimates of aggregate food supply. The essence of this division lies in keeping the two estimates separate so as to provide a basis for independent cross checking. Were the two approaches fused at an early stage in the analysis, this possibility would be irretrievably lost and the result would be an undefinable amalgam of two different types of data. As well as built-in checks on each other, the independence of the Demand and Supply Approaches also provides some clues as to the magnitude of error contained in the final consolidated Account into which they are ultimately combined.

The heart of the Supply Approach is the food balance sheet, the mechanism through which information on production, trade, and disposition is equated to obtain an estimate of net supplies available for human consumption. It is important to sound some caveats about the technique. The net supply for human consumption, the final item in the balance sheet, is a residual figure, and hence influenced by all the errors and omissions contained in each of the individual components of the equation. Reliability for the estimate of net supply can be claimed only if accurate information exists for all the components. This does not obtain even in nations with the best statistical information. In an underdeveloped economy it is rare for more than a few of the separate sub-items to be truly trustworthy. The approach, then, can only be treated as a first step towards arriving at more positive conclusions in the Consolidated Account.

By the same token, the estimation of aggregate food absorption through the Demand Approach must also be treated as a preliminary phase of the analysis. The Demand Approach consists of an effort to construct a reliable picture of national consumption patterns, and draws principally on nutritional surveys, household budget studies, and other small-scale investigations. It is "micro" analysis, in contrast to the "macro" analysis involved in the Supply Approach. Evidence of this kind, although it proves accurate and detailed information for individual persons of households, commonly gives rise to problems in creating a nationally representative picture. The bulk of this micro information most often relates to minority groups which have received special attention because of their interest to nutritionists, sociologists, anthropologists, or other investigators. Much nutrition work is confined to low-income families or particularly vulnerable age groups (pre-school schildren and the like) among whom nutritionists see the most acute dietary problems. Anthropologists frequently investigate the more "interesting" but numerically less significant, groups within a society; and household budget surveys are usually restricted to the urban population or industrial workers among whom interest on the cost of living, employment, and wages focuses. Still, these materials can generally form the basis of a valid picture of aggregate consumption behavior if pains are taken to interpret them with care.

The crux of the whole strategy lies in the meeting of the two independent analyses and in subjecting them to additional weighing and testing in the formation of the Consolidated Account. A key link in the process is the use of nutritive values for individual food items. These conversion factors enable the comparison of aggregate food supplies and utilization to be make in terms of a few common demoninators. For nutritional or medical analysis the choice of appropriate conversion factors is crucial; it is less critical for our purposes. In fact, obtaining an accurate conversion factor is well nigh impossible given the variety of estimates available, the heterogeneity of even apparently simple food commodities, and the lack of information on local varieties, growing conditions, and milling methods. Some or the conversion factors suggested as being applicable to Malaysian rice are given in Table 2 to demonstrate the wide range of nutritive values found by different researchers. But since our focus is on the use of such factors as rational weights for assessing aggregates, these problems are not critical so long as the same factors are used in evaluating both the Supply and Demand Approachs.

Although similarly imprecise, n tional nutritional norms (so-called "requirements" and "allowances") are also taken into consideration in the preparation of the Consolidated Account. But as such yardsticks can reveal only the grossest of errors - for example, aggregate daily per capita calorie supplies of 2,200-2,600 would seem acceptable in Uganda, a range which allows considerable scope for alternative estimates for individual commodities - their principal value is in the corroboration they provide and in establishing ceiling and floor values between which the aggregates can be expected to lie.

An important part of the synthesis in the Consolidated Account is the establishing of judgement internals around the final estimates, indicating the range within which they can confidently be asserted to occur. The size of the expected error is as important as the figures themselves. Yet such information is seldom, if ever, published by compilers of aggregate statistics.

Once the Consolidated Account has been established, a new estimate of domestic food production can be derived by putting the balance sheet process in reverse. The probable error in these estimates will naturally be greater than those in the estimates of total food supplies because any errors in deductions, allowances for non-food uses, trade, and so forth will be transferred back. Nevertheless, the final production estimates can be considered much more satisfactory than the original figures used in the Supply Approach, since they are now consistent with established aggregate supply and absorption, and are bounded with reliable confidence intervals.

The approach, then, is nothing more than a rational attempt to analyse underdeveloped materials in a manner which will yield the maximum amount of reliable information. Such exercises are not unique to food economists or students of the agricultural sector of low-income countries. They are common to all positive economic research. The search for meaningful statistics and for checking and correborating research findings is a routine part of all scientific inquiry. In the present context, however, this kind of work demands considerable flexibility and ingenuity. We have found that the exact mechanics of investigation appropriate to one country and set of problems can be totally unsuitable for another. Whomever I can persuade to do the Uganda study, therefore, will break new ground .

CITATIONS

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4. FAO, Food Balance Sheets, Second Issue (1955)

5. U.J. Lele, "Discussion of the Level of Foodgrain Production in India" (mimeo., Dept. Agr.Econ., Cornell Univ., December 1964).

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12. USDA, Econ. Res. Service, Food Balance for 12 Countries in the Far East and Oceania, 1959-61 (ERS Foreign 88, August 1964).

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Table I:- Mexico: Maize Production According to the Ministry of Agriculture and the Decennial Censuses

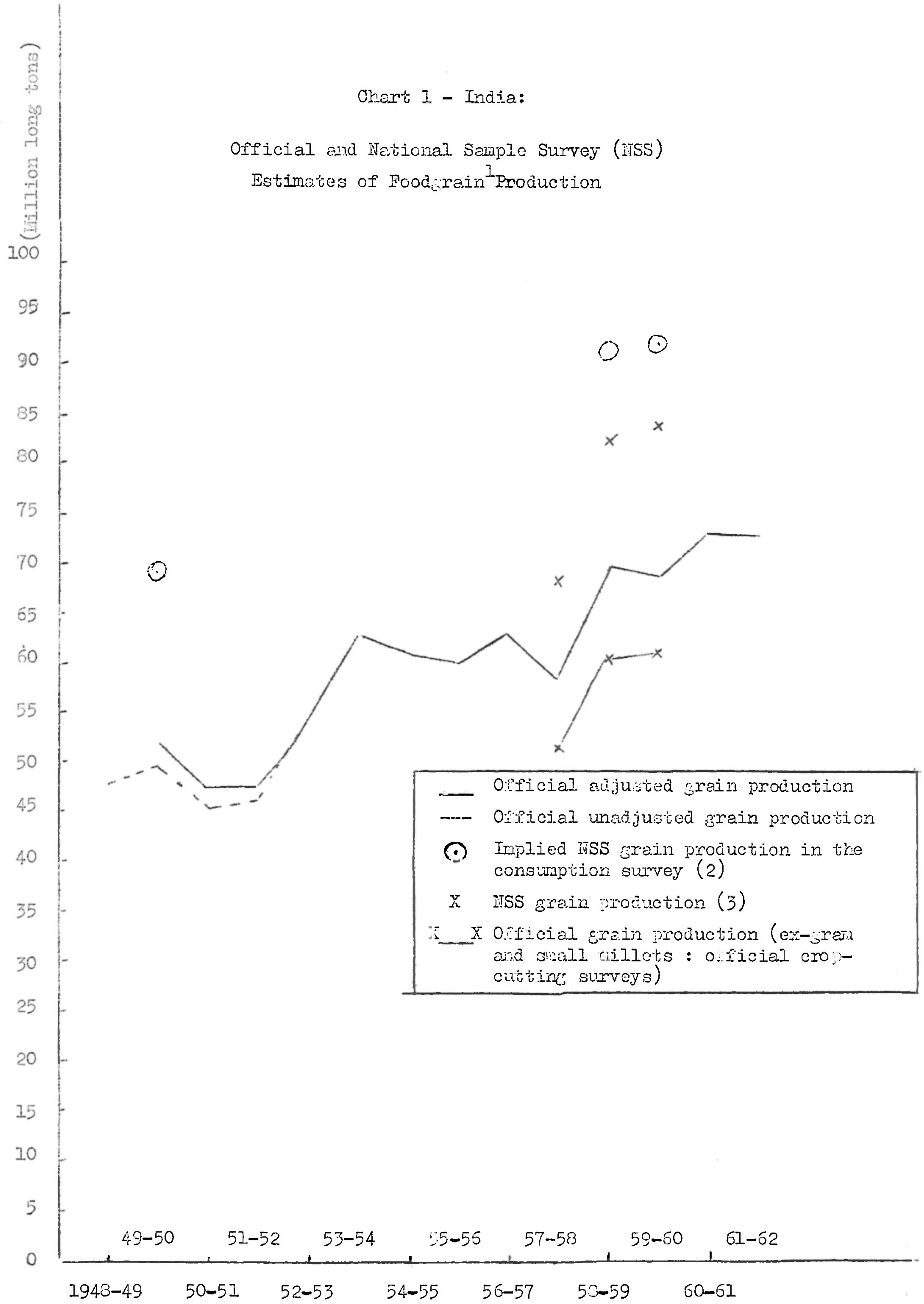
Crop Year	Ministry of Agriculture[(a)] Population (millions)	Production (1000 M/T)	Area (1000 Ha.)	Census[(b)] Production (1000 M/T)	Area (1000 Ha.)	Net Imports (1000 M/T)
1897/98	13.0	3,006	5,213			-
1898/99	13.2	2,747	4,780			-
1899/00	13.4	2,404	4,166			-
1900/01	13.6	2,309	4,036			-
1901/02	13.8	2,305	4,042			30
1902/03	13.9	2,201	3,871			25
1903/04	14.1	2,242	3,950			4
1904/05	14.2	2,211	3,881			13
1905/06	14.3	2,135	3,653			12
1906/07	14.5	2,716	4,743			37
1907	14.7	5,075	8,685			53
1925/26	15.2	1,968	2,936			66
1926/27	15.5	2,135	3,137			109
1927/28	15.7	2,059	3,181			28
1928/29	16.0	2,172	3,112			10
1929/30	16.3	1,469	2,970	1,991	3,812	8
1930/31	16.6	1,377	3,075			79
1931/32	16.9	2,139	3,377			19
1932/33	17.2	1,973	3,243			-
1933/34	17.5	1,924	3,198			-
1934	17.8	1,723	2,970			(71)
1935/36	18.1	1,674	2,966			(81)
1936/37	18.4	1,597	2,852			(4)
1937/38	18.7	1,635	3,000			4
1938/39	19.1	1,693	3,094			22
1939/40	19.4	1,977	3,367	2,989	4,771	54
1940/41	19.8	1,640	3,342			8
1941/42	20.2	2,124	3,492			-
1942/43	20.6	2,356	3,747			-
1943/44	21.2	1,775	3,048			32
1944	21.7	2,400	3,504			163
1945/46	22.2	2,186	3,451			48
1946/47	22.8	2,383	3,313			10
1947/48	23.4	2,518	3,512			1
1948/49	24.1	2,832	3,722			-
1949/50	24.8	2,871	3,792	4,529	5,727	(15)
1950/51	25.8	3,122	4,328			-
1951/52	26.5	3,424	4,458			118
1952/53	27.3	3,202	4,236			24
1953/54	28.0	3,720	4,863			373
1954	28.8	4,488	5,253			145
1955/56	29.7	4,490	5,371			(57)
1956/57	30.5	4,382	5,459			123
1957/58	31.4	4,499	5,392			810
1958/59	32.3	5,276	6,372			807
1959/60	33.3	5,563	6,324	5,706	6,802	32

(a) Data from Mexica, Sec. Agr. Gan., Dir. Gen. Econ. Rural, Boletin Mensual de Economia Rural (various issues)

(b) Data for 1929/30 from Mexico, Sec. Econ., Dir. Gen. Estad., Primer censo agricola-ganadero, 1930. Resumen general (1936), pp. 70, 74; for 1939/40 from ibid., Segundo censo agricola ganadero de los Estados Unidos Mexicanos, 1940. Resumen general (1951), pp. 32, 201 and ibid., Segundo censo ejidal de los Estados Unidos Mexicanos, 1940. Resumen general (1949), pp. 165, 171; for 1949/50 from ibid., Tercer censo agricola gandero y ejidal, 1950. Resumen general (1956), pp. 85, 88, 94, 96. Data for 1959/60 are unpublished final figures supplied by the Direccion General de Estadistica, 8 March 1965.

Chart 1 - India:

Official and National Sample Survey (NSS) Estimates of Foodgrain[1] Production



Footnotes to Chart 1.

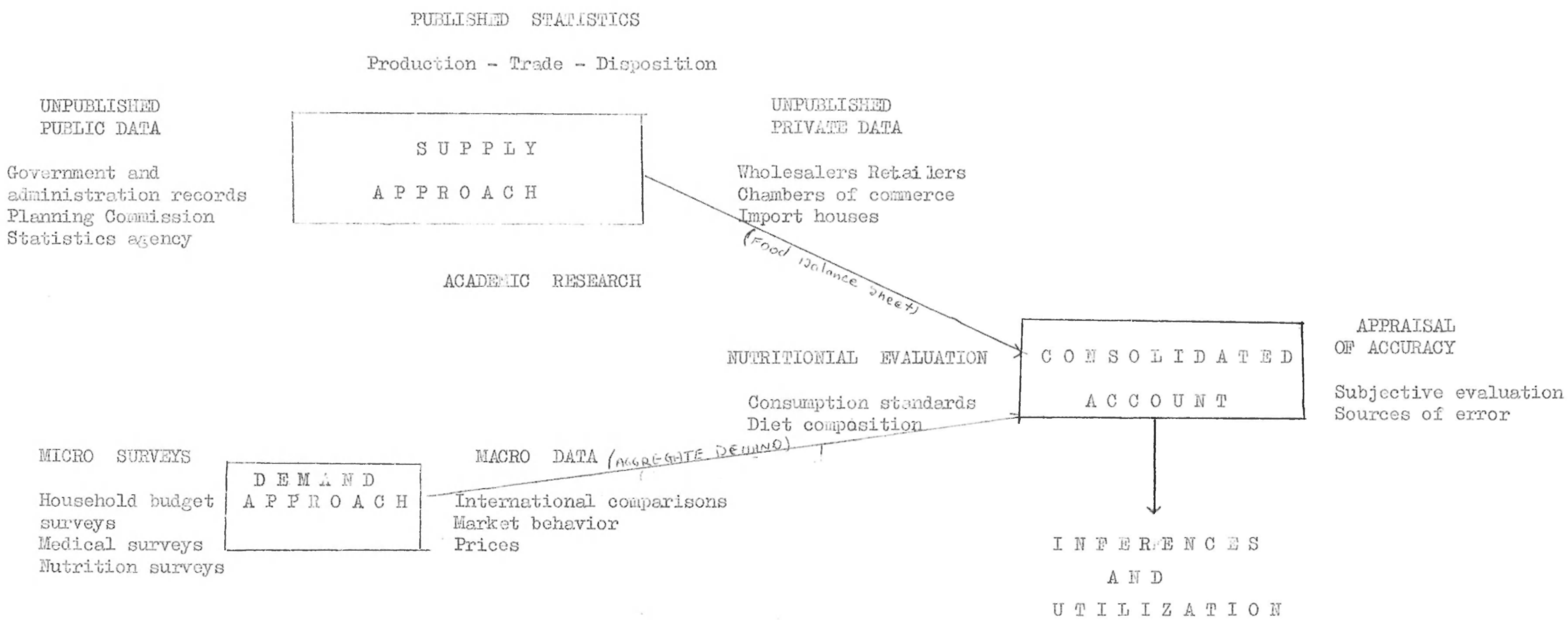
1. Foodgrains are here defined as including rice, wheat, jowar, bajara, maize, ragi, barely, small millets and gram. This is different from the official definition in that it does not include tur and other pulses that are included in the official definition. The above definition has to be adopted to make NSS and official data comparable.

2. Implied NSS grain production is estimated from the NSS consumption estimates at the national level by making allowance for feed, seed, wastage imports and industrial use. Seed rate is used as 7 per cent of the production, the rate estimated by the NSS through random surveys. Mahalanobis states grain used as feed to be 3.4 million tons in 1958-59 and 2.70 million tons in 1959-60. He makes an allowance of 4.5 million tons for wastage and feed from cereals, industrial use, losses in transport, etc. Release from imported stocks is estimated to be 3.5 to 4 million tons by Mahalanobis (see source 4 below). The same figure is used here. These estimates of Mahalanobis for 1958-59 approximate the 12.5 per cent rate of deduction used by the Ministry of Food and Agriculture to allow for feed, seed and wastage. As NSS did not estimate production from their consumption estimates in 1949-50, the implied production estimate for that year is arrived at by using 12.5 as the rate of deduction which appears to be acceptable by Mahalanobis.

3. The NSS estimates of grain production based on random sampling of area sown and yields per acre are not directly comparable to the official estimates as the official estimates include summer crops whereas the NSS estimates exclude them. NSS estimates also exclude some hilly and forest areas which are included in the official estimates. The difference arising from this exclusion is, however, not likely to be very significant.

Source:
1. Agricultural Situation in India, Ministry of Food and Agriculture.
2. Bulletin on Food Statistics, Ministry of Food and Agriculture.
3. National Sample Survey, General Report No.1 on The First Round, October 1950-March 1951.
4. P.C. Mahalanabis, "A Preliminary Note on the Consumption of Cereals in India", Bulletin de l'Institute International de Statistique, 33e session Paris 1961.
5. National Sample Survey, "Notes on the Result of the Land Utilization Survey and Crop-cutting Experiments", Twelth Round, March-August 1957, No. 69.
6. National Sample Survey, "Some Results of the Land Utilization Survey and Crop-cutting Experiments", Fourteenth Round, July 1958-June 1959, No. 73.
7. National Sample Survey, "Some Results of the Land Utilization Survey and Crop-Cutting Experiments," (Fifteenth Round: July 1959-June 1960) nO. 79.

Chart 2 - THE ANALYTICAL APPROACH SCHEMATIZED



Footnotes for Table 2

* Based on sources indicated by numbers in the column headings. All Values are per 100 grams edible portion.

(1) A.J. Woon, "Tables of Representative Values of Foods Commonly Used in Singapore," (mimeo., University of Malaya in Singapore, Dept. Soc. Med. and Public Health, 1962).

(2) S.G. Willimott, Malayan Food Composition Table (Fed. Malaya Dept. Agr., 1946).

(3) Philippines, Nat. Econ. Council, Office of Statistical Co-ordination and Standards, The Food Balance Sheet Manual (1962).

(4) B.S. Platt, Tables of Representative Values of Food Commonly Used in Tropical Countries (Med. Res. Council, Special Report Series 302, London, 1962).

(5) USDA, Bur. Human Nut., Composition of Foods Used in Far Eastern Countries (Agri. Hdbk. 34, 1952).

(6) I.A. Simpson, A.Y. Chow and C.C. Soh, "A Study of the Nutritional Value of Some Varieties of Malayan Rice," Institute of Medical Research Bulletin (Kuala Lumpur), New Series, No. 5, 1951. Average, maximum and minimum values from a sample of 30 Malayan rice varieties.

(a) Unpolished rice.

TABLE 2 - SOUTHEAST ASIA: ALTERNATIVE CALORIE AND PROTEIN CONVERSION FACTORS FOR RICE*

Grade	Calories per 100 grams					Protein per 100 grams							
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	6(a) Max.	6(b) Min.	6(c) Mean
Highly milled	360	310	367	352	360	6.8	7.0	7.3	7.0	6.8	8.7	4.4	6.6
Home pounded, undermilled	363	-	373[(a)]	-	363	7.6	-	8.3[(a)]	-	7.6	-	-	-
Husked or brown rice	355	310	-	-	355	7.4	7.5	-	-	7.4	8.7	5.5	7.0
Parboiled	364	356	-	354	364	6.8	7.5	-	8.0	6.8	-	-	-
Glutinous	346	-	366	-	362	8.1	-	6.9	-	6.7	-	-	-