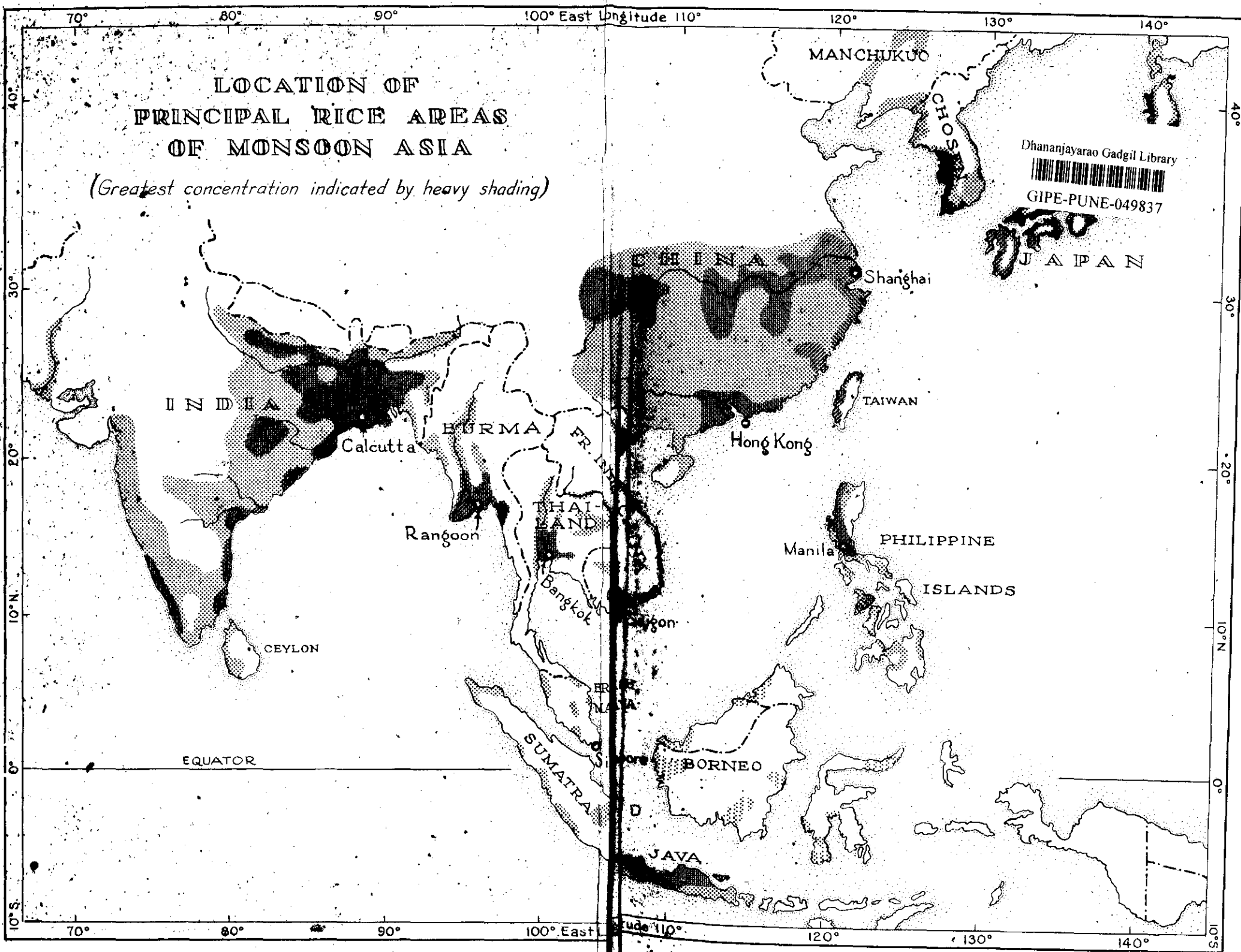


LOCATION OF  
PRINCIPAL RICE AREAS  
OF MONSOON ASIA

*(Greatest concentration indicated by heavy shading)*



***The* RICE ECONOMY *of* MONSOON ASIA**

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*The*  
**RICE ECONOMY**  
*of*  
**MONSOON ASIA**

By

**V. D. WICKIZER and**  
**M. K. BENNETT**



**Published in co-operation with the International Secretariat,  
Institute of Pacific Relations**

**FOOD RESEARCH INSTITUTE  
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## FOOD RESEARCH INSTITUTE

Established at Stanford University, California, in 1921, jointly by Carnegie Corporation of New York and the Trustees of the Leland Stanford Junior University, for research in the production, distribution, and consumption of food

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## DIRECTOR'S PREFACE

Rice is the great staple in the diet of hundreds of millions of people, particularly in the Orient, and it is the cereal preferred by millions more whose poverty forces them to eat even cheaper foods. Wheat holds the premier position among the food grains for other hundreds of millions—in Europe, Australasia, and the Americas as well as parts of the USSR and the Orient. Both rice and wheat are of major importance in the world's agriculture, but rice dominates agriculture and economic life in Monsoon Asia to a degree that is equaled by wheat in only a few limited regions.

The economics and politics of wheat have been much explored. The Food Research Institute alone has devoted a large part of its energies for twenty years to national and world wheat developments and problems. The world rice economy has been far less adequately investigated. Despite the importance of rice, there has been available no comprehensive study of its position in even the agriculture, trade, and consumption of Monsoon Asia, where 95 per cent of the world's rice is produced and consumed. It is hoped that this book will not only help to fill this need but also contribute to a better understanding of Far Eastern food problems, at a time when many eyes are turned toward the Orient, and that it will stimulate the growth of fuller knowledge through the work of others in the years ahead.

Study of rice at the Food Research Institute was initiated by the late Carl L. Alsberg, while he was one of its directors. As an outgrowth of discussions at the Honolulu conference of the Institute of Pacific Relations in 1927, that Institute secured substantial grants of funds from the Social Science Research Council for two related series of investigations under Dr. Alsberg's direction. These were on trends in consumption of agricultural products in southeastern Asia and trends in Pacific agriculture from subsistence farming to cash-crop farming. In connection with this enterprise Dr. Alsberg

spent several months in the Orient in 1929, and subsequently directed the work of a number of research workers in China and at Stanford University. Among the products published in Food Research Institute series were W. Y. Swen and C. L. Alsberg, "Japan as a Producer and Importer of Wheat" (*Wheat Studies*, July 1930) and E. F. Penrose, *Population Theories and Their Application, with Special Reference to Japan* (Miscellaneous Publication 7, September 1934).

In the course of these investigations, materials on rice were gradually assembled, with aid from officials and others in the rice world. Before the grants expired in June 1933, Mr. Penrose and Mr. Wickizer had devoted months of their time specifically to rice. Dr. Alsberg long planned to utilize their manuscripts in producing a joint work. This he never succeeded in doing—chiefly because so much of his energy was absorbed by other heavy responsibilities on behalf of the Institute of Pacific Relations and the Social Science Research Council.

The present book is largely the work of V. D. Wickizer. Because of his own plans to study in the Far East, and his earlier work on rice, the Food Research Institute arranged in 1939 for him to pursue the subject afresh. In the course of his travel he visited most of the countries of Monsoon Asia. Upon his return to this country in 1940 Mr. Wickizer rejoined the Institute staff, and he has since devoted himself primarily to the completion of this project. Dr. Alsberg's untimely death in October 1940 put an end to a collaboration which had been strongly counted upon. Thereafter, M. K. Bennett worked with Mr. Wickizer in revising and completing the manuscript, and contributed portions involving his own specialized knowledge. In various other respects, experience accumulated in the Food Research Institute has facilitated the present work.

As noted on the title page, *The Rice Economy of Monsoon Asia* is published in co-operation with the International Secretariat of the Institute of Pacific Relations; but neither the

*DIRECTOR'S PREFACE*

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secretariat nor the national councils of that Institute assume any responsibility for statements of fact or opinion contained herein.

Perfection in a task of this sort is at best an unattainable goal, and the authors are aware that the book has various shortcomings. Many of these are attributable to difficulties inherent in the subject and limitations of accessible materials, to the unforeseen absence of Dr. Alsberg's potentially rich contributions, and to war conditions that have interfered with having drafts given critical readings by qualified persons in the Orient. Nevertheless, the very protraction of the research period has permitted an unusual degree of maturing of the study, and our experience strongly points to the desirability of avoiding extreme delays incidental to eliminating every remediable flaw. We shall of course be grateful to readers, including reviewers, who bring errors and omissions to our attention.

JOSEPH S. DAVIS

October 1941

## ACKNOWLEDGMENTS

The authors feel peculiarly indebted to the late Carl L. Alsberg, whose interest in Far Eastern agriculture and food problems provided the stimulus for initiating and pursuing an extended economic study of rice. Joseph S. Davis shared Dr. Alsberg's view of the importance of the subject, actively sponsored the project which resulted in this book, and has contributed generously to its completion. Other colleagues have critically read all or portions of the proof and have been most helpful.

The chief burden of statistical compilations, computations, and revisions has fallen on Rosamond H. Peirce; the drawing and finishing of charts and maps on P. Stanley King; and the typing, checking, and general assistance in seeing the book through the press, on Ruth Lee Young. The co-operation of these three principal assistants has been invaluable, and the authors' appreciation is far greater than can be expressed in a brief note of acknowledgment.

To those both in this country and in the Far East who have indirectly contributed to this book through conversations, correspondence, or help in uncovering materials, the authors wish to express their thanks even though the specific influence of these individuals on the final product can no longer be identified.

V. D. WICKIZER  
M. K. BENNETT

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## CHAPTER I

### INTRODUCTION

No food has a longer, more colorful, history than rice; no food has entered the lives of so many people over the centuries; and probably no food looms so large today in both economic and social significance. Despite its long dominance in the diet and food supply of Oriental nations, and despite the close connection between its cultivation and cultural and economic development, rice remains a cereal about which comparatively little is known in a quantitative sense. From the Occidental viewpoint, the world of rice is a world apart, because 95 per cent of all rice is produced and consumed in Monsoon Asia, an area which extends across the southeastern part of the continent of Asia from India to Japan, and includes practically all of the adjacent tropical and subtropical islands.

As used in this book, "Monsoon Asia" is a convenient designation for a specific group of countries<sup>1</sup> in which monsoonal climatic conditions profoundly influence both agriculture and economic life. Practically all of the territory within Monsoon Asia is characterized by summer maximum and winter minimum of rainfall with seasonal reversal of wind direction—from the ocean toward the Asiatic highlands in summer (the summer monsoon), and vice versa in winter. Where these phenomena are strongly developed, as in much of the Indian subcontinent and in the Indo-Chinese Peninsula, the climate is commonly designated as of "monsoon" type. Various modifications emerge along the Equator, in regions

<sup>1</sup> Japan Proper, Chosen, Taiwan, China without Manchukuo, French Indo-China, Thailand, Burma, British Malaya, India, Ceylon, and the adjacent islands mainly of the Philippines and the Netherlands Indies.

The word "Malaya" by itself (without the "British") is an English hybrid applied only to British possessions and protectorates. These include, in addition to states on the Peninsula, also Labuan, the protected Malay state Brunei, the Cocos or Keeling Islands, Christmas Island, the territory of the British North Borneo Company, and Sarawak.

far inland, and in the higher latitudes. Thus the climate of Monsoon Asia is not everywhere of monsoon type, nor is rice in every locality important in production or consumption. But quantitative economic study of rice can proceed only on the basis of political boundaries to which available statistics refer; countries as well as climates must be considered.

These countries in which rice is the mainstay of the diet are, in the main, inhabited by countless millions living under rather adverse conditions. Agricultural pursuits commonly provide no more than a bare subsistence. In many cases the people live apart from their neighbors; the customs, language, standards of measurement, and practices of one part of a country differ from those in another part. The general level of literacy is low, and the difficulties of communication are frequently great. It is not surprising, therefore, that, although rice has not been neglected by classical or modern sociological literature, factual information necessary for an appraisal of its position in the world's economy is scarce, faulty, or altogether lacking.

As sources of food energy, cereals of one kind or another far outweigh all other foodstuffs, whether of animal or of plant origin. It has been estimated that the cereals, together with white and sweet potatoes and cassava, provided 75 per cent of world disappearance of food calories in 1933-38;<sup>2</sup> and potatoes and cassava could hardly have contributed 5 per cent of the total. Cereals are available almost everywhere and are comparatively cheap. The most palatable and conveniently available cereals tend to become the preferred cereals; and others, less expensive, are used only when the preferred ones are out of reach. Although rye, maize, certain millets, and grain sorghums qualify in some places for human food, and may even be preferred to other grains, only wheat ranks with rice in food use. Roughly four out of five of the earth's inhabitants prefer and consume predomi-

<sup>2</sup> M. K. Bennett, "International Contrasts in Food Consumption," *Geographical Review* (New York), July 1941, XXXI, 365-76.

nantly rice or wheat. Within historical times, rice has been the preferred if not always the dominant food of the yellow and brown races; and, for several centuries at least, wheat has probably been the preferred cereal food of the white race.

As a group the principal cereals occupy over half of the plowed land of the world.<sup>5</sup> In acreage sown, rice exceeds oats, rye, barley, and probably the millets and grain sorghums, but is exceeded slightly by maize and is only about half as important as wheat. In volume of world production, rice may rank somewhat above maize and far above all other cereals except wheat. With respect to use for human food, rice far outranks maize because very little of the world's rice crop goes to nonfood uses whereas the maize crop is used heavily as feed for livestock.

Rice and wheat are about equal in volume of production (some 150 million metric tons annually) if comparisons are based upon the weights respectively of rough rice and threshed wheat. But the flour that might be produced from the world's wheat harvest would probably outweigh the edible rice that might be produced from the world's rice harvest, since the inedible fraction of rough rice is considerably larger than the inedible fraction of threshed wheat.

Rice and wheat are thus unquestionably the most important cereal sources of food calories for mankind. Which is the more so is perhaps indeterminate. Yet rice probably looms larger in the daily life of more people than does wheat. The farmers of the world whose principal crop is rice presumably far outnumber those whose principal crop is wheat, for much of the world's wheat is produced by commercial growers on large tracts whereas rice is produced typically on tiny plots by subsistence farmers. Similarly, the consumers

<sup>5</sup> Writing in 1923, O. E. Baker ("Land Utilization in the United States: Geographical Aspects of the Problem," *Geographical Review*, January 1923, XIII, 25) estimated the cultivated land area of the world, excluding pasture, as about 2,370 million acres. The average area sown to the cereals in 1920-34 was not far from 1,300 million acres (M. K. Bennett and Helen C. Farnsworth, "World Wheat Acreage, Yields, and Climates," *WHEAT STUDIES OF THE FOOD RESEARCH INSTITUTE* [hereafter cited as *WHEAT STUDIES*], March 1937, XIII, 266).

of the world whose principal food is rice probably far outnumber those whose principal food is wheat. Moreover, the wheat-eating populations of the world are a more prosperous group than the rice eaters, and enjoy on the average greater diversification in their diets. Finally, the populations dependent upon wheat for a large fraction of their food calories—60 per cent or more—are considerably smaller in number than the populations similarly dependent upon rice.

Rice, though in some respects similar to wheat in its importance in the world as a whole, differs sharply from wheat with respect to geographical concentration of acreage, production, and consumption.\* Wheat is widely diffused. It is found on every continent, particularly in the subhumid parts of the temperate zones. Europe (including the European part of the USSR), though the major producing continent, contains considerably less than half of the world wheat acreage and consumes somewhat less than half of the world wheat output. Rice, on the other hand, is predominantly an Asiatic and Oriental crop, other continents and areas being of very minor importance in the world total.

Monsoon Asia as a whole is relatively densely populated but little urbanized and industrialized. The principal occupation is rice production, and rice is outstandingly the major foodstuff. The general level of living is low, and the population tends to increase rapidly. The land of Monsoon Asia not now cultivated but adaptable to rice culture is perhaps so limited in extent or so difficult of access or preparation that maintenance of recent levels of per capita rice consumption for the rapidly growing population may seem difficult or impossible. Since rice is the principal food, Monsoon Asia seems to be an area of which a question may legitimately be raised concerning the probability that food supply can be expected to keep pace with normal population growth.

\*For a more complete discussion of these and many other contrasts between rice and wheat, see V. D. Wickizer, "Rice and Wheat in World Agriculture and Consumption," *WHEAT STUDIES*, March 1941, XVII, 261-314.

With wheat, no such question seems significant at present. In the late 1890's, however, the English physicist, Sir William Crookes,<sup>5</sup> when he chose to appraise the prospects of an ample wheat supply for the peoples of the world in the twentieth century, concluded that a serious shortage of wheat was impending for the world as a whole. Yet there has been no suggestion of wheat shortage since the recovery of European agriculture in the decade following the Armistice of 1918. Indeed, during the world economic depression of the early 1930's, the four great wheat exporters, Argentina, Australia, Canada, and the United States, found it necessary to attempt a curtailment of supplies. Although they came to an understanding on the exportation of wheat and agreed to place themselves upon production quotas, the agreement soon broke down. Surplus rather than shortage has characterized the world wheat situation in most years since 1928.

No one today believes in an impending shortage of wheat. On the contrary, the problem is how to reduce surpluses and carryovers in order to prevent prices in exporting countries from falling so low as to cause serious distress among wheat farmers—a situation quite different from that forecast by Crookes. A few of the reasons for this change of outlook may be enumerated here.<sup>6</sup>

The extension and cheapening of costs of transportation since the 1890's have made it possible to market wheat from many outlying regions where wheat formerly was not grown because it was not profitable, or where wheat culture was limited to supplying the local demand. This development in transportation was accompanied by the opening up of vast regions, notably in Canada and Australia, from which little wheat had reached Europe before the turn of the century.

<sup>5</sup> "Presidential Address," *Report of the Sixty-Eighth Meeting of the British Association for the Advancement of Science Held at Bristol in September 1898* (London, 1899), pp. 3-19, 33-38.

<sup>6</sup> More fully discussed in J. S. Davis, "The Specter of Dearth of Food: History's Answer to Sir William Crookes," in *On Agricultural Policy, 1926-1938* (Food Research Institute, Misc. Pub. 9, Stanford University, Calif., 1934), pp. 3-23.

Both of these countries, and Argentina also to a large extent, have become important factors in the wheat markets of the world only in the present century.

Another major influence in the world wheat situation, more recently in evidence, is the decline in per capita consumption which has occurred in many countries where the standard of living has been fairly high. There seems to have been in these countries a considerable shift in diet, mainly from staple foods like wheat to more expensive foods like meat, dairy products, sugar, fruits, and vegetables. Furthermore, in many of the wheat-eating countries total demand has not increased as rapidly as formerly, because the rate of population increase has been falling off. European countries have also striven for more than a decade to make themselves self-sufficient in wheat, and have succeeded in expanding their domestic output. These developments, and others, were not foreseen at the time Crookes made his challenging address.

At present, and on cursory examination, rice seems to occupy somewhat the position that Crookes envisaged for wheat in the 1890's. The question of the probable future adequacy of the rice supply seems sufficiently important to justify an attempt in this book to deal at least indirectly with the problem. Is the world rice outlook similar to that of threatening shortage that Crookes foresaw for wheat half a century ago, or is it nearer the situation of prospective wheat abundance now generally foreseen?

Current views of the prospective world wheat situation rest upon an extensive accumulation of statistical data, and long-continued analysis of their significance. No such accumulations of data and interpretations are available for rice. The countries of Monsoon Asia are not all highly developed and therefore lack an adequate body of statistics on rice production, consumption, trade, and population trends. In addition to the undeveloped records of many of these countries and unfamiliarity of officials with statistical methods, the language barrier itself creates difficulties of first importance.

Although great strides have been made in some countries in improving both the completeness and accuracy of the data compiled and in providing additional translations, there exists as yet no really good basis for appraising the adequacy of the statistics on rice in this part of the world.

The reader must, therefore, constantly bear in mind these limitations. Because such deficiencies are not easily appraised, it is necessary to consider the statements made here as reflecting only the logical interpretation of the record such as it is. If the record is imperfect and misleading, the conclusions drawn therefrom may likewise be faulty, despite earnest efforts to render the analysis as adequate as possible.

The sketchiness of the statistical record itself, however, provides some justification for this book. Even fragments of information, if properly fitted together, may prove illuminating and provide the bases for significant hypotheses in the stead of the proved generalizations that one would wish to advance. The effort has been made here to synthesize and interpret fragments of information, mainly as they pertain to the period from shortly after the first world war to the outbreak of the second, late in 1939. If the economy of Monsoon Asia is worth understanding, no other procedure is feasible; and if understanding must wait upon the collection of completely timely, truly adequate and reliable data, it will be long delayed.

The primary objective in the chapters that follow is to present a comprehensive picture of rice in its general habitat—Monsoon Asia as a whole—and to explain why rice occupies the important economic position that it does. Many writings can be found that deal with rice in one or another of the countries of Monsoon Asia, or with one or another aspect of rice production, marketing, consumption, trade, or prices in particular countries or places. But a broad and general survey of the economic aspects of rice in what is really the rice world has not hitherto appeared. The attempt is made here to illuminate the general situation by examining the rice

economy from successive points of view—production, trade, consumption, prices, and the like; and by emphasizing contrasts that emerge from study of the several parts of the whole region. If the general economic position and prospects of rice in the world's great rice-producing region are brought a step nearer to clarification, the major objective of this book will have been attained.



## CHAPTER II

### ENVIRONMENT OF THE WORLD RICE ECONOMY

Rice is the name given to the grain of the rice plant from the time the hard, rather tight-fitting hull surrounding the kernel is removed by milling until it is ultimately consumed as cooked food, or until it is otherwise used. "Paddy" is the term commonly applied in Oriental countries to the rice plant as it grows in the field, to the cut and harvested stalks, and to the grains that are detached by threshing. The flooded field in which the plant grows is also given the same name in English translation. In Occidental countries the unhusked grain of the rice plant is more often referred to as "rough rice" than as paddy, but in order to avoid confusion with various forms of milled or partly milled rice, we have chosen to follow the custom of Far Eastern countries in referring to rice in the hull as paddy.

The rice plant, *Oryza sativa*, L., is an annual grass belonging to the same family as wheat, corn, oats, barley, and the grain sorghums. Its culms (stalks) commonly grow 3 or 4 feet high and are topped by spikelets bearing grains. The spikelets form a loose panicle (head) somewhat in the fashion of oats and quite unlike the tight ears of wheat and rye.<sup>1</sup> There are over a dozen known species of rice, but all of the cultivated varieties belong to the same species.<sup>2</sup>

#### VARIETIES AND THEIR IMPORTANCE

There are several thousand more or less distinct cultivated varieties of rice, more than are known for any other cereal. All are summer crops, grown either in the summer season

<sup>1</sup> Readers interested in a botanical description of the rice plant are referred to E. B. Copeland, *Rice* (London, 1924).

<sup>2</sup> There are a number of related species of wild rice found in tropical Africa, south-eastern Asia and adjoining islands, and elsewhere. The so-called wild rice or Indian rice (*Zizania aquatica*) found in the northern United States and Canada is not true rice, but belongs to a different botanical group.

north and south of the Equator, or at the Equator at any time of year if conditions in addition to temperature are appropriate. From germination to maturity, all varieties of rice grow continuously without passing through the dormant winter stage characteristic of some of the fall-sown grains, wheat and rye particularly. Details of the different varieties of rice, however, are of minor significance here. It suffices to distinguish between *common rice* and *glutinous rice*; and, although the second distinction does not rest upon botanical characteristics, between *upland rice* and *lowland* (or irrigated) *rice*.

Common rice comprises the varieties whose kernels can be cooked so that they remain separate. It is the article ordinarily referred to in discussions of rice production, trade, and consumption. Rice of common types constitutes the great bulk of production and consumption everywhere. Glutinous rice is far less important, and is mostly produced and consumed in restricted localities, especially in China.<sup>3</sup> When boiled it forms a gluey, sticky mass. This stickiness is not objectionable in the preparation of special foods such as pastries and confections, but detracts from the desirability of glutinous rice as a cereal for consumption as such. In fact, glutinous rices are so distinctive that in many places they are called by special names. They contain no substance resembling the gluten characteristic of wheat, but are termed "glutinous" because of their behavior in cooking.<sup>4</sup>

Upland rice, whatever its variety, is grown without irrigation or not in surface water; while lowland rice, whatever

<sup>3</sup> Estimates of Chinese rice production place glutinous rice at a little over one-tenth of the total rice output; C. C. Chang, *An Estimate of China's Farms and Crops* (Nanking, 1932), p. 15.

<sup>4</sup> Glutinous rices are also sometimes called dextrinous rices, because they have been assumed to contain dextrin instead of starch. This is an error; they contain genuine starch. This starch differs from the starch of common rice in that it gives a reddish-brown color when treated with iodine, as does dextrin, rather than a blue color as do nearly all starches. Glutinous rices are types with a "chalky" endosperm rather than the vitreous endosperm of ordinary rice. In them there are fine air spaces between the starch granules and the matrix in which they lie. Glutinous rices also have relatively soft and pliable straw.

its variety, is grown under irrigation or in natural swamps where there is standing water at appropriate seasons. Upland rice is also known as "hill" or "mountain" rice; lowland rice as "irrigated" or "swamp" rice.<sup>5</sup> Commonly, the varieties grown as upland rice are not the same as those grown as lowland rice, for some varieties do relatively well in the drier environment, others relatively well in the moister environment. But a single variety can be grown under either system of cultivation.

Very little of the world's rice crop is upland rice,<sup>6</sup> very little is glutinous rice, and very little is grown in natural swamps. Hence common rice grown under artificial systems of irrigation is the outstandingly important type of rice in the world economy. No other grain crop, and perhaps no other major crop of any sort, is grown under irrigation to the extent that is characteristic of rice.

#### UPLAND-RICE CULTURE

Upland rice, though accounting for only a very small proportion of total world rice production, is of some importance in certain portions of Monsoon Asia and therefore warrants brief comment. Upland rice is found in the sparsely populated portions of southeastern Asia and the neighboring islands where land is abundant but agriculture is poorly developed. It is also a crop of some importance in regions where all of the land suited for the lowland or irrigated form of culture has been appropriated. It is sometimes the first crop on land ultimately intended for some other permanent

<sup>5</sup> "Wet padi" and "dry padi" are terms commonly used in Malaya to describe the system of culture and the product. About 93 per cent of the area planted to rice in British Malaya is wet padi, only 7 per cent dry padi. For a brief discussion of cultural methods of both types in various parts of Malaya, see "Padi Planting Methods in Malaya," *Malayan Agricultural Journal* (Straits Settlements and Federated Malay States Dept. Agr.), February 1939, XXVII, 40-59.

<sup>6</sup> In countries compiling and reporting information on upland rice, the proportion of the total rice area planted to upland varieties ranges from less than 2 per cent (Chosen) to somewhat over 10 per cent (Java and Madura); the proportion of total production accounted for by upland rice, however, is even smaller because of the low yields obtained from this type of culture.

crop. Upland methods of culture are mostly primitive; the yields obtained are characteristically small, and the crop uncertain. Although some varieties are locally well regarded, in general the eating quality of upland rice is considered inferior.

Upland-rice culture plays a part in the primitive system of "fire farming" found in out-of-the-way places of Monsoon Asia. Crops are grown by a process which amounts to mining the soil. A piece of jungle is burned off, and on the virgin soil which has been fertilized by the ashes, rice is planted by making a hole with a sharpened stick, dropping a number of seeds into it, and then tamping down the soil with the heel. No special irrigation is provided, and nothing further is done until harvest time. When the field ceases to yield well, it is abandoned. This form of rice culture has been practiced for centuries, and continues to be found in certain parts of the West as well as the East.

The burnt clearings are known in the Philippines as *kaingin* (or *caingin*), in Malaysia as *ladang*, and in French Indo-China as *râÿ*. So-called fire farming is open to the objection that it favors soil erosion and laterization.<sup>7</sup> The danger of erosion is especially great in the tropics because of torrential rains. In Java denudation greater than 1 millimeter of surface soil per year is not unusual.<sup>8</sup> Similar losses of soil have been observed elsewhere. When the population is not dense, this system of fire farming is really a system of farming with long-time fallow and is not too injurious to the soil. After a bit of jungle has been cleared and maize or upland rice has been grown for about two years, the clearing is abandoned for perhaps 20 years until the jungle has grown up

<sup>7</sup> Pierre Gourou, *L'utilisation du sol en Indochine française* (Centre d'études de politique étrangère, Travaux des groupes d'études, Publication XIV, Paris, 1939), pp. 85-86, 347. Laterization is the process by which tropical red soils form. The ultimate product of this process is laterite, an infertile soil made up of various mixtures of aluminum and iron hydroxides, with perhaps a few inert materials like quartz.

<sup>8</sup> Rutten, *Le paysage géographique des Indes Orientales et Occidentales*, Comptes rendus du Congrès International de Géographie, Amsterdam, 1938. Tome I, p. 62; cited by Gourou, *op. cit.*, p. 86.

again. The soil has been exposed to erosion only for a short time. But in regions where the population is becoming dense, the system is dangerous.

Even when the population is so sparse that fire farming does not by itself cause erosion, it is nevertheless dangerous because it leads to extensive annual forest fires. A forest soil deprived of its trees is destined to ruin. Because of the vegetable matter that fire devours, the impoverishment of the soil due to the disappearance of the forest, and the erosion that occurs on soils deprived of plant cover, fire farming consumes far more wealth than it produces. But it is not easy to combat. It is often the sole means of subsistence for the tropical mountaineer and will disappear only when the people who practice it can be given other means of livelihood.

Upland rice is also grown, in a less primitive manner, on hillsides in regions where the population is denser and there is no free jungle to burn off. This is known as the *tegalan* system in Java and Malaya. Land is used that cannot be converted into irrigated rice fields. The grass and brush are burned off, and the field is then worked over with a hoe that really serves as a hand spade, the ordinary spade not being usable by workers without stiff-soled shoes.<sup>9</sup> The field that has thus been hoed is left until the plants growing on it are dead and dried up, when it is again hoed and harrowed. Sometimes if the land is level enough, it is plowed. All of this may take three or four months. If the land is very steep, it may be protected from erosion by brush and logs.

#### ORIGIN AND SPREAD OF RICE<sup>10</sup>

Rice probably originated in the southeastern part of the Asiatic continent, though the exact place of origin cannot now be determined. It is not likely that it originated in the Malay Archipelago, because human culture moved from the conti-

<sup>9</sup> Unlike American hoes, these hoes have large and heavy blades attached at an acute angle to the handle so that they cut out a clod.

<sup>10</sup> This section is based upon information to be found in: Amory Austin, *Rice: Its Cultivation, Production, and Distribution in the United States and Foreign Countries* (U.S. Dept. Agr., Div. Statistics, Misc. Series, Report 6, 1893); Carl Bachmann, "Der

ment to the adjacent islands. In classic Chinese, rice culture is synonymous with agriculture, and in many Asiatic languages rice and food are synonymous. This would suggest the origin of rice long before recorded history. It was certainly known in India and China by 3,000 B.C.

Species of wild rice occur outside of southeastern Asia—not only in India, Indo-China, and the Philippines, but also in tropical North Australia, Kordofan, Northwest German East Africa, Central Sudan, Senegambia, the valley of the Niger, near Lake Chad, and even in the interior of Brazil. Curiously enough no wild species has been described from China. The grain of some of these wild species is small, white, and sweet. In places where such rice is used, its price is high, but, because yields are small, it is not cultivated. It is difficult to say whether all these rices are truly wild plants or merely domesticated rices escaped from cultivation; consequently the existence of wild species does not point clearly to the localities of origin.

Probably the earliest location of rice culture was in swamps or on periodically flooded land, the upland form of culture being a later development perhaps taken over by more primitive peoples. Support is found for this belief in the fact that preparing the soil and combating weeds, at least in the tropics, is comparatively easy in wet-land farming as contrasted with dry-land farming. A dry-land crop like wheat requires some sort of tool for working the ground, though it be only a digging stick. For lowland rice no such tool is required. Even today there are localities where the rice field is

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Reis. Geschichte, Kultur und geographische Verbreitung, seine Bedeutung für die Wirtschaft und den Handel," *Beihfte zum Tropenpflanzer* (Kolonial-Wirtschaftliches Komitee, Berlin), August 1912, XVI, 213-386; Copeland, *op. cit.*; Victor Hehn, *Kulturpflanzen und Haustiere in ihrem Übergang aus Asien nach Griechenland und Italien sowie in das übrige Europa* (2d ed., Berlin, 1874); Friedr. Körnicke, *Die Arten und Varietäten des Getreides* (Vol. II of *Handbuch des Getreidebaus*, by Friedr. Körnicke and Hugo Werner, Berlin, 1885), pp. 221-37; Augustin Krümer, "Der Taro und die Nasskultur," *Dr. A. Petermanns Mitteilungen aus Justus Perthes' Geographischer Anstalt* (Gotha), 1928, LXXIV, 165-72; Walter May, "Die Reiscultur, insbesond. in Brasilien," *Botanische Zeitung* (Leipzig), Jan. 29, 1892, pp. 55-66; U. R. Werner, *Der Reis im Wirtschaftsleben kolonialer Länder* (Weida i. Thür., 1931).

neither plowed, spaded, nor hoed. The soil may be thoroughly puddled and all the weeds destroyed merely by driving a carabao around in the flooded field, or the farmer and his family may accomplish the same purpose by splashing around in their bare feet.

Rice culture had spread over much of southeastern Asia in very early times. It had reached "Upper Asia prior to, at least, the later movements of the Aryan dispersal; for its name is alike in Zend and Sanskrit and similar in Old High Persian, and the migrants to the north-west would naturally have lost it."<sup>11</sup>

By the time of Alexander, rice culture was well established on the upper Oxus and the lower Euphrates in western Asia; perhaps it was introduced from the Indus by the Persians. Rice became known to Europe through Alexander's campaigns, but was probably not cultivated there until much later. In the time of the early Roman Empire it was an expensive import, used in part by Greco-Roman physicians for the preparation of an emollient drink. Since rice was grown in the Euphrates and Tigris valleys, it is not astonishing to find it mentioned in the Talmud, although it is not referred to in the Old or New Testament.

Rice was not cultivated in the Mediterranean basin until the Arabs introduced it in the delta of the Nile, and spread it in Continental Africa. The Malays brought rice to Madagascar, the Indians to the East African islands. The Moors introduced rice in Spain, even exporting some outside of Europe. The Spaniards brought it to Italy, where a veritable rice boom occurred in Milanese and Venetian territory. The Turks brought it with them in their invasion of southeastern Europe, where it once spread over much of the Balkans but was of no great importance in most places. In the time of Maria Theresa, rice was grown in southern Hungary, and it was once cultivated in southern France. The spread of rice culture in Europe was sometimes opposed by governments

<sup>11</sup> Copeland, *op. cit.*, p. 2.

for reasons of public health (malaria); in the sixteenth and seventeenth centuries cultivation near towns was forbidden.

Rice came later to the Americas and Oceania. The Portuguese probably introduced it into Brazil, the Spaniards into Central America and parts of South America. It was introduced into the United States in 1694 at Charleston, South Carolina. Upland-rice varieties were probably brought there, perhaps from Cochin China, as late as 1772. The development of rice cultivation in the Americas drove out much of the European acreage. Rice did not reach Hawaii, New Caledonia, and New Guinea until the last century. It was brought to Hawaii in 1853. The French brought it to New Caledonia, the Germans to New Guinea.

In some of the Pacific islands, culture of taro seems both to have preceded rice and to have facilitated its introduction. In many places in Oceania the early inhabitants "made terraces in which they grew irrigated taro."<sup>12</sup> They seem to have come from regions where rice was still unknown and taro, a swamp plant, was the most important crop. Perhaps taro was domesticated earlier than rice and prepared the way for rice. It is grown not from seed but by planting corms, a method of propagation probably more obvious to a primitive people than sowing seed. For such people taro also has the advantage that it can be harvested as needed; it does not require the development of a social organization based on the alternation of sowing and harvesting; and, unlike rice, it is ready for consumption without other preparation than boiling. Rice must be threshed and its hulls removed, and some type of milling had to be devised before it could become the staff of life.

#### TEMPERATURE, MOISTURE, AND SOIL REQUIREMENTS<sup>13</sup>

Although varieties differ one from the other, in general, the rice plant must have high temperatures and an abundant

<sup>12</sup> F. M. and Marie Keesing, *Taming Philippine Headhunters* (Stanford University, Calif., 1934), p. 55. See also W. J. Perry, *The Children of the Sun. A Study in the Early History of Civilization* (London, 1923), p. 45.

<sup>13</sup> The discussion in this section is based in large part upon the works of: Austin,



supply of water for germination and growth. The high water requirements of rice mean that the temperate zones of the world are far less favorable for rice culture than are the tropical and subtropical zones. The water requirements of rice are also so high that the desert, semiarid, and subhumid parts of the tropical and subtropical zones, except for such areas in them as are very easily irrigated, are much less favorable for rice cultivation than the humid parts. The typical form, lowland rice, grows in a flooded field. A consequence of the high water requirement is that rice culture tends to concentrate on level or gently sloping land with soils characteristically heavy in type.<sup>14</sup> Provision, control, and retention of adequate water supplies are easiest under these conditions.

Hence the relatively flat lowlands, river basins, and deltas of the world's moist tropical and subtropical regions are best adapted to the rice plant and its cultivation.<sup>15</sup> Such regions

*op. cit.*; Bachmann, *op. cit.*; Paul Blankenburg, *Der Reis. Eine wirtschaftsgeographische Untersuchung* (Berlin, 1933); Copeland, *op. cit.*; G. B. Cressey, *China's Geographic Foundations: A Survey of the Land and Its People* (New York, 1934); Gouron, *op. cit.*; Naum Jasny, *Competition among Grains* (Food Research Institute, Grain Economics Series 2, Stanford University, Calif., 1940), esp. p. 250; J. B. Kincer, "Does the Formation of Abnormally Heavy Ice in the Bering Sea Cause Famine in Northern Japan? A Review," *Monthly Weather Review* (U.S. Dept. Agr.), November 1922, L, 582-83; Siam Ministry of Commerce and Communications, *Siam, Nature and Industry* (1930); H. A. Tempany and G. E. Mann, *Principles of Tropical Agriculture* (Kuala Lumpur, 1930).

<sup>14</sup> Soils are commonly classified according to the percentage of clay which they contain: sandy soils (less than 5 per cent clay), sandy loams (5-10 per cent), loams (10-20 per cent), clayey loams (20-30 per cent), clay soils (30-40 per cent), and heavy clay soils (over 40 per cent); see Tempany and Mann, *op. cit.*, pp. 57, 65. The tabulation below shows for several tropical crops the soils found from experience to be most suitable:

Rice—heavy clay	Coconuts—clay loam
Maize—sandy loam	Oil palms—clay loam
Tapioca—light loam	Rubber—light clay loam
Sugar cane—fairly heavy loam	Cotton—light sandy loam
Tea—medium clay loam	Sisal hemp—sandy loam
Coffee—medium clay loam	Tobacco—light sandy loam
Cacao—heavy clay loam	

<sup>15</sup> Usually in such regions are also found the heaviest concentration of population, the largest cities, and sea ports. For example, in India the Ganges-Brahmaputra delta region is one of the principal rice areas, the population density is one of the greatest in Asia, and Calcutta is one of the largest cities and seaports. Likewise in China the great Yangtze Plain is the leading agricultural region, and Shanghai is one of the most important cities and ports in all Asia.

are particularly favorable when they are characterized by a seasonal rhythm of rainfall involving concentration of precipitation in the growing season and a relatively dry season at the time when the rice matures. Little rice is grown in tropical forest regions of very heavy rainfall having no dry season at all. Not only is the soil less adaptable and the topography largely unfavorable, but the absence of some dry weather hampers maturing of the rice grain and harvesting. Perhaps also the absence of rice from such regions is explained partly by sparseness of population, itself a reflection of unfavorable natural conditions.

For germination, rice seems to require higher temperatures than the other major grains. Minimum temperatures permitting germination are described as ranging between 1° and 5°C. for wheat, rye, barley, and oats, and between 8° and 10° for corn and millet. The minimum temperature of germination of rice varies with the variety. Those found at the northern limit of culture can germinate at temperatures as low as 10°–13°C., while those grown near the Equator may require 15°–20°C. Too low a temperature not only delays germination, but also seems to interfere with formation of the crown roots. Rice germinates as well under water as in the air, provided that the seed has previously absorbed enough moisture. During its growing season, lowland rice typically requires at least two months, and preferably three, of temperatures of about 20°C. (68°F.). Upland rice thrives at somewhat lower temperatures, and is therefore grown at relatively higher elevations—up to 7,500 feet in the tropics.

Night frosts, cold winds, and cold rains are injurious to growing rice. Farmers in northern Italy commonly protect themselves by carrying frost insurance. In Japan, on Hokkaido and in Amori, the northernmost prefecture on the island of Honshu, there is occasional loss of crop if the autumn is cold and rainy. So important is this that Japanese meteorologists have endeavored to forecast a cold autumn from the temperature at Dutch Harbor in the Aleutian Islands, which

is assumed to be indicative of the position of the southern edge of the circumpolar ice-cap.<sup>16</sup>

The heat requirement of rice is commonly assumed to be the principal factor determining the geographical limits of rice culture, and certainly this is the factor that restricts it to the tropical and subtropical zones of the world. But the rice plant does not require high humidity if there is abundance of irrigation water; it thrives in dry heat, as in the irrigated-rice fields of the Nile and Sacramento valleys.

The minimum amount of water necessary for lowland rice is very large, though it varies with the soil, the presence of hardpan,<sup>17</sup> and the climate. Under various conditions of seepage and evaporation, the requirements (not, of course, wholly of rain falling directly on the fields) seem to run from 15 to about 35 inches per month—about 15 in part of the tropics, 19 in Thailand (Siam), 21 in Bombay and Sind, 25 in Spain, 26 in northern Italy, up to perhaps 36 in Russian Asia where humidity is low. Rainfall as such is important for irrigated lowland rice mainly in so far as it may determine deficiency or excess of water for irrigation. Broadly, however, not much rice is grown where the annual rainfall is less than 40 inches. It is easier to collect and distribute water adequate for lowland rice in the moister regions without building vast and expensive irrigation projects.

Excessive rainfall, however, is disadvantageous; if it comes at harvest time, the crop may be damaged and the cost of harvesting increased without compensatory improvement in quality. The danger of rain damage during harvest is the chief reason why varieties giving relatively low yields of poor quality, but maturing early, are cultivated in some localities. Also: "Unseasonable or excessive floods are destructive. These are comparatively local; still, they are

<sup>16</sup> See discussion of investigations of T. Okada in Kinser, *op. cit.*

<sup>17</sup> Hardpan—an almost impermeable layer of clay-like subsoil—not too far below the surface is desirable to prevent water on the flooded field from soaking too deeply. Hardpan has to be built artificially if not found naturally in places where the water supply available for irrigation must be used carefully and efficiently.

second only to the absence of sufficient water, as factors which cut down the total of each year's crop."<sup>18</sup> The cloudiness likely to accompany heavy rainfall is itself unfavorable,<sup>19</sup> and in the typhoon belt, storms also cause serious losses.

Within Monsoon Asia, the circumstances under which the necessary minimum of water becomes available may determine many cultural practices. Thus there may be enough water in some places to produce two or even three successive rice crops under irrigation, and in others only enough for one. On the other hand, especially in the flood plains of rivers, the prevalence and duration of floods may preclude the cultivation of more than one crop in a year. Hence some of the land in a given region may be double-cropped to rice and some single-cropped.

This occurs in parts of Thailand, Indo-China, and southern China. The low-lying land may be flooded when the river is at flood stage, and therefore cannot be planted until the flood waters subside. Under these circumstances a crop is produced between two high waters of the river. Other land lying at a somewhat higher level and not submerged by flood water may grow two crops. Still other land lying somewhat higher may be irrigable only when the river is at flood stage, and will produce only one crop, because at low water irrigation is difficult or impossible. According to conditions the crop may be planted so as to mature before the river reaches the flood stage, or it may be planted as flood waters subside so as to mature before the next high water is due. Such adaptations of rice culture to floods and the intervals between them help to explain the great number of rice varieties grown in some regions<sup>20</sup> with abundant warmth throughout the year. There

<sup>18</sup> Copeland, *op. cit.*, p. 44.

<sup>19</sup> "A prolonged spell of cloudy weather is accompanied by very poor growth and by increased susceptibility to disease. No amount of manure can make up for the deficiency of light in such cases . . ." (Tempany and Mann, *op. cit.*, p. 119). "Rice wants all of the illumination that in nature it can get. Generally, cloudy weather is bad for it. Woods which rival or exceed it in height are especially injurious. And in the shade of trees practically no crop is produced" (Copeland, *op. cit.*, p. 16).

<sup>20</sup> In many places where the water surface along rivers varies as much as 10-15 feet

the late-maturing varieties and early-maturing varieties both have a place. Early-maturing varieties are thus not confined to areas such as northern Japan where the growing season is short.

As to soil, rice apparently makes no special demands, but the circumstances of lowland-rice cultivation favor concentration of production on soils of heavy type. Copeland observes:<sup>21</sup>

The growing of typical, lowland, or irrigated rice, however, involving an investment in the preparation of the land and the provision of water such as no other great crop requires, is very permanent agriculture, and the important question is not as to the soils which will produce a good crop, but as to the production of a long succession of good crops. Taking account of the permanency with which land must be devoted to lowland rice, and of the cost of water and the risks involved in its waste, it can be said flatly, and as a remarkably invariable rule, that lowland rice is a plant adapted to heavy soils, and that only heavy soils are by their character suited to rice.

This follows from the semi-aquatic origin of the plant. It follows from what has already been said about its need of water, its ability to do with little oxygen, and its preference for ammonium over nitrates; for heavy soils hold water well, much water excludes much air from the soil, and the absence of air makes oxidation imperfect. There is also good economic reason for preferring heavy soils, already suggested. Irrigation water is expensive, and rain is an unreliable source of water to be impounded; and water is much more securely held in and on heavy soils than in and on light ones. The same considerations which make heavy soils wanted for rice, also make it desirable that there be, at a depth below the reach of the roots, but not too much further down, an impervious substratum—subsoil or hard-pan. Water which percolates or seeps through the ground, downward or laterally, is wasted; and whatever it may take with it is also lost to the rice. The soil through and from which the least water can get away is in that respect the best.

“Rice thrives on some decidedly alkaline soils, which are improved for other crops by rice culture, as the water re-

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and where the duration of high water is unpredictably variable, an unusual type, so-called “floating rice,” may be planted, especially in Indo-China and Thailand. This rice is planted before high water is expected. As the water rises, the stem lengthens until at flood its growing end floats on the surface, while its roots are still anchored to the bottom. When the water has subsided, it lies on the surface of the ground where it roots at the nodes of the stems and then starts growing and tillering. The crop matures before the next high water comes. The harvesting of rice grown in this fashion is often difficult because the slimy surface does not have an opportunity to dry sufficiently.

<sup>21</sup> *Op. cit.*, p. 45

moves some of the alkali. Some varieties endure a very considerable concentration of common salt."<sup>22</sup> Such types are especially important when rice is grown near the mouths of streams. In certain localities (e.g., Indo-China, Thailand, South Carolina), the irrigation of some rice fields is accomplished by the tides. The flood tide dams back the fresh river water so that it may be diverted into the paddy fields through sluices in the dikes. At ebb these sluices may be closed so as to retain the river water in the paddies, or the fields may be drained by opening them. When the volume of the river water varies greatly at different seasons or from year to year, the point at which the water becomes brackish varies correspondingly. Great danger therefore exists that in certain years or at some seasons rice fields so located may receive brackish water. In such localities salt-tolerant varieties of rice are of prime importance.

#### GEOGRAPHICAL DISTRIBUTION OF PRODUCTION

The extent to which world rice production is concentrated in eastern and southeastern Asia is indicated in Table 1. Of an annual average rice crop of about 95 million tons in recent years, less than 5 per cent was produced in 35 or 40 countries outside of Monsoon Asia. A decade or so ago, these countries were even less important producers; but increased attention has recently been given to rice growing in many of the smaller colonies of European powers, and production has expanded considerably in South American countries.<sup>23</sup> Of the numerous rice-producing countries outside Monsoon Asia, only Brazil and the United States come within striking distance of the production of Taiwan (Formosa), the smallest rice-producing area of Monsoon Asia except British Malaya and Ceylon. The rice crops of Italy, Madagascar, and Egypt average less than half of that of the small Japanese colony, and those of

<sup>22</sup> Copeland, *op. cit.*, p. 50.

<sup>23</sup> In Argentina, for example, the rice crop of 1930-31 amounted to only slightly more than 5,000 metric tons; in 1938-39 and 1939-40 it had increased to nearly 100,000 tons.

**ENVIRONMENT OF THE WORLD RICE ECONOMY** 23

**TABLE I.—RICE PRODUCTION IN MONSOON ASIA AND WORLD TOTAL,  
FIVE-YEAR AVERAGES FROM 1930-31 TO 1939-40\***

(In terms of cleaned rice)

Country	Thousand metric tons		Per cent distribution	
	1930-31 to 1934-35	1935-36 to 1939-40	1930-31 to 1934-35	1935-36 to 1939-40
China .....	29,990	<i>34,950</i>	33.3	36.6
India .....	27,126	25,770	30.1	27.0
Japan .....	8,085	8,637	9.0	9.0
Burma .....	4,870	4,940	5.4	5.2
Java and Madura .....	3,637	4,007	4.0	4.2
French Indo-China .....	3,547	3,945	3.9	4.1
Thailand (Siam) .....	2,939	2,711	3.3	2.8
Chosen (Korea) .....	2,287	2,728	2.5	2.9
Philippine Islands .....	1,364	1,444	1.5	1.5
Taiwan (Formosa) .....	1,093	1,242	1.2	1.3
British Malaya and Ceylon.....	506	527	.6	.5
<b>Total 11 countries (ex-China).....</b>	55,454	55,951	61.5	58.5
<b>Total Monsoon Asia*</b> .....	<i>85,444</i>	<i>90,901</i>	<i>94.8</i>	<i>95.1</i>
<b>All other<sup>b</sup></b> .....	<i>4,656</i>	<i>4,699</i>	<i>5.2</i>	<i>4.9</i>
<b>World total<sup>c</sup></b> .....	<i>90,100</i>	<i>95,600</i>	<i>100.0</i>	<i>100.0</i>

\* See Appendix Table II; figures in italics are approximations only.

<sup>a</sup> Excludes the Outer Provinces of the Netherlands Indies (all of the Netherlands Indies except Java and Madura) upon which reliable data are not available; British Borneo; and Manchukuo, the production of which is small but is included in the "world total."

<sup>b</sup> Includes some 35-40 countries or states, but the figure given here is merely the difference between the production estimates computed for Monsoon Asia and the "world total."

<sup>c</sup> Estimated Chinese production added to the world production estimates (ex-China) of the International Institute of Agriculture (89.2 and 91.3 million metric tons of rough rice or 59.3 and 60.7 million tons of cleaned rice, converted at 100 to 66.5, the factor used by the U.S. Department of Agriculture in deriving its world production estimates from that of the International Institute of Agriculture), and the (British) Imperial Economic Committee (60.9 million metric tons of cleaned rice for the earlier five-year period).

French West Africa and Spain are smaller than that of British Malaya.

China has undoubtedly ranked as the largest rice-producing country of Monsoon Asia and of the world, since the separation of Burma from India in 1937, with India not far be-

hind.<sup>24</sup> The third most important producer, Japan, ranks far below both, though the gap is less wide if her colonies of Chosen (Korea)<sup>25</sup> and Taiwan be included in a total for the Japanese Empire. Eleven countries of Monsoon Asia, excluding China, produce about 60 per cent of the world rice output.

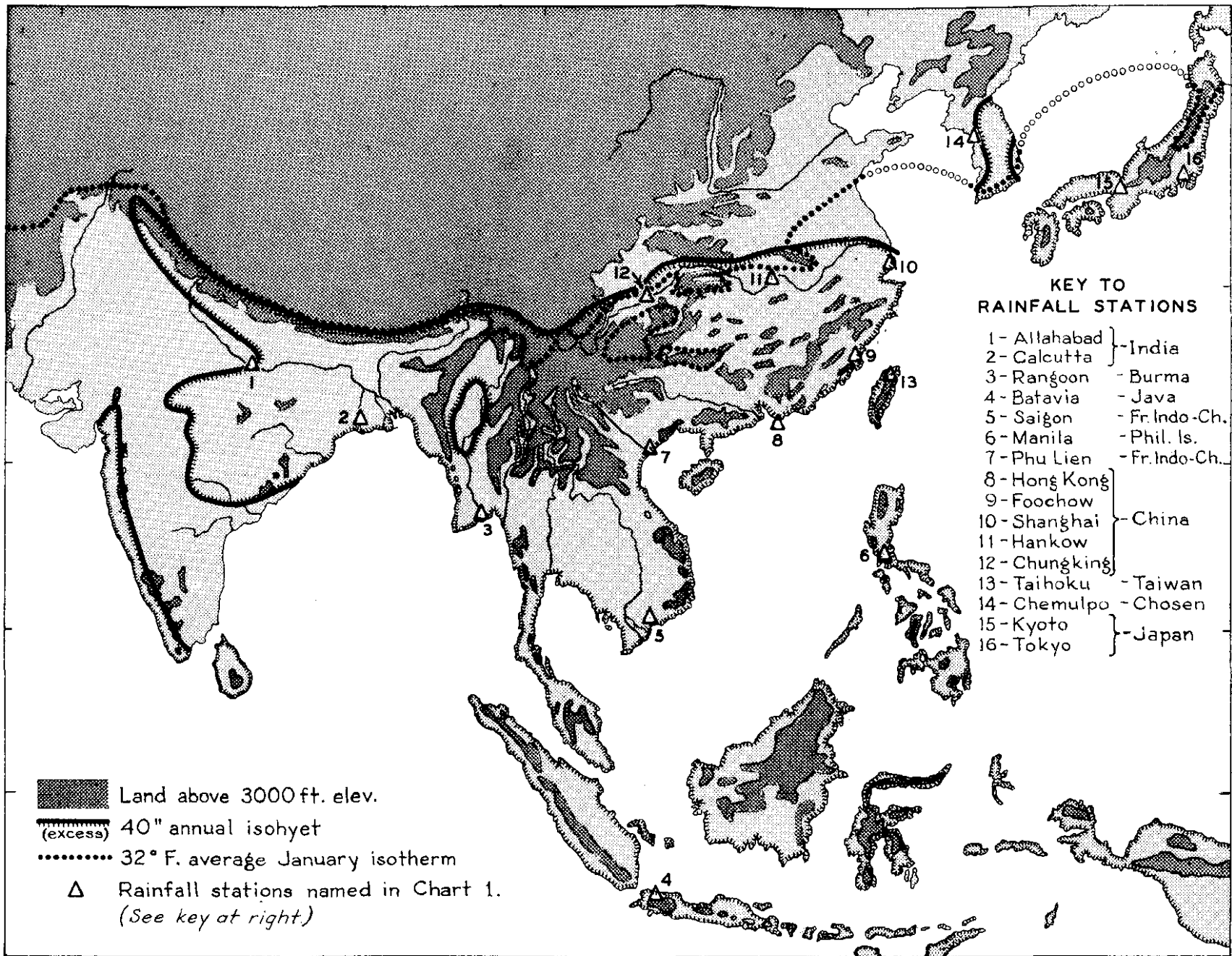
Rice culture is not spread throughout all parts of any of the countries of Monsoon Asia, as indicated by the general reference map inside the covers of this book. Broadly, the rice-growing areas do not lie in territory where the annual rainfall is less than 40 inches, as is evident from Map 1. Nor is there much rice culture at land elevations exceeding 3,000 feet, or in areas where average January temperatures fall below the freezing point, as also is suggested by Map 1. In the drier and/or cooler parts of China (the north and west) and India (the central strip and the northwest), the principal grain crops of the rather dense populations tend to be either millets and sorghums or wheat, less commonly maize or barley, and rarely oats. These are crops with much lower water requirements than lowland rice, and most of them thrive with less heat. Rye is nowhere an important grain crop in Monsoon Asia.

Within the zones of Monsoon Asia where temperatures are sufficiently high and rainfall abundant, the rice acreage lies mostly along the valley plains of great rivers and in deltas and other coastal plains. Here the construction of level, floodable, and fertile rice fields is simplest and least costly for reasons both of topography and soil. There are no extensive and heavy concentrations of rice production in lands lying directly upon and within 5 degrees north and south of the Equator, a region including most of Sumatra, Malaya, Borneo, the Celebes, and the northwestern part of the great island of New Guinea. Here

<sup>24</sup> The statistical data from China seem to warrant this observation, but they are so inadequate and unreliable that China must be omitted in much of the analysis to follow in this book. Similarly, the data on rice in Manchukuo are too incomplete for inclusion in the present study, although in recent years estimates of unknown quality have been published by the Japanese which show a very marked increase in rice production from about 180,000 metric tons in 1924 to almost 700,000 tons in 1938, with the crop for 1939 officially estimated at slightly over 800,000 tons.

<sup>25</sup> The official Japanese romanization is now "Tyosen," but Chosen was the form until recently and remains so in the country itself.





MAP 1.—SIGNIFICANT CLIMATIC AND TOPOGRAPHIC FACTORS IN THE AGRICULTURE OF MONSOON ASIA

the annual rainfall is very heavy and so distributed throughout the year that no season is dry.<sup>26</sup> Dense tropical forest, difficult to clear, is the typical natural vegetation, and the topography even at the lower elevations is largely very uneven and steeply sloping. These regions are much less densely populated than areas farther north and south of the Equator, presumably in large part because of the prevalence of natural conditions adverse to arable agriculture, and perhaps also (especially toward New Guinea on the east) because the migration of primitive peoples was from the continent toward the islands.

Relatively little rice is grown also in large stretches of western China, and parts of Indo-China, Thailand, and Burma where the rainfall and temperature conditions might seem to satisfy the requirements of the rice plant. In much of this wide area the population is considerably denser than in the equatorial regions, though much less dense than in the rice-producing regions. The relatively high elevations (Map 1) and the irregular terrain are probably important factors in reducing the importance of rice among the crops produced.

Even in Monsoon Asia the climatic zones apparently adapted to rice culture extend beyond the areas where it is much practiced, and this is even more apparent in other parts of the world. Enormous land areas where rice is of negligible importance stretch north and south of the equatorial rain forests especially in South America and Africa; and climatologists indicate that the climates of these regions fall into the same broad classifications as those prevailing in the principal rice-producing regions, especially of India and the Indo-Chinese Peninsula.<sup>27</sup> Whether and in what degree the obstacles to expansion of rice culture in such regions are

<sup>26</sup> At Singapore, only a little north of the Equator, the average monthly rainfall in the two wettest months (November and December) is 10-11 inches, and that in the two driest months (February and March) is about 6 inches.

<sup>27</sup> Cf. maps of the climatic regions of the earth such as those after W. Köppen and R. Geiger in J. P. Goode, *School Atlas* (New York, 1933), pp. 20-21; C. W. Thornthwaite, "The Climates of the Earth," *Geographical Review*, July 1933, XXIII, facing p. 440; and G. T. Trewartha, *An Introduction to Weather and Climate* (New York, 1937), Plate I.

natural (topography and soil), demographic, historical, or economic are questions not to be answered easily, if at all. But they have relatively little bearing on near-term prospects for the rice economy of Monsoon Asia.<sup>20</sup>

#### ADAPTABILITY TO ASIATIC CONDITIONS

Of all the cereals, rice alone is a crop supremely well suited to the natural, demographic, and economic conditions of the moister parts of Monsoon Asia. A hot-moist climate and wide stretches of land naturally flooded at seasons, or easy to irrigate by primitive, inexpensive means, are natural conditions favorable to rice. The dense population existing at a relatively low level of living must engage predominantly in agriculture, for labor is abundant and capital scarce. Agriculture is typically small scale and predominantly of a subsistence type. Millions of farm families use their available resources of land, labor, and a little capital to produce food mainly for home consumption; they sell a relatively small amount of farm produce for cash, and purchase very little food or other commodities. The motive is strong to concentrate upon a crop that will provide abundant food from little land with the least possible labor, that will involve a minimum risk of crop failure, and that will provide food that can be successfully stored.

Lowland rice fits the circumstances, and indeed helps to make possible the density of population and consequent abundance of labor. The climatic and soil conditions best suited for rice are poorly adapted to any other food crop; few agricultural alternatives present themselves. Neither wheat, barley, rye, nor oats will thrive as summer crops under such conditions of moisture and heat. Millets, grain sorghums, and maize do better, but can equal rice only in areas of lower summer rainfall. None of these grains can be stored as successfully as rice in a hot-moist climate, and none can produce as much food per unit of land in the places where lowland rice

<sup>20</sup> See chapter xii.

thrives. Even if such crops as sugar cane, cassava, and yautia (a tropical tuber allied to taro) produced more food per acre,<sup>29</sup> they would require a longer growing season and therefore be suitable only in certain places, or they would be less adaptable in the diet or probably more difficult to store between harvests.

Lowland rice is also a relatively safe crop, partly because the practice of growing it on flooded fields provides a control over diseases and pests, and partly because the major potential risk of drought is not often encountered in the moist sections of Monsoon Asia where rice culture dominates agriculture. Irrigated-rice culture is adaptable to the circumstances of abundance of labor and relative scarcity of land and capital; rice can be and is grown by farmers operating only a few acres without draft power.<sup>30</sup> Indeed, rice production in Monsoon Asia is one of the most labor-intensive forms of agriculture known. Finally, rice is an economical crop for the subsistence farmer, since it requires only 3-5 per cent of the yield for seed.<sup>31</sup>

#### TRADE AND AREAS OF CONSUMPTION

The international geographical distribution of rice consumption differs somewhat from the distribution of rice production, first because Monsoon Asia exports rice to other parts of the world, and second because some countries of Monsoon Asia are net exporters while others are net importers. Pertinent statistics for recent years are summarized in Table 2, (p. 28). By small margins, per capita rice utilization must exceed per capita rice production outside of Monsoon Asia, while within Monsoon Asia per capita production must exceed per capita utilization.

<sup>29</sup> In this connection see Copeland, *op. cit.*, esp. pp. 338-40.

<sup>30</sup> See below, pp. 50-51. Outside the Orient, irrigated rice is sometimes grown with little labor on large holdings and with a heavy capital outlay for machinery.

<sup>31</sup> Rice requires little seed because the common practice is to plant in a seedbed and transplant the seedlings to the field (see below, p. 51). In regions where this practice is not followed, as in California and most places in Italy, seed constitutes a higher proportion of the crop. Maize, however, is a crop even more economical in the use of seed since only a few kernels are sown to a "hill" and the hills are as much as three feet apart.

## RICE ECONOMY OF MONSOON ASIA

TABLE 2.—INTERNATIONAL TRADE IN RICE, MONSOON ASIA,  
AVERAGE 1936-38\*

(In terms of cleaned rice; thousand metric tons)

Country	Exports	Imports	Net trade	Average production <sup>c</sup>
Burma <sup>b</sup> .....	2,950	... <sup>d</sup>	-2,950	4,940
French Indo-China .....	1,279	... <sup>d</sup>	-1,279	3,945
Thailand (Siam) <sup>b</sup> .....	1,266	... <sup>d</sup>	-1,266	2,711
Chosen (Korea) .....	1,114	20	-1,094	2,728
Taiwan (Formosa) .....	622	1	- 621	1,242
Japan .....	30	1,750	+1,720	8,637
India <sup>b</sup> .....	276	1,565	+1,289	25,770
British Malaya .....	177	763	+ 586	327
Ceylon .....	... <sup>d</sup>	533	+ 533	200
China .....	16	354	+ 338	34,950
Netherlands Indies .....	23	248	+ 225	4,007 <sup>d</sup>
Philippine Islands .....	... <sup>d</sup>	58	+ 58	1,444
<b>Total</b> .....	<b>7,753</b>	<b>5,292</b>	<b>-2,462</b>	<b>90,901</b>

\* See Appendix Tables IV and V, and Table 1, p. 23.

<sup>b</sup> From 1935-36 to 1939-40, as in Table 1, p. 23.<sup>c</sup> Averages for period April 1, 1936 to March 31, 1939; other averages are for calendar years 1936-38.<sup>d</sup> Negligible.<sup>e</sup> Java and Madura only.

International trade in rice is predominantly intra-Asiatic, less than a third of the gross exports of Monsoon Asia moving to countries outside of the region.<sup>22</sup> The aggregate net rice exports of other areas (among which the principal exporters are the United States, Italy, Spain, Brazil, the British and Dutch Guianas, Iran, and Egypt) are barely more than a tenth as large as the net exports of Monsoon Asia.<sup>23</sup> The principal

<sup>22</sup> Table 2 somewhat understates the extent to which exports of Monsoon Asia are held within that area, since no account is given of the imports of British Borneo, Manchukuo, Hong Kong, and various French and Portuguese possessions within the region. These imports are drawn from neighboring countries and much exceed the very small imports from non-Asiatic sources into Monsoon Asia as a whole.

<sup>23</sup> The proportion of world rice production that moves across national boundaries is not large. Rice net exports of the world's net-exporting countries were some 8-9 per cent of world rice production in 1936-38, including the net exports of Chosen and Taiwan and of Burma, which are not truly international. This is smaller than the figure for wheat, perhaps a little larger than those for corn and barley, and considerably larger than the figures for oats and rye, and millets and sorghums, all of which probably fall below 4 per cent.

net-importing region of the non-Asiatic world is western Europe. Such exports as leave Monsoon Asia for outside markets go from Burma, Thailand, and Indo-China; all of the exports of Chosen and Taiwan are destined for Japan.

The five net-exporting countries of Monsoon Asia are heavily dependent upon rice exports, since rice is their principal crop and agriculture their principal industry. From rice Burma, Thailand, and Indo-China derive from 40 to 70 per cent of their total income from exports—the revenue which makes possible the purchase of foreign goods. Hence the lives of their people are profoundly affected by shortages of rice for export or by fluctuations in the price of export rice in relation to imported commodities. Burma exports about three-fifths of her rice production, Taiwan about half, Thailand almost half, Chosen more than two-fifths, Indo-China not much below a third. Per capita rice utilization thus falls considerably below per capita production in these parts of Monsoon Asia.

Of the net-importing countries, Ceylon and British Malaya depend on rice imports in much larger degree than the others. Ceylon imports almost three-fourths of her total rice requirements, British Malaya about two-thirds. Japanese net imports add about 20 per cent to Japanese production. Corresponding figures for the Netherlands Indies, India, and the Philippine Islands are 6, 5, and 4 per cent respectively; and for China only about 1 per cent during recent years.

Within each country, domestic rice moves in trade from one region to another. Conspicuous examples are to be found in the largest countries, India and China. In India the domestic trade moves mainly from east to west, in China from south to north. This represents trade from rice-producing to non-rice-producing regions and from surplus-producing areas to areas of deficit supply. In addition, there is movement from rural to urban areas everywhere. Detailed evidence concerning the internal trade of nations, however, is not available. Since internal transport is generally poorly developed,

there can hardly be so large a relative outflow of rice from southern China to northern or from eastern India to western as occurs with the movement of wheat and flour in the United States from the central wheat belt to the Atlantic coast states and the South. Much larger differences in per capita rice consumption would therefore be expected between regions of China and India than would be found in per capita wheat consumption between states of the United States.

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## CHAPTER III

# GENERAL FEATURES OF LOWLAND-RICE CULTURE

### RICE IN LAND UTILIZATION

The dominance of rice in the agriculture of Monsoon Asia is suggested by the following tabulation, showing for most of the producing countries the rice acreage as percentage of *total crop-producing area*:<sup>1</sup>

French Indo-China . . . . .	86	Java . . . . .	45
Burma . . . . .	65	Chosen . . . . .	30
Philippines . . . . .	64	India . . . . .	23
Taiwan . . . . .	54	China . . . . .	21
Japan . . . . .	45		

In no country is the area in rice (lowland and upland together) less than a fifth of the crop-producing area, and in some countries the rice area exceeds four-fifths of the total acreage under crops.

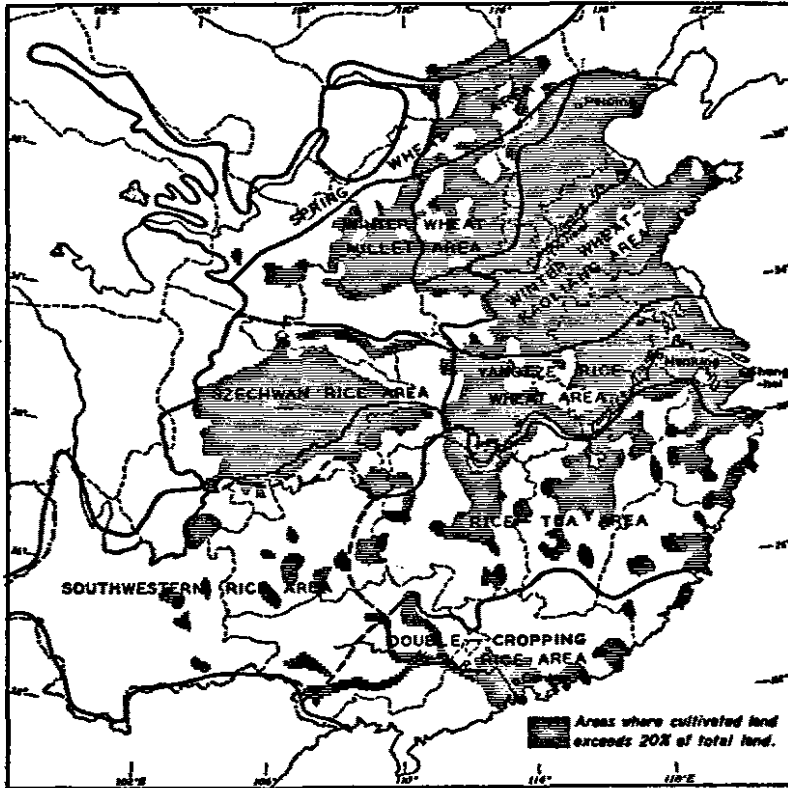
Within each country, of course, the importance of rice varies from region to region. In China, for example, 21 per cent of the total crop-producing area of the country is in rice, but only 2 per cent in the provinces north of the valley of the Yangtze as against 42 per cent in and south of that valley. Within this "rice region" the importance of the crop also varies from province to province, increasing as one moves either from north to south or from east to west. Thus, of the total crop-producing area of Kiangsu province in the extreme northeast of the Chinese rice region, only 21 per cent is rice

<sup>1</sup> Figures for French Indo-China, and the Philippines, calculated or derived from data in International Institute of Agriculture, *International Yearbook of Agricultural Statistics, 1938-39* (Rome, 1939), pp. 192-93, 202-06, 211-13; for the Japanese Empire, from R. B. Hall, "Agricultural Regions of Asia. Part VII, The Japanese Empire," *Economic Geography* (Worcester, Mass.), April 1935, XI, 144-45; for Java, from Samuel Van Valkenburg, "Agricultural Regions of Asia. Part IX, Java," *ibid.*, January 1936, XII, 33-36; for India and Burma, from India Dept. Commercial Intelligence and Statistics, *Agricultural Statistics of India, 1936-37, Vol. I, Area, Classification of Area, Area under Irrigation, Area under Crops, Live-Stock, Land Revenue Assessment and Harvest Prices in British India* (No. 3553, 1939), pp. 2-7; for China, Chang, *An Estimate of China's Farms and Crops*, p. 21.



acreage; the corresponding figures are 36 per cent for Szechwan on the northwest, 41 per cent for Yünnan on the southwest, and 86 per cent for Kwangtung which lies in the extreme southeast, adjacent to Indo-China where rice has about the same dominance in the crop-producing area.

MAP 2.—AGRICULTURAL AREAS AND CULTIVATED LAND OF CHINA\*



\* After J. L. Buck, *Land Utilization in China: Atlas* (Nanking, 1937).

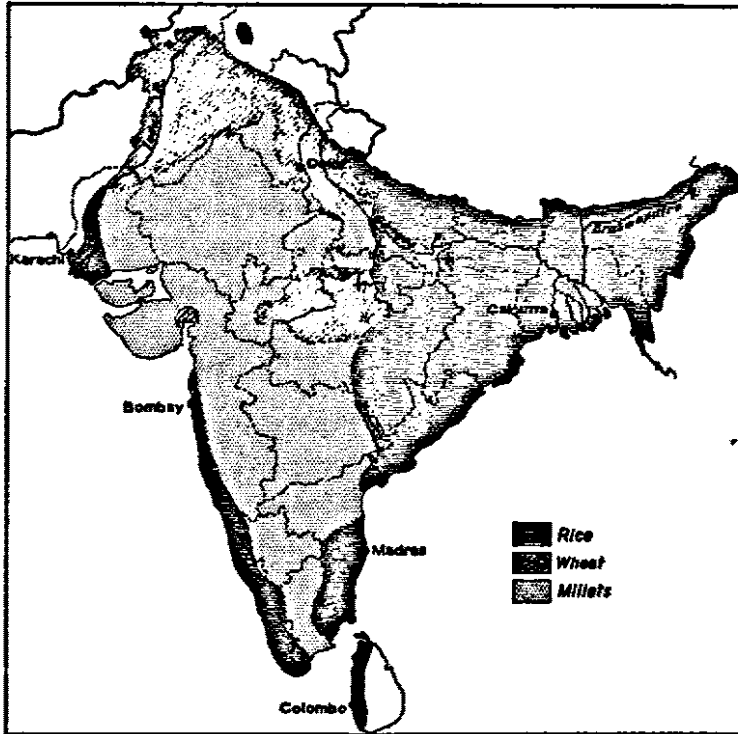
Map 2, based mainly on Buck's investigations, illustrates the use of land in China. Shaded areas indicate the approximate location of places where cultivated land exceeds 20 per cent of the total land area. Cultivated land constitutes a much larger fraction of total land area north of the Yangtze

than it does in the south where the terrain is so much more irregular (Map 1, facing p. 24). Regions wherein specific crops dominate in land use are indicated by the heavy boundary lines. In the north, the dominant crops or crop combinations are given as spring wheat, or winter wheat and millet, or winter wheat and kaoliang (a sorghum). Rice appears as one of the dominant crops only in and south of the Yangtze Valley.

Similarly in India rice looms much larger in some regions than in others. If one groups all of the provinces and states where appreciable densities of rice culture are shown in the endsheet map, rice covers on the average about 32 per cent of the cropped area, as compared with 5 per cent in other parts of the country and 23 per cent in India as a whole. Rice constitutes on the average about 52 per cent of the cropped area in those portions of the rice region lying east of a line drawn north from Cape Comorin on the extreme south, but only 20 per cent in those portions of the rice region lying west of this line. Within the eastern part of the rice region, the proportion of the cropped land in rice rises to 73-75 per cent in Assam, Bengal, and Orissa in the northeast and adjacent to Burma. Map 3 (p. 34) shows approximate locations of regions where different crops dominate in land use. Rice dominates on the west only in the delta of the Indus, in a coastal strip of land south of Bombay, and on the extreme north in Kashmir province. In the south, rice dominates also on the eastern coastal territory around Madras. Elsewhere west of the 80° meridian, however, wheat is the dominant crop in the north and in parts of the central area, and the millets and sorghums are dominant in wide territories elsewhere. A more detailed map would show small regions where barley dominates, and others where maize is the leading grain crop. In the rice region east of the 80° meridian, the degree of dominance of rice is lower on the west than on the east. There are localities, especially in Bengal, where rice occupies more than 80 per cent of the cultivated land.

Java shows similar contrasts. Rice occupies 68 per cent

MAP 3.—CULTIVATION OF PRINCIPAL FOOD GRAINS IN INDIA AND CEYLON



of the cropped area in the western part of the island, 45 per cent in the central part, 28 per cent in the eastern part. Illustrations need not be multiplied. In most parts of Monsoon Asia, if one excludes the western part of India, and China north of the Yangtze Valley, agricultural operations center about rice; rice is by far the dominant crop, in the main occupying one-fifth up to nearly all of the crop-producing acreage.

Just as the importance of rice acreage in the total crop area varies from country to country and from region to region, the importance of the nonrice acreage varies, but inversely. By countries, the nonrice acreage is most important in India, China, and Chosen, where much land devoted to agriculture

is too dry (and in China partly too cold) for rice production. Here the nonrice acreage constitutes 70–80 per cent of the total crop acreage. In Japan and Java, nonrice areas constitute somewhat more than half the total crop acreage, and in Taiwan somewhat less; in Burma and the Philippines, about a third; in Thailand and Indo-China, probably only around a fifth. Crops other than rice are thus of some importance everywhere—outstandingly so in what we have called the nonrice region of Monsoon Asia, and significant even within the parts of the rice region where rice is by far the dominant crop.

Within the rice region the nonrice crops are both numerous and difficult to classify. Table 3 (p. 36), however, gives an approximate indication of the uses made of crop land in major segments of the rice region. The data exclude the tree and bush crops, such as tea, coffee, coconuts, rubber, kapok, quinine, and others (except mulberry, which is included in the Japanese statistics). Land devoted to these crops does not loom large in the total arable area.<sup>2</sup>

The nonrice crops of the rice region are mostly used for food—grains, pulses, and vegetables among which cassava and sweet potatoes occupy much of the acreage. Relatively little land is sown to crops used wholly or mostly for fodder, to the fiber crops (chiefly cotton, with jute in eastern India) and tobacco, or to the oilseeds. Since the latter yield much edible oil, they might reasonably be counted as food crops.

Rice leads in acreage in each of the regions specified in Table 3. The nonrice crops of greatest relative importance vary from one region to another. In the northern part of the rice region of Monsoon Asia—the Japanese Empire and China in and south of the Yangtze Valley—small grains (chiefly barley and wheat)<sup>3</sup> are outstandingly dominant, and

<sup>2</sup> In Java, British Malaya, and Ceylon especially, the tree and bush crops are cultivated more largely in plantation agriculture than in native agriculture. Sugar cane is another prominent plantation crop. Mulberries and tea in Japan and China, however, are cultivated by peasant farmers.

<sup>3</sup> Oats are relatively unimportant, and hardly any rye is grown. Some writers, however, confuse rye with naked barley in the Japanese Empire, and list rye as a small grain of appreciable importance there.

TABLE 3.—APPROXIMATE DISTRIBUTION OF CROPPED ACREAGE IN THE RICE BELT OF MONSOON ASIA TO DIFFERENT CROPS, ABOUT 1935\*

Crop	Japanese Empire <sup>a</sup>		Southern China <sup>b</sup>		Northeastern India <sup>c</sup>		Burma		Java and Madura	
	1,000 acres	Per cent	1,000 acres	Per cent	1,000 acres	Per cent	1,000 acres	Per cent	1,000 acres	Per cent
Rice .....	13,282	40.5	46,595	42.1	32,583	77.3	12,634	67.7	9,570	45.6
Other small grains <sup>d</sup> .....	7,661	23.2	29,338	26.5	750	1.8	447	2.4	0	.0
Millet and sorghums .....	2,919	8.8	5,305	4.8	1,166	2.8	832	4.5	57	.3
Maize .....	127	.4	5,153	4.7	104	.2	213	1.1	5,508	26.2
Vegetables <sup>e</sup> .....	2,750	8.4	3,637	3.3	1,401	3.3	1,040	5.6	3,237	15.4
Pulses <sup>f</sup> .....	2,941	8.9	11,884	10.8	983	2.3	564	3.0	1,408	6.7
Fibers and tobacco .....	2,725	8.3	5,639	5.1	2,827	6.7	624	3.3	445	2.1
Oilseeds <sup>g</sup> .....	270	.8	2,570	2.3	1,841	4.4	2,229	11.9	635	3.0
Sugar cane .....	311	.9	452	.4	490	1.2	90	.5	138	.7
Total considered .....	32,986	100.0	110,623	100.0	42,145	100.0	18,673	100.0	20,998	100.0

\* Basic data for the Japanese Empire from R. B. Hall, "Agricultural Regions of Asia, Part VII, The Japanese Empire," *Economic Geography* (Worcester, Mass.), April 1935, XI, 144-45; for China, from C. C. Chang, *An Estimate of China's Farms and Crops* (Nanking, 1932), pp. 15-21; for northeastern India and Burma, from India Dept. Commercial Intelligence and Statistics, *Agricultural Statistics of India, 1936-37, Vol. I, Area, Classification of Area, Area under Irrigation, Area under Crops, Live-Stock, Land Revenue Assessment and Harvest Prices in British India* (No. 3553, 1939), pp. 6-7; for Java and Madura, from International Institute of Agriculture, *International Yearbook of Agricultural Statistics, 1938-39* (Rome, 1939), pp. 196-99.

<sup>a</sup> Japan Proper, Chosen, and Taiwan.

<sup>b</sup> Provinces of Kiangsu, Anhwei, Hupeh, Hunan, Kiangsi, Szechwan, Yunnan, Kweichow, Chekiang, Fukien, and Kwangtung. Data for Kwangsi, which lies within the same area, are not available.

<sup>c</sup> Assam, Bengal, and Orissa.

<sup>d</sup> Wheat, barley, oats, and buckwheat.

<sup>e</sup> Mainly sweet potatoes and cassava.

<sup>f</sup> Soybeans, other beans, peas, and other legumes.

<sup>g</sup> Peanuts, sesame, rapeseed, linseed, and others.

either pulses (beans and peas, including soybeans) or millets and sorghums rank second and third respectively. Either vegetables (mainly sweet potatoes) or fiber crops and tobacco are next in importance as to acreage occupied, while maize, oilseeds, and sugar cane are least important.

In the warmer parts of the rice region nearer the Equator, the relative importance of the various nonrice crops is quite

different. Rice occupies so much of the crop acreage in northeastern India and Burma that no other type of crop is very important. Among the minor crops, the small grains are far less commonly cultivated than in the northern part of the rice belt, the pulses are considerably less important, and millets and sorghums, maize, vegetables, and fibers and tobacco somewhat less important. The oilseeds, on the other hand, occupy an appreciably larger, and sugar cane a slightly larger, proportion of the total crop acreage.

Less emphasis falls on the small grains in Java than even in northeastern India, as is true also in less marked degree of the millets and sorghums and the fibers and tobacco. The pulses each occupy a smaller fraction of the crop acreage than in the Sino-Japanese part of the rice belt, but a larger fraction than in northeastern India and Burma. The opposite is true in the case of oilseeds. Sugar cane constitutes only a small proportion of the total crop acreage here as elsewhere. But maize particularly, and vegetables (notably cassava) in lesser degree, loom larger in Javanese agriculture than in the other parts of the rice belt. Maize in Javanese agriculture is about of the same importance as the small grains in the Sino-Japanese part of the rice belt; it even becomes the dominant crop in eastern Java where rice occupies less of the crop acreage.

#### PADDIES AND IRRIGATION

Paddies are fields leveled and diked, often only with mud walls, in such a manner that for months water can be held in them after the fashion of a flat basin. Their major but not their sole use is to grow lowland rice. In flat country, ditches thread between them, for the purpose both of bringing water on and of draining it off the fields. In rolling country, many adjacent fields may be flooded and drained by opening or closing small outlets at the edge of the paddies, depending on the force of gravity for the desired flow of water.

In lowland-rice-growing districts where topography is ir-

regular, paddies are typically small in size and irregular in shape. They are arranged along different levels frequently giving the effect of broad steps rising from the lower land to the higher. Above and sometimes between these fields may lie other cultivated areas, not leveled, diked, or flooded, upon which crops other than rice are grown. These fields comprise the "upland," but it is not usual to find upland rice in districts where water resources are sufficient for supporting the lowland form of culture. Other crops grow typically on upland areas in predominantly lowland-rice regions; upland rice tends to appear in drier or poorer regions. Set down at fairly frequent intervals in the midst of numerous paddy fields are small, compact villages where the growers and their families live.

Paddies located in great river valleys where the land is level tend to be larger and more uniform in size, with little suggestion of the terracing effect produced by the arrangement of fields in areas with a more rugged topography. Upland fields are not interspersed with the paddies, but appear as the flat land terminates and the hill country begins. Villages tend to be farther apart, going back and forth to the fields is easier, and vegetative covering is more definitely spotted around and in the small communities.

Since a paddy must be level to be evenly flooded, the size of individual fields tends to vary with the slope of the land, the smaller and narrower paddies being found on the steeper slopes.<sup>4</sup> But some very small fields are found on flat land as well as in regions of more irregular topography. The explanation is usually to be found in the distribution of ownership. The paddies cultivated by a single family, and the upland fields as well, may be scattered throughout the growing district. Under these conditions, the farmer spends much time and effort in going to and from his tiny fields.

<sup>4</sup> Construction of paddies in some parts of Monsoon Asia has been pushed by terracing far up the sides of rather steep mountains. One of the most spectacular examples is to be found in northern Luzon in the Philippine Islands, where the famous Igorot terraces sometimes require retaining walls 75 feet high.

The unsystematic method of constructing paddies one after another over a long period of time has also led to inefficiency in the location of irrigation ditches, and consequent waste of labor and water. The governments of some countries have devised programs for remedying this situation, but very little real progress has been made except possibly in Japan.<sup>5</sup> The obstacles to redesigning land holdings to conserve labor and water supply are numerous and not quickly or easily overcome.<sup>6</sup>

The average size of farm operated by one family is very small, especially within the districts of the rice belt of Monsoon Asia where paddy fields predominate in the arable area. Only about 2.7 acres of "farm land" are operated by a farm family in Japan; only 3.8 acres in Chosen (and within Chosen, only 2.7 acres in the southern district where much rice is grown).<sup>7</sup> In the southeastern provinces of China where rice most strongly predominates, "cultivated acreage per farm-

<sup>5</sup> In Japan, if the landowners of the village desire, the government engineers take hold, redesign the whole irrigation system and the layout of the paddies, and rebuild, as it were, the whole cultivated area belonging to the village. Through a system of exchange, the villagers and individual landowners receive in the end consolidated pieces of land, sometimes with financial compensation. See C. L. Alsberg, "Japanese Self-Sufficiency in Wheat," *WHEAT STUDIES*, November 1935, XII, 71. Even though a large part of the expense is borne by the government, the Japanese program apparently has not been outstandingly successful. The difficulty seems to lie in the farmer's resistance to changes in his tax assessment resulting from a revaluation of his new plots of land. In Japan the land tax was for a long time levied on the basis of an assessment of 1873. Fundamental amendments were not effected until 1930 when rental values became the basis of tax assessments. New assessments are scheduled to be made every 10 years, the first amendment coming in 1938. Before this reform there were many cases of unfairness in the distribution of the tax burden. Although the Japanese authorities have been working on this problem for many years, very little has been done in other countries.

<sup>6</sup> Fragmentation of holdings is a serious problem particularly in old and densely populated countries. In some areas of India more than a third of the farmers hold more than 25 separate small plots within the same village, and holdings of a fraction of an acre in size are common in many parts of the country. See Great Britain Royal Commission on Agriculture in India, *Report* (Cmd. 3132, *Parl. Papers*, Commons, 1928, VIII), pp. 132-35. "Fragmentation of land is among the most important characteristics of Chinese agriculture. There are on an average 5.6 different parcels of land per farm . . ." (J. L. Buck, *Land Utilization in China*, Nanking 1937, p. 181). These parcels average less than 1 acre in size. Also, numerous spaces reserved for burial mounds make cultivation difficult and inefficient. Another condition leading to inefficient cultivation in some places, e.g., Burma, is that "a surprisingly large proportion of the tenants cultivate a different plot of land each year" rather than lease and work the same land year after year. See J. S. Furnivall, *An Introduction to the Political Economy of Burma*, ed. by J. R. Andrus (2d ed., Rangoon, 1938), p. 77.

<sup>7</sup> Hall, *op. cit.*, p. 145.



ily" averages only about 2.1 acres.<sup>8</sup> Lava suggests similar figures for the Ilocos region of the Philippines.<sup>9</sup> In India, "Keatinge estimates the average holding of rice-land in Konkan in the Bombay Presidency as only two or three acres . . . ."<sup>10</sup> Since the above figures are averages of both larger and smaller farms found within regions concentrating on rice production, the typical farm family operates an even smaller holding. The average size of farm tends to be somewhat larger in the newer rice regions (as in Burma, Thailand, and Indo-China), and probably also in areas where the proportion of arable land devoted to paddy is smaller in relation to the acreage used for upland crops.

In a sense all paddy fields are "irrigated"; within them there is manipulation of the level of water in which the rice grows. Yet by no means all paddies are supplied with water brought in by ditches or pumps from points of impoundage or storage. Many are merely rain-fed and some are flood-fed. The rain-fed paddies simply catch and hold water as it falls, the excess being allowed to flow out. The flood-fed paddies in or near river bottoms receive and retain water brought to them by the rise in the level of the river; after the river level falls, any excess not needed is allowed to flow out.

Many paddy fields, however, are supplied with water in addition to rainfall or flood by various artificial means. In hilly country, diversion ditches are built from small streams, and the paddies fed by gravity. In flat valleys, water is pumped or lifted from large streams; or lifted from wells; or caught in open tanks during the season of rains or floods, and drained by gravity if the tanks are higher than the paddies, or lifted or pumped if the tanks are level with the paddies. In some places large storage dams permit water to be fed to the paddies by gravity through wide canals and smaller distributing ditches. Near the sea, advantage is sometimes

<sup>8</sup> Chang, *op. cit.*, p. 14.

<sup>9</sup> H. C. Lava, *Levels of Living in the Ilocos Region, Philippines* (unpublished Ph.D. thesis, Stanford University, Calif., 1939), pp. 100-01.

<sup>10</sup> Radhakamal Mukerjee, *The Rural Economy of India* (London, 1926), p. 39.

taken of high ocean tides to force fresh river water into the paddies.

The relative importance, respectively, of paddy land and of upland in the arable acreage of the rice belt of Monsoon Asia cannot be determined with precision. However, upland rice probably accounts for barely more than 10 per cent of the total rice acreage and upland fields are presumably less commonly double-cropped<sup>11</sup> than are paddy fields. If this is true, the importance of paddy fields in the total arable area would seem to be roughly similar to, or somewhat greater than, the importance of rice area in total area under crops. Our earlier discussion of the importance of rice acreage in total crop acreage (pp. 31-37) then provides something of a basis for the conclusion that paddy fields tend to constitute from two-fifths to over three-fourths of the total arable land in major subdivisions of the rice belt, with the heavier ratios of paddy to arable land occurring in northeastern India, Burma, probably Thailand and Indo-China, extreme southeastern China, and western Java. Conversely, arable upland would be of relatively least importance in these areas. It is particularly in Burma, Thailand, and Indo-China—relatively the newest agricultural regions of this group—that one would expect to find possibilities for expansion of arable-upland acreage, and perhaps also in some parts of the Netherlands Indies aside from Java.

Similarly, an adequate account cannot be given of the relative prevalence of “naturally irrigated” and “artificially irrigated” paddies. Yet it seems probable that most paddy fields in the Sino-Japanese part of the rice region of Monsoon Asia are artificially irrigated, whereas natural irrigation prevails elsewhere. Buck states that “in China . . . rice land . . . is almost all irrigated”;<sup>12</sup> Hall states that virtually “all of the paddy rice of Japan Proper is irrigated . . . ,” but that “probably 50 per cent of the wet rice area must depend

<sup>11</sup> On double cropping, see below, pp. 43-47.

<sup>12</sup> Buck, *op. cit.*, p. 186.

upon rainfall alone" in Chosen and Taiwan.<sup>13</sup> In contrast, Van Valkenburg says of Java: "One-third of the rice acreage is really technically controlled so far as irrigation is concerned. A minor part of the rest has a kind of casual type of irrigation, while the greater part depends entirely upon rain."<sup>14</sup> In Java the possibilities for extending irrigation are apparently becoming fewer and fewer, although in the Outer Provinces of the Netherlands Indies the opportunities for bringing new lands under irrigation are considered to be very promising.<sup>15</sup> In Assam, Bengal, and Orissa, provinces of eastern India which contain over a third of the total Indian rice area, official statistics indicate that the proportion artificially irrigated is less than 15 per cent. This is true in Burma as well, and probably in Thailand and Indo-China. In general, natural rather than artificial irrigation prevails where the rice acreage is largest in relation to crop acreage and paddy area largest in relation to total arable land.

Major irrigation projects involving huge dams and long and large canals are not important as the sources of irrigation water in most rice-producing regions,<sup>16</sup> nor is tide-water irrigation. The principal sources of irrigation water are streams, tanks, and wells, although canal systems built along great rivers and not involving the construction of expensive dams are important in some regions, especially China. In important river deltas, networks of canals fed by the river not only render rice growing safer and double cropping possible, but are a necessary link in the system of communications. The

<sup>13</sup> Hall, *op. cit.*, pp. 131-32.

<sup>14</sup> Van Valkenburg, *op. cit.*, p. 34.

<sup>15</sup> W. A. van der Meulen, "Irrigation in the Netherlands Indies," *The Netherlands Indies: Bulletin of the Colonial Institute* (Amsterdam), June-August 1940, III, 152.

<sup>16</sup> India is the outstanding example of the development of major irrigation projects in Monsoon Asia, yet the systems that have been built are mostly located in regions where rice is a minor crop. In countries like Indo-China, the construction of major canals has progressed further than has secondary-canal development, though the latter are also necessary for bringing additional lands under rice. In the delta of the Mekong, major canals serve in place of roads. In Cochin China especially, the excavation of canals for transport preceded settlement much as railroads preceded the opening up of the western part of the United States and Canada. In the future, in many sections of Indo-China, the digging of canals will have to precede settlement (Gourou, *L'utilisation du sol en Indochine française*, p. 139).

relative prevalence of the various sources of irrigation water, or of the methods of application by gravity or by pumping or lifting, remains somewhat conjectural.

#### DOUBLE CROPPING

The practice of double cropping occurs in many parts of the rice belt. Commonly, this means two harvests from a given piece of land within a single year. On paddy land, the first or summer crop is almost invariably rice; the second or winter crop is sometimes rice, but often some other crop, especially a small grain, maize, pulse, or vegetables. On upland fields within the rice belt, practices seem much less easy to infer. The first or summer crop may perhaps be either upland rice, or more commonly maize, or millet or sorghum; the winter crops may perhaps be mostly pulses or vegetables. In regions close to the Equator and having a fairly even seasonal distribution of rainfall, the distinction between first and second or summer and winter crops tends to become meaningless.

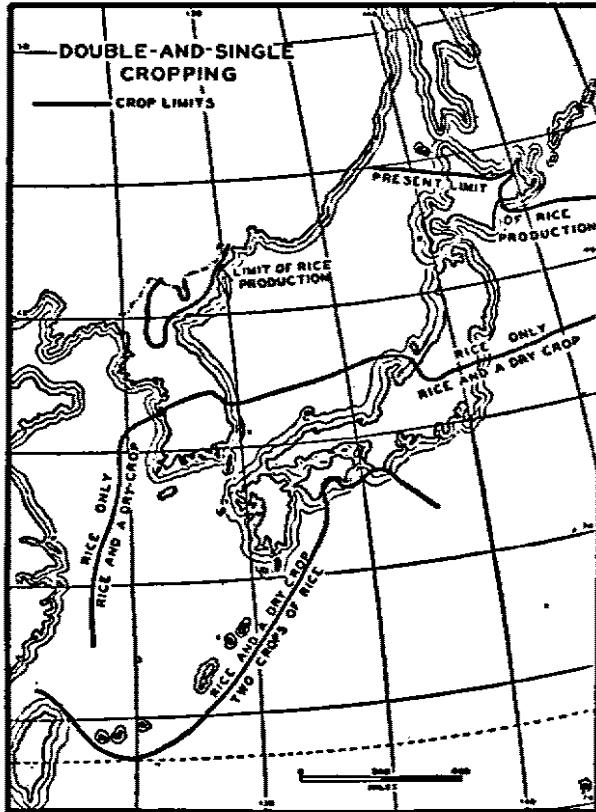
Double cropping, taking paddy land and upland together, seems to be most prevalent in the Sino-Japanese part of the Asiatic rice belt. In Japan Proper, the area under crop exceeds the arable area by about 20 per cent, implying a considerable amount of double cropping; and the paddy land is double cropped to the extent of about 38 per cent.<sup>17</sup> Double cropping of paddies is considerably more common in the southern than in northern regions (Map 4, p. 44), suggesting that a limitation is imposed by low winter temperatures. For the Chinese rice belt, Chang gives data indicating that the total area under crop exceeds the arable area by about 23 per cent;<sup>18</sup> but here the excess tends to be larger in the tier of provinces along the Yangtze Valley than it does further south, suggesting some other influence than temperature. Presumably the double-cropped paddy acreage, as in Japan, would exceed the paddy land by a larger fraction than the total area in crops exceeds the total arable area. In Java also

<sup>17</sup> Hall, *op. cit.*, pp. 144-45.

<sup>18</sup> Chang, *op. cit.*, p. 12.

## RICE ECONOMY OF MONSOON ASIA

MAP 4.—RICE-CROPPING AREAS OF THE JAPANESE EMPIRE\*



\* Reproduced from *Economic Geography*, October 1934, X, 339.

there is excess of cropped area over arable area, but little suggestion that the excess is as large as in China or Japan. In northeastern India, total areas sown exceed "areas sown only once" by only about 17 per cent, and the figure is only about 7 per cent in Burma. Thus there can be relatively little double cropping, either of paddy land or of upland, in Burma; probably the same is true in Thailand and in Indo-China, except in the northern and eastern regions.

Conditions of temperature would necessarily limit the possibilities for double cropping either of paddy land or of up-

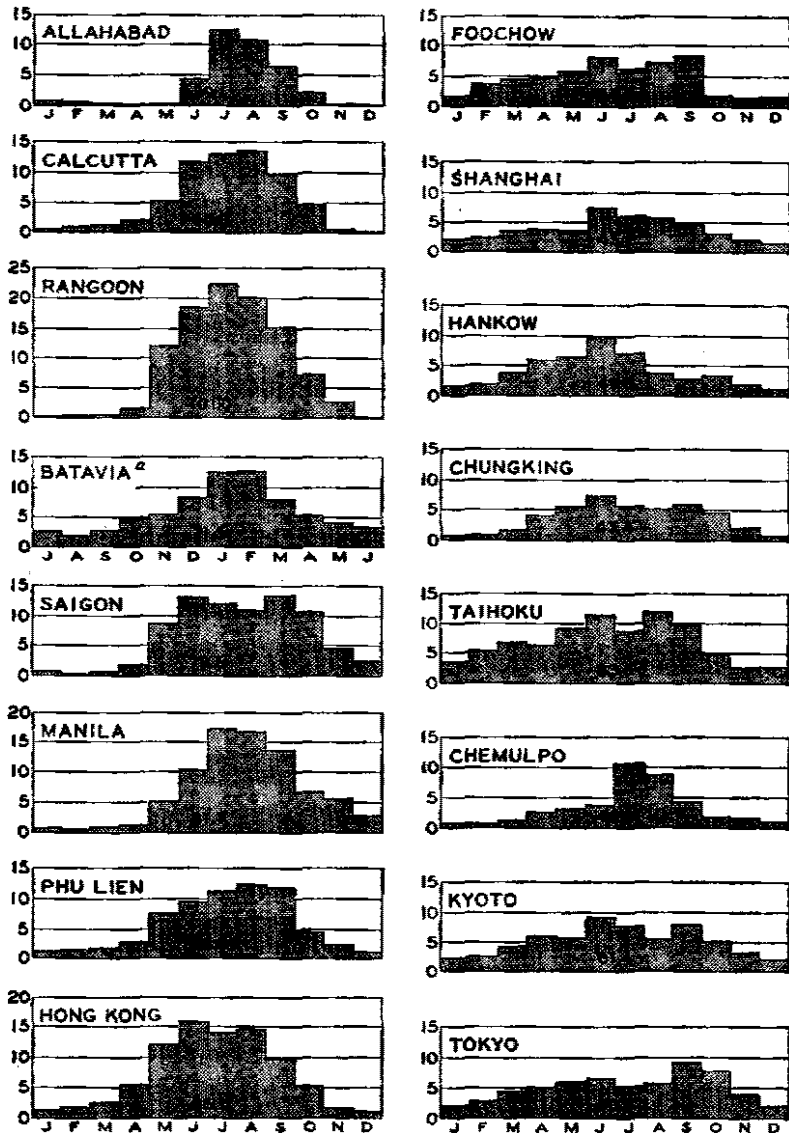
land, for cold winters would preclude successful growth of winter crops. This may constitute the principal explanation of the relatively small amount of double cropping of paddies in northern Japan, and possibly also in Chosen (see Map 4). In sufficiently warm regions, the principal factor limiting double cropping on arable upland would presumably be lack of winter rainfall, while on paddies the limiting factor might be either lack of rainfall or lack of irrigation.

Chart 1 (p. 46) shows the average seasonal rainfall distribution at various observation points scattered through the Asiatic rice belt from northeastern India to Japan. The stations lying nearest the Equator, in general the warmest, are those in the first column. All of these points have the typical monsoon distribution of rainfall—an abundance in the summer, from May or June to October or November (October or November to May or June in Java in the Southern Hemisphere), and very little from October or November through April. The summer rainfall provides adequate moisture either for rice in the paddies, or for upland crops. But in the relatively dry (and warm) winter, the upland fields receive too little moisture to bear crops. So also do the paddies unless they can be irrigated artificially from stored water. This goes far to explain why double cropping is relatively unimportant in the regions nearer the Equator. It cannot be practiced on upland, and, since only a small fraction of the paddies are artificially irrigated, it cannot be practiced on most of the paddy land.

The seasonal distribution of rainfall is more favorable to double cropping in the Sino-Japanese part of the rice belt. Here the rainfall of November–April, the relatively dry winter season, is considerably heavier than in the rice regions farther south. It is also cooler in the winter, so that less evaporation occurs. Winter crops can be grown both on upland and on naturally irrigated as well as on artificially irrigated paddy land. Since the last type is relatively prevalent (p. 41)—perhaps largely because there is enough rainfall in the winter

CHART 1.—SEASONAL DISTRIBUTION OF RAINFALL AT SELECTED STATIONS  
IN MONSOON ASIA\*

(Normal inches)



\* Basic data from *World Weather Records* (Smithsonian Misc. Coll., Vol. 79, Washington, D.C., Aug. 22, 1927, and Vol. 90, May 18, 1934); for China, from G. B. Cressey, *China's Geographic Foundations: A Survey of the Land and Its People* (New York, 1934).

<sup>a</sup> Note different arrangement of months, applying to Batavia only.

season to maintain water supplies in storage—the practice of double cropping is considerably more common in the Sino-Japanese part of the rice belt, except on the colder peripheries to the north and in the higher elevations where, in addition, low temperatures preclude the growth of winter crops.

Other factors tend to limit the extent of double cropping throughout the Asiatic rice belt. Even where there is sufficient winter warmth and ample winter moisture from rainfall or from artificial irrigation, fields cannot be double cropped indefinitely unless some means are devised for maintenance of soil fertility. In places this problem is perhaps solved by nature through annual deposits of silt brought down by the rivers. In other places, particularly in China and Japan, growers commonly apply either artificial fertilizers, or barnyard manure, or night soil. But data are not at hand to indicate the extent of the limitations maintenance of soil fertility places on double cropping of the arable land adequately supplied with moisture for both summer and winter crops.

#### LAND UTILIZATION RECONSIDERED

A basis has now been established for offering a better explanation of why the dominance of rice in the cropped area of the Asiatic rice belt varies so much from region to region, and why the secondary crops are different in different parts of the rice belt.

The circumstances most favorable for complete dominance of rice in the cropped acreage of a region are fairly clear. They are (a) prevalence of *naturally* irrigated paddy land in the total arable acreage, with scanty winter rainfall in a climate characterized by warm winters; or (b) prevalence of *artificially* irrigated paddy land in the total arable acreage in a climate warm enough to mature rice as the second crop. Under the first set of circumstances paddy land will be used for rice only; there can be no summer upland crops if all of the arable area is in paddy; and there can be no winter crops on paddy fields so long as they are dry. Under the second set of



circumstances, practically all of the crop acreage must be in rice if rice is both first and second crop. Such extreme conditions are found locally, but not over wide areas. As the area considered increases, the cultivation of upland territory, and the production of nonrice crops, is bound to appear in greater or lesser degree.

Five areas may be selected for consideration: (1) northeastern India—Assam, Bengal, and Orissa; (2) the Indo-Chinese Peninsula—Burma, Thailand, and Indo-China; (3) Java; (4) the Chinese rice belt in and south of the Yangtze Valley; and (5) Japan Proper. Rice acreage constitutes 73–75 per cent of total crop acreage in northeastern India; 65–85 per cent in the Indo-Chinese Peninsula; 45 per cent in Java and Japan; and 42 per cent in southern China.

The heavy dominance of rice in both northeastern India and the Indo-Chinese Peninsula is explained by the prevalence of paddy land in the arable acreage, the scarcity of artificially irrigated paddy, and the relatively dry winter climate. In one respect, however, these two regions are different. Prevalence of paddy land in northeastern India means that almost all of the *potential* arable land has been occupied and was flat enough to convert to paddies. The Indo-Chinese area is demographically a newer territory. There only the relatively accessible arable land has been occupied and converted to paddy land, although it is likely that considerable acreage might still be devoted to upland crops. If this should occur, the dominance of rice in the total cropped area would diminish. Such a development has already occurred in Java, Japan, and southern China. Upland territory unsuited to paddy has been placed under crops to a large extent, diminishing the importance of rice in the crop acreage.<sup>29</sup> Artificial irrigation is more common in these three areas than in northeastern India and the Indo-Chinese Peninsula, permitting more cultivation

<sup>29</sup> Van Valkenburg (*op. cit.*, p. 34) observes for Java that the planted paddy-rice acreage (the great bulk of the total rice acreage) declined from 51 to 40 per cent of the total planted acreage between 1916 and about 1935.

of winter nonrice crops. These two factors go far to explain the lesser importance of rice in the planted acreage of Java, Japan, and southern China,<sup>30</sup> than in northeastern India and the Indo-Chinese Peninsula. The prevalence of artificial irrigation presumably has relatively larger influence in southern China and Japan than in Java, the prevalence of upland cultivation relatively more influence in Java than in China and Japan.

As to relative importance of crops secondary to rice, the small grains are conspicuous in China and Japan, while maize and cassava are conspicuous in Java. In general this is explained by relative temperatures and relative prevalence of upland-crop acreage. Maize and cassava thrive as summer upland crops in Java where upland is more prevalent, and maize as a winter paddy crop where paddies are artificially irrigated. The small grains cannot compete successfully with maize and cassava either as summer upland crops or as winter paddy crops, being less productive per acre under the prevailing conditions of temperature. In much of southern China and in Japan, on the other hand, there is relatively less upland for summer nonrice crops, and on paddy land the small grains as winter crops are more productive than maize or cassava which suffer from the relatively low winter temperatures. Other factors such as preference of populations for the different food crops, or familiarity of cultivators with one or another, doubtless help to explain these contrasts in land use. But relative temperatures and prevalence of upland cultivation seem to be influences of major importance.

#### PLANTING, HARVESTING, AND THRESHING

The typical Asiatic method of growing paddy rice is a distinctive form of agriculture. Practices vary somewhat in dif-

<sup>30</sup> In some parts of southern China, however, as in Kwangtung province, rice dominates the planted acreage to the extent of more than 75 per cent (Chang, *op. cit.*, p. 21). These are areas where most of the arable land is artificially irrigated paddy land; the prevalence of rice depends not only upon this but also upon the practice of planting rice as the second or winter crop.

ferent countries of the Orient and within the same country,<sup>21</sup> but the most pronounced differences in methods are between Asiatic practices and those of the more advanced rice-growing regions in the West.

In the United States, for example, rice is cultivated in essentially the same manner as wheat, oats, or barley, except that the crop is irrigated.<sup>22</sup> Farm machinery is used extensively. In some places, California especially, the production of rice is highly mechanized. In seeding on dry ground or in water, horses, tractors, or even airplanes may be used. Harvesting is commonly done with a combine which cuts, threshes, and sacks the rice in one operation.

In contrast, very little machinery is used in Asiatic rice-producing countries. Tools and implements are generally of the simplest type. Tractor cultivation has been attempted, but has not met with much success in the places where it has been tried. Harvesting and threshing are usually by hand with the aid of some simple device.<sup>23</sup>

Rice growing in the Orient is thus understandably one of the most labor-intensive types of agriculture known. In the more densely populated areas, land is not available for growing both food and feed; hence beasts of burden tend to be

<sup>21</sup> Over large areas (as in China), however, methods of transplanting, cultivating, and harvesting the rice crop are practically the same, and have been for generations. Thirty years ago, F. H. King (*Farmers of Forty Centuries, or Permanent Agriculture in China, Korea and Japan*, Madison, 1911, esp. pp. 271-310) made detailed observations of cultural practices in China, Korea, and Japan which are essentially the same as those recorded by more recent writers.

<sup>22</sup> "Contrary to popular opinion, rice is not grown in the United States on low marshy land but on irrigated level land of rather heavy texture, underlain at from 1½ to 5 feet from the surface by an impervious subsoil" (J. W. Jones, "Improvement in Rice," U.S. Dept. Agr., *Yearbook of Agriculture*, 1936, p. 419).

<sup>23</sup> The advanced technical methods and the extensive system of cultivation in California mean relatively low costs of production per unit of output. Costs per cwt. in Butte County, California, in 1931-35 were less than half those in Kauai County, Hawaii, in 1932-36, where intensive Asiatic methods prevailed. See *Rice Production in Hawaii: A Five-Year Summary of Cost and Efficiency Studies . . .*, compiled by H. B. Cady, M. Maneki, and K. Murata (Hawaii Agr. Ext. Serv., Ext. Circ. 33, June 1937), p. 28. This difference in costs goes far to explain developments in Hawaii. Around 1910, before the California industry existed, about half of the rice consumed in Hawaii was produced locally and some of this was shipped to California, while the balance of local consumption was imported from Japan. As the California rice industry expanded, Hawaiian production and outshipments declined and imports from Japan fell off. California now furnishes practically all of the rice consumed in Hawaii.

relatively scarce. In other regions where work animals are plentiful, their use for plowing is often precluded because the paddies are so small. Thousands of rice fields, in fact, are so tiny that the use of machinery would be impracticable even if it were available. Most of the work in connection with the production of rice and its preparation for consumption must be done by more flexible human beings.

*Planting the crop.*—The bulk of the world's rice crop is transplanted by hand from carefully prepared seedbeds, or nurseries, to the paddy fields. In some regions, however, especially where labor is scarce, seed is sown broadcast directly on the field, and this is the general practice in most Western rice-growing areas. But transplanting is a practice having a significant bearing upon the yields obtained in the Orient, and is generally the preferred method (pp. 240-44). In the cultural cycle, the seedbeds are the first to be cultivated. As soon as the soil has been softened by the early rains, they are plowed and harrowed several or many times, with or without the assistance of work animals, the amount of time and labor expended upon the preparation of the seedbed being about twice as great as that employed in the preparation of a similar area for transplanting.

When the soil of the seedbed has been worked up to the consistency of a fine, soft mud by hoeing, plowing, trampling, or harrowing, and is free from weeds, it is ready for sowing. Seedbeds are usually small, about 4 per cent of the area to be transplanted, but may extend to about one-tenth of it. In most areas the seed to be planted is first soaked in water and then broadcast by hand on the seedbed from which the water has been drained. Sometimes the seed is allowed to sprout before sowing in order to obtain a better foothold against heavy rains which may fall soon thereafter. The practice in some regions is to cover the seedbed with leaves or grass to afford protection against birds and other pests. After a few days, or immediately after the seeds have germinated, 1 or 2 inches of water are reintroduced and allowed to cover the surface of

the nursery. The water level is gradually raised as the seedlings grow, and after 25–40 days they are large enough to be uprooted and transplanted. Uprooted, they are tied together in small bundles and carried to the paddies. In some areas, the seedlings are pulled up and planted again in nurseries before the final transplanting to the paddy field. The plants are usually from 1 to 2 feet high when uprooted, but their tops are commonly cut off before replanting in the paddies.

Once the nursery beds are ready, work begins on the preparation of the paddy fields. The methods used are similar to those employed in preparing the seedbeds except that cultivation is ordinarily not so thorough.<sup>24</sup> Manures or fertilizers, in countries where they are used, are sometimes applied about ten days before the seedlings are transplanted. In other cases fertilizer, or additional fertilizer, is added after planting.<sup>25</sup>

With a few inches of water standing on the field, seedlings are planted by hand (usually by women) in rows 3–8 inches apart or in hills with 2–6 seedlings per hill, simply by pushing them into the soft mud, using the fingers or a simple planting tool.<sup>26</sup> Rows or hills are ordinarily 8–12 inches apart, and planting is usually done with 2–4 inches of water standing on the field. Once the tasks of sowing and transplanting are completed, the crop itself requires little attention until harvest. The paddy field remains flooded with 4–8 inches of water from the time the seedlings are 6–10 inches high until it is ready for draining before the harvest, though in some countries while the crop is maturing it may be drained at intervals for weeding. This is common practice in Japan and Chosen where the paddies may be drained and weeded three or four times; but in the Philippines and in Thailand it is not common

<sup>24</sup> Swampy regions are commonly dug over with hand implements, but in some places (as in parts of Burma) certain low-lying delta areas are not plowed at all.

<sup>25</sup> The use or nonuse of fertilizers is one of the most important cultural practices explaining the differences in yields obtained in various parts of Monsoon Asia, but this subject is more appropriately considered at a later point. See chapter xi, pp. 251–62.

<sup>26</sup> A typical planting tool found in many parts of Malaya consists of an iron rod, about 2 feet long, with a bent wooden handle. At the end of the rod are two short prongs between which two or three seedlings are placed before being thrust into the mud.

to weed after transplanting. As the flowers appear and the ears begin to fill just before harvest, the water is allowed to drain off the fields.

At times flood damage may require a certain amount of repair work, and rats, birds, various insects and diseases may cause the grower real trouble. One of the most important tasks during the growing period is the regulation and maintenance of the water supply on the fields. Water should not be allowed to stagnate, but should be changed at intervals in order to insure sufficient aeration of the soil. This is often impractical, however, for many of the irrigation systems are dependent upon rainfall, and the individual field may not be sufficiently close to a main irrigation canal.

*Harvesting and threshing.*—The rice harvest usually begins 3–6 months after transplanting,<sup>27</sup> depending upon whether the varieties planted mature early or late. Except in Japan and China, harvesting is often a group enterprise; neighbors of the village help each other, with men, women, and children participating. Outside labor is imported in some areas especially for the harvest.<sup>28</sup> Helpers commonly receive compensation in the form of a certain portion of each day's harvest, the harvested grain being collected into small bundles, and distributed at the end of the working day—in places like Java, before the afternoon showers begin. In virtually all the rice-growing countries of the East, picturesque ceremonials accompany both harvesting and planting.

Methods of reaping, threshing, and winnowing are usually primitive. Although machinery has been designed and is on the market for mechanizing these preliminary operations, it is not yet widely used. Machine harvesters and threshers are

<sup>27</sup> The total time between germination and maturity of the rice plant varies greatly. Ignoring perennial rice, according to Copeland (*Rice*, p. 12), varieties have been reported that mature in as little as 50 days from germination, others in as much as 221 days, while Cambodian floating rice requires 10 months. The interval between flowering and maturing varies from 11 to 69 days, the average being about 33 days (p. 34).

<sup>28</sup> For example, in Lower Burma, some 200,000–300,000 Indians come for the harvest each year, many remain and work in the mills, and finally return, mostly to the famine areas of southern India.

seldom employed except on large estates or on experimental farms operated by governments.

In most countries harvesting is done with hand sickles, and 1 or 2 feet of straw are usually cut off with the ears. In some parts of southeastern Asia (e.g., the Malay Peninsula, Java, and the southern Philippine Islands) another common method of harvesting involves cutting each ear separately with a special type of knife.<sup>29</sup> In the latter case the straw is not always utilized but is left on the field to be burned off or plowed under.<sup>30</sup> Once cut, the ears and attached stalks may be left on the ground for a few days or as much as a week for drying; but in Japan, where drying is more difficult, they are bundled and hung over small bamboo fence-like arrangements surrounding the paddy fields.

Bundles of harvested ears and attached stalks are carted to the threshing floor, where some further drying occurs before threshing; or they may be placed in bags for "curing" for a period from two weeks to three months. Removal of the straw stalks from the grain is the first stage in the preparation for consumption, and is generally done locally on the many thousand threshing floors scattered through the growing regions.

The threshing floor is often a paddy field scraped smooth and plastered with cattle dung and clay to give it a hard, smooth surface, or it may be a hard earthen or cement floor or a compound surrounding the cultivator's home. In some areas bullocks, carabaos, or oxen tread out the grain; in other places humans perform the same operations. In still other areas the grains are beaten from the ears by flails—

<sup>29</sup> In Malaya this knife is set in "a wooden base which fits into the palm of the hand," and its use is connected with superstition concerning the spirits hovering over the paddy fields. "The setting of the small knife represents a bird," and the natives are said to believe "that the spirits have no prejudice against birds but would resent the brutal use of a large knife" in harvesting (D. H. Grist, *An Outline of Malayan Agriculture*, Straits Settlements and Federated Malay States Dept. Agr., Malayan Planting Manual 2, 1936, p. 125).

<sup>30</sup> This is a practice of southeastern Asia. One seldom observes such stubble in Japan and China, as the straw stalks are fully utilized; usually the roots only are left in the field for improving the soil.

long sticks (usually bamboo) at the end of which are attached stout reeds which swing freely as the operator alternately raises his pole and then brings it down hard on the threshing floor.

The tramped or beaten material is winnowed by allowing it to fall gently from a platform while the wind carries away the chaff, dust, short pieces of straw, and the lighter kernels. Sometimes threshing consists merely of pounding the rice heads on a log. Such crude processes leave a residue of rough grain (paddy) containing more or less foreign matter and dirt. A very large part of the crop, however, is daily converted by these crude methods for immediate use in local consumption.

#### THE INDO-CHINESE EXPORT AREA

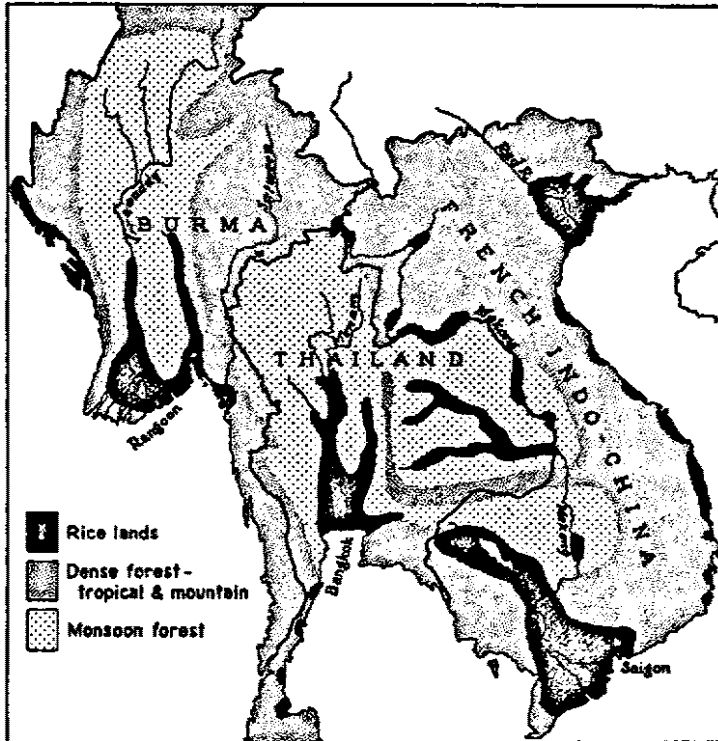
Burma, Thailand, and Indo-China, all part of the Indo-Chinese Peninsula, constitute the great rice-surplus region not only of Monsoon Asia but of the world (Table 2, p. 28). As compared with India to the west and China to the north, they are also relatively new countries, not as densely populated or as fully exploited. The conditions of rice culture in this region, the most important area of *commercial* rice production in the world, merit some additional consideration.

Most of the rice is grown in the river valleys and deltas of the Irrawaddy in Burma, the Menam in Thailand, and the Mekong in Indo-China. A less important rice area lies in northeastern Indo-China, in the delta of the Red River;<sup>21</sup> and there are numerous but small producing areas along the coasts. These regions are shown in Map 5 (p. 56), together with the important seaports of the peninsula—Rangoon, Bangkok, and Saigon, through which passes the bulk of the rice entering into international trade. As the map shows, forests of monsoon type (moderately open rather than dense jungles) lie adjacent to the rice fields especially of the Irrawaddy,

<sup>21</sup> This Tonkinese area is older, more densely populated, and much less of a rice-surplus region than the valleys of the Irrawaddy, Menam, and Mekong.



MAP 5.—RICE LANDS AND FOREST AREAS OF THE INDO-CHINESE PENINSULA\*



\* After Van Valkenburg, *Economic Geography*, January 1933, IX, 10.

Menam, and upper Mekong; much of this forest is teak and provides the basis for a substantial lumbering industry. The rest of the territory is practically all dense tropical forest, largely mountainous.

Each of the three countries is something of a replica of the others in climate, topography, and land utilization, a similarity of conditions with important economic implications. Rice crops mature and are harvested at about the same time; hence rice shipments into export channels are highly concentrated. This nearly simultaneous movement is commonly supposed to result in intensified competition and con-

sequent pressure on prices, with adverse effects upon returns to growers and government revenues.<sup>32</sup> Such importance in the world economy as rice enjoys from the standpoint of trade and shipping is derived largely from the surpluses produced on the Indo-Chinese Peninsula. Rice exports are so important a source of revenue that fluctuations of prices or yields are of paramount concern to some 50 million inhabitants.

The whole Indo-Chinese Peninsula is, of course, climatically dominated by the Asiatic monsoons. Various densely forested mountain ranges extend to the south and southeast from the high plateau of southern China and Tibet (Map 1, facing p. 24); upon their windward faces over 80 inches of rain falls annually. On the opposite sides of these mountain ranges the rainfall is less, but is generally sufficient for the rice crops grown on the great river plains. Over the years in all three countries, the important rivers have been slowly enlarging the land area by depositing rich silt washed down from the highlands.

The rivers overflow at least once a year, and either supplement the rains so that little irrigation is necessary for the summer crop, or destroy a portion of the crop by failure to flood enough or by flooding too much. As the floods slowly and gently subside, alluvial deposits of silt are left which enrich the soil and permit rice to be grown continuously year after year with little fertilization and no rotation of crops. Flooding of the Red River in northeastern Indo-China, however, is more violent and constitutes a major hazard with which the Tonkinese rice growers have to contend.

Over long periods of time wide estuaries have been created. The Menam River system of Thailand, for example, has deposited enough alluvial clay to leave a flat delta plain about 100 miles wide near Bangkok. The Mekong, which rises near the headwaters of the Yangtze in the distant mountains of Tibet, is similarly responsible for the actual formation

<sup>32</sup> See chapter vii, pp. 162-64, for further consideration of typical postharvest depression of rice prices and alleged effects upon producers.

of Cochin China and a large part of Cambodia in southern Indo-China. Here the rainfall is more than 78 inches annually, comes mostly in the summer, and is therefore sufficient for the summer rice crop without irrigation. In Burma the annual rainfall over the Irrawaddy-Sittang delta is generally about 80 inches and is more reliable than that in Thailand or Indo-China.

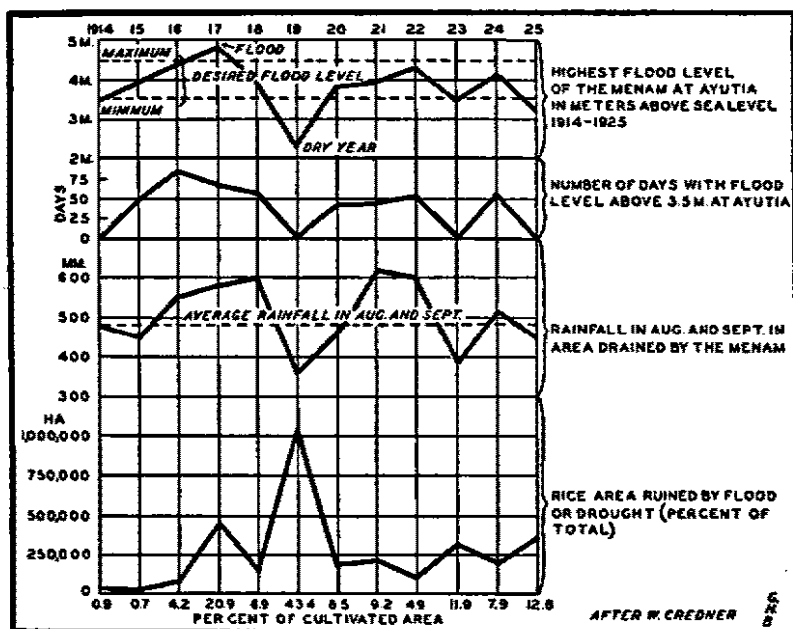
Though not as thickly populated as, for example, the rice region of northeastern India in the delta of the Ganges and Brahmaputra, the great Burmese river valley is just as productive. But relative sparseness of population makes it necessary to import considerable labor from India to care for the crops, particularly for transplanting and harvesting. The relatively new character of the 'rice-growing region along the Irrawaddy is suggested by the fact that the political center of Burma, and its densest concentration of population, still lie in the drier section of central Burma north of the delta.

In Thailand the political center, capital, and rice center are found together around Bangkok. Central Thailand embraces the lower and middle parts of the Menam valley known as the Great Central Plain where there is less rain and more frequent drought than in Burma, since much of the monsoon moisture is lost by precipitation on the western mountains. Although the average annual rainfall on the central plain is about 60 inches, only about 40 inches fall during the summer. The need for supplementary irrigation of the summer rice crop is great enough to have led the government to construct a system of canals and controls for the purpose of impounding water supplies. When the Menam overflows its banks, there is a great inland extension of the Gulf of Bangkok and, although this flooding produces rich silt and more adequate water, it may nevertheless be either excessive or inadequate from the point of view of the rice growers.

The hazards of drought and flood in the Menam valley of Thailand are perhaps greater, but more or less similar to those in the Irrawaddy and Mekong districts, and are well

illustrated by Chart 2. Here plowing of the paddies begins early in June, after the first monsoon rains of May have softened soil that lay parched and cracked throughout the dry winter. Rice is transplanted from the seedbeds to the paddies in July. The rains usually keep the fields flooded

CHART 2.—RELATION BETWEEN FLOODS AND RICE HARVESTS IN THE MENAM VALLEY OF THAILAND\*



\* Reproduced from *Economic Geography*, January 1933, IX, 8.

during this month and August–September (their seasonal peak). Then, on account of the preceding accumulation of rainfall, the river begins to flood; more commonly than not, as Chart 2 shows, it remains at the “desired” level for more than 50 days. In some years (1919, 1923, 1925) the rainfall in August–September may be exceptionally low, and the flood may not reach the desired level; under such circumstances of drought much of the rice acreage may be ruined.

In other years, of which 1917 seems the best example, the flood level may considerably exceed the level desired, and again the acreage destroyed may be large, presumably by drowning the plants. Exceptionally long duration of the flood level above the desired minimum, as in 1916, does not seem to be a major crop hazard unless accompanied by exceptional depth of water, though over-long duration might reasonably be expected to interfere with the harvest. Damage from drought appears to be a greater hazard in the Menam delta than damage from excessive water, since the water supply was excessive in only nine years out of ninety-nine, whereas river levels were distinctly poor in thirty of these years.<sup>33</sup>

Some parts of the great river deltas of Indo-China necessarily lie so low that the flood waters are too deep to permit rice culture and such land remains uncultivated.<sup>34</sup> So does much of the higher land out of reach of the flood waters and receiving too little rainfall to mature rice; but this land may be used to some extent for production of upland crops, and might be used for rice if adequate irrigation and better control over malaria were provided. On the whole, however, very little of the principal rice region receives too little water for at least one rice crop a year, and in Indo-China floods probably do more damage than drought.

#### LEVELS OF YIELD PER HECTARE

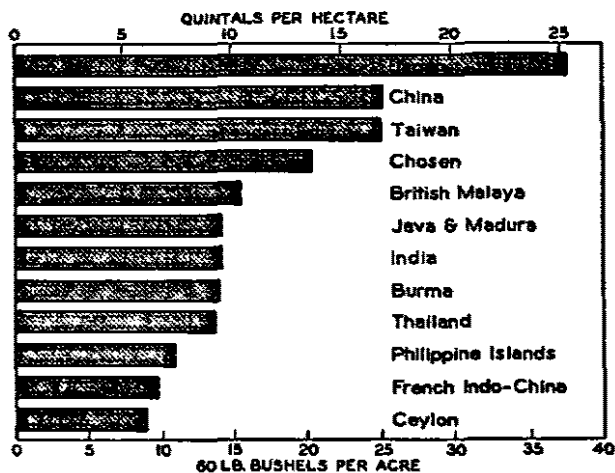
The outcome of the growers' efforts is indicated by the yields obtained per unit of land cultivated. Chart 3 gives average data for all 12 countries of Monsoon Asia including China. The contrasts are striking. Yields in Japan are much the highest, those in China and Taiwan are about two-thirds as high, and those of Chosen a little over half. In India, Burma, Thailand, and Java and Madura, yields average under 40 per cent of the Japanese. Yields in British Malaya are a

<sup>33</sup> Siam Ministry of Commerce and Communications, *Siam, Nature and Industry*, p. 190.

<sup>34</sup> However, in places, recourse may be had to the growing of so-called floating rice; see pp. 20-21 n.

CHART 3.—COMPARATIVE LEVELS OF RICE YIELDS IN COUNTRIES OF MONSOON ASIA, AVERAGE 1930-31 TO 1934-35\*

(In terms of cleaned rice)



\* Data from Appendix Table III; for China, from China Ministry of Economic Affairs, National Agricultural Research Bureau, *Crop Reports*.

little better, and those in Indo-China considerably lower, than in the neighboring countries. Yields are poor also in the Philippines, and lowest of all in Ceylon—less than a fourth of those in Japan.

Yields differ also from region to region within countries. In India, among the principal rice-producing provinces, the yield is nearly 80 per cent higher in Madras than in the United Provinces; in southern China the yield in Hunan province exceeds that in Kiangsu by nearly 50 per cent; and in Indo-China the yield in Tonkin exceeds that in Cambodia by about 45 per cent.

The influences responsible for regional differences in unit yields of any crop are always numerous, complex, and inter-related. At this point there is little occasion to press beyond the more obvious reasons for the larger contrasts in levels of rice yields indicated by the chart.<sup>35</sup> In general, it can be

<sup>35</sup> For further discussion of factors influencing yields, see chapter xi, pp. 229-65.

said that natural conditions favor higher yields in the Sino-Japanese part of the rice belt than in the southern part, for flood and drought in particular are greater hazards in the south. In addition, the paddy area of the northern region is more largely irrigated by artificial means and the use of fertilizers is more common, presumably with beneficial effects upon the level of yield despite a wider prevalence of double cropping with rice. Moreover, cultivators of the northern regions, especially in the Japanese Empire, use superior varieties and seemingly employ better methods of cultivation in such details as transplanting or weeding. It is not entirely clear why average yields should be lower in the Philippines, Indo-China, and Ceylon than in other countries of the southern part of the rice belt. The explanation seems to be a matter partly of less favorable natural conditions (Ceylon), and partly also of less intensive cultivation or absence of any crop rotation, poorer seed, greater damage from diseases and pests, generally poorer cultural methods, and possibly also of misleading statistics.

## CHAPTER IV

### MARKETING AND MILLING THE CROP

Because it is consumed in the general regions where it is grown, the problem of physical distribution is far smaller for rice than for a cereal like wheat, which is produced and consumed in important measure in widely separated parts of the world. Furthermore, the process of converting paddy into rice which may then be cooked and eaten is a very simple one compared with the process of milling wheat into flour with which some baked product is then made. These differences, and the comparative prevalence of subsistence economies in rice-producing areas, are chiefly responsible for the slower development of rice-marketing methods and rice-milling techniques in Oriental countries.

#### CONVERSION OF PADDY INTO RICE

According to stages of preparation for market or consumption, there are four principal classifications of rice:

1. *Paddy or rough rice*: Harvested paddy, including some stalk; threshed paddy, including dirt and chaff; or paddy threshed and cleaned by sifting and winnowing. Paddy always is rice with the hard outer hull intact.
2. *Brown, husked, hulled, shelled, or whole rice*: Paddy rice with the husk removed.
3. *Cleaned, white, or skinned rice*: Brown rice after "skinning" or "pearling."
4. *Polished rice*: Cleaned rice after polishing. Polished rice may be further treated by coating or dressing with glucose and talc.

Paddy or rough rice is not consumed as such, but the other three classes of rice may be cooked and eaten without further processing. Brown rice is the least and polished rice the most highly milled. A ton of paddy yields less than a ton of brown,



still less of cleaned, still less of polished rice. By volume, the ratio of paddy to cleaned rice is approximately 100 : 50. By weight, this relation varies between 100 : 50–80, but the most commonly accepted ratio for Oriental rice is 100 : 60–65. In dealing with rice statistics of various countries, it is especially important to know the form of paddy or rice to which the figures refer. In this study care has been taken to reduce all statistics to the common basis of "cleaned" rice.<sup>1</sup>

The kernel of brown rice consists in greater part of the endosperm, which is surrounded by tightly adherent layers of bran. The small embryo or germ lies at one end of the kernel. Most brown rice is straw-colored with a white endosperm, but some varieties have colored bran coats, and a few have a colored endosperm. In common rice the endosperm is usually vitreous; in glutinous rice it is chalky. Chalkiness may also occur in common rice, for reasons not too well understood.

After the hard outer hull enclosing the rice kernel has been removed, complete milling consists of scraping off the bran and the embryo, leaving the endosperm as smooth, unbroken, and nearly intact as possible. But the nature of the rice-milling process is such that milling may involve merely removal of hulls, or removal of hulls and partial removal of bran, or removal of hulls and complete removal of bran and embryo. Thus, the milling process may be carried on either in a single establishment that takes in paddy and delivers fully polished rice, or it may be accomplished in a series of steps involving different locations and usually smaller establishments. The first step may be removal of the hull on the farm where the

<sup>1</sup> This has often been difficult because of divergencies in terminology. In the production statistics of the Japanese Empire, for example, "unhusked" rice does not mean paddy, but *genmai* or "brown" rice. "Cleaned" rice is commonly referred to as "milled" rice in the United States and other Occidental countries, whereas "milled" rice means "brown" rice in other regions. "Unpolished" rice is a term often used in the trade to mean "uncoated," but should more properly be applied to brown rice since practically all cleaned rice is also polished, though not always coated. Furthermore, no system of reducing statistics to a common basis can yield exact results, because the gradations of the product from brown to polished are gradual rather than sharp.

rice is grown; the final one polishing and coating in some distant area where the rice is ultimately consumed.

### THE MILLING PROCESS<sup>2</sup>

The earliest and crudest form of rice milling seems to have been by hand pestle with mortar or hollowed log. Pounding with the pestle broke the hulls and removed some of the bran through the abrasive action of the hulls. Bran and chaff were then removed by fanning or winnowing. The "woodpecker" rice mill, still widely used in some parts of Asia, represents an improvement on the earlier process in technique but not in principle. A larger and heavier pestle is attached to a wooden pole 6-8 feet long, which is placed on a fulcrum. The mortar (perhaps enlarged) remains about as it was. By alternately stepping on and off the end of the pole, the native operator raises and lowers the pestle and is able to treat 10-12 bushels of paddy daily. The resulting product is brown rice, with varying amounts of the bran removed along with the hulls—more if intended for home use, less if destined for market and further milling.

In a modern rice mill that performs all of the milling processes, the paddy as it arrives from the threshing floor is first cleaned of accumulated dirt, foreign matter, and unfilled or

<sup>2</sup>In this and the sections on rice mills and their distribution, aspects of local marketing, and mill grades and products, most of the details have been obtained by drawing freely on the following sources: Burma, *Interim Report of the Committee Appointed to Enquire into the Rice and Paddy Trade* (1931); Burma Dept. Agr., *Rice* (Markets Section Survey 9, 1940); Copeland, *Rice*; J. W. Grant, *The Rice Crop in Burma: Its History, Cultivation, Marketing and Improvement* (Burma Agr. Dept., Agricultural Survey 17 of 1932, reprinted 1939); Grist, *An Outline of Malayan Agriculture*, and "Rice in Malaya in 1939," *Malayan Agricultural Journal*, April 1940, XXVIII, 164-70; Yves Henry, *Économie agricole de l'Indochine* (French Indo-China Inspection générale de l'agriculture, de l'élevage et des forêts, 1932); H. W. Jack, "Rice Mills in Malaya," *Malayan Agricultural Journal*, June 1931, XIX, 283-84; J. A. LeClerc, *Rice Trade in the Far East* (U.S. Dept. Comm., Bur. For. Dom. Commerce, Trade Promotion Series 46, 1927); L. Lord, "The Improvement of Rice Cultivation in Malaya, Indo-China and Java," *Tropical Agriculturist*, *The Agricultural Journal of Ceylon* (Ceylon Dept. Agr., Peradeniya, Ceylon), December 1929, LXXIII, 323-46; Philippines, *Report of the Rice Commission to the President of the Philippines* (1936); Siam Ministry of Commerce and Communications, *Siam, Nature and Industry*; Ellen A. Tsao, "Chinese Rice Merchants and Millers in French Indo-China," *Chinese Economic Journal* (China Ministry of Industry, Bur. For. Trade, Shanghai), December 1932, XI, 450-63.

small hulls. This is commonly done by passing it over a series of riddles (perforated in different sizes) subjected to air currents strong enough to remove the lighter materials. Or, in the most modern mills, the paddy is shifted successively through three types of equipment: the scalper, which removes sticks, stones, etc.; the clipper, which removes beards and stems; and the monitor, which eliminates blighted grains.

The second phase is shelling or hulling. Cleaned paddy is fed through hoppers which regulate its flow into the hulling machines. These machines consist of two disks of stone or cast iron, coated on their opposed surfaces with a special composition of emery and cement. One disk remains stationary while the other revolves, the cleaned paddy being fed through a narrow hole or passage in the stationary disk. The setting of the disks requires considerable skill, since different varieties and different lots of the same variety are sufficiently nonuniform to result in excessive breakage of kernels if the "set" is not good. As the movable disk revolves, the hull is cracked or split by the pressure exerted on the ends of the grain and the kernels drop out.

Whatever the miller's skill in setting his disks, some paddy below the average in size of grain comes through unhulled, and some hulled kernels above the average in size are broken. The hulls, dust, other light material, and fine heavy material are removed by winnowing machines, screens, or aspirators. The mixture of hulled grains and paddy, known as "cargo rice," is conveyed to a shaker, which is a large rectangular tray inclined at an angle, with zigzag divisions formed by metal plates. Shaking and gravity cause the remaining unhulled grains to separate by working to the top of the tray. The recovered paddy is then fed to auxiliary shelling disks with a closer set, and after hulling is returned to the main stream of brown or hulled rice.

Cargo rice, i.e., brown or hulled rice mixed with 5-20 per cent of paddy (before separation by the shaker), was formerly shipped to Europe in considerable volume from the

export areas of Asia, and further separation, milling, and polishing took place in European mills. With the development of modern mills in the export areas, however, most overseas shipments are now of cleaned rice. This change is in contrast to developments in world wheat trade, wherein overseas shipments of flour have tended to become a diminishing fraction of total wheat-and-flour shipments.

The brown rice that results from hulling is next skinned or pearled, to remove the bran layers. A skinning machine (sometimes misleadingly called a huller) consists of a grooved, tapering drum revolving within a concentric hollow cylinder. The drum is so spaced as to rub off the bran with as little breakage of the kernels as possible, the loosened bran being separated by devices similar to those used in earlier stages of milling to remove lighter materials. The grain in process is sent through the skinning machines several times, the setting being adjusted so as to remove a little more of the bran each time. In many mills a pearling cone is used instead of a skinning machine. This is essentially an inverted, truncated cone, covered with a mixture of emery and cement, which revolves inside a steel-wire screen encased in an iron casing with openings for the grain to enter and leave as the cone spins. Rice is fed in from the top, rubbed between the cone and the sieve, and released at the bottom. By raising or lowering the revolving cone, thus adjusting the distance between cone and screen, the amount of scouring can be regulated. To minimize breakage, rice is usually passed through a series of these pearling cones in order that the scouring action may be gradual and gentle rather than rapid and harsh.

The main product of skinning or pearling is of course cleaned or white rice, most of it whole but a varying proportion of it broken. A high percentage of brokens lowers the value of the milled product; hence millers prefer, and tend to pay premium prices for, varieties that withstand milling with a minimum amount of breakage. The higher grades of broken rice can be marketed for human consumption, but the

intermediate and lower grades are used only for industrial purposes and the preparation of feedstuffs. Other products obtained in processing are rice bran (the embryo and part of the outer layers of the kernel) and meal (fine particles of rice that escape through the steel screen in pearling), both of which are used mostly in feed for cattle, pigs, and poultry.

The final or semifinal process in rice milling is polishing, an operation similar in principle to pearling but less drastic. Cleaned rice is passed through a series of revolving rollers or drums (ordinarily covered with sheepskin) encased in fine wire mesh. The rollers remove the remainder of the innermost (aleurone) layer and any floury particles adhering to the grain, leaving the surface smooth. The byproduct, rice polish, is commonly mixed with rice bran or meal, and the mixture sold for feed.

Much rice is not processed beyond the polishing stage, but some is coated to improve its appearance, by slight oiling and glazing with powdered talc, glucose, or other materials. Sometimes coloring, usually a blue pigment, is added after milling and before polishing to counteract the milky whiteness of the rice. When rice is exported abroad or transported a considerable distance a certain amount of deterioration in appearance is inevitable, and final processing is commonly postponed until just prior to sale in the ultimate consuming center. But rice is coated also to improve its keeping quality when in storage, as coating offers some protection against attack by insects.

Rice used in Monsoon Asia ranges from the crudely milled brown to the fully polished and coated white product, but the proportion of the different classifications consumed cannot be stated with any precision. Presumably the form most commonly eaten by the growers themselves is nearer to brown than to polished, while that consumed in urban centers tends to be the most highly milled. Since rural consumers far outnumber urban consumers, consumption of the slightly milled forms of rice would seem to exceed that of the highly polished

forms. In the heavy net-importing areas such as British Malaya and Ceylon, however, the predominance of milled forms in imports suggests that relatively more cleaned or polished rice is consumed. The general tendency in Monsoon Asia is for consumption of highly milled rice to increase at the expense of brown rice, as communications gradually improve and milling establishments are built at remote places.\* In the Occident, the rice consumed as food is almost entirely polished rice.

*Parboiled rice.*—Not all of the rice milled in southeastern Asia is of types previously described. The production of parboiled or boiled rice has been expanding with increasing demand, and many of the new mills built even before 1930 were equipped for parboiling.\*\* Parboiling involves steeping paddy in water for 1–3 days at a temperature of 100° F. It is then transferred to cylindrical containers and subjected to steam under low pressure for a period of a few minutes up to 15–20 minutes or until the hulls open slightly. Paddy thus treated is then removed from the cylinders, spread out on drying floors in the sun for a day or two, and finally milled in the ordinary way. The preliminary operations harden the grain, make the hull easier to remove, and reduce the percentage of brokens. Rice so treated is brownish in color, and usually has less of the bran removed than has polished rice. Its flavor is also distinctive; although much appreciated by some consumer groups, it is disliked by others.

Parboiled rice is chemically superior to white rice as a

\* Regardless of nutrition needs (see chapter vi), even consumers of ordinary qualities of rice tend to prefer higher milling. Note the complaint in Y. H. Chutima, *Siam: Height and Weight of Population with Comments on Diets* (Siam Ministry of Economic Affairs, Dept. Science, Siam Science Bull. 3, April 1939), pp. 54–55: "Nowadays there are hundreds of rice mills all over the country, even in remote corners having no decent highways or railways, the rice milling machinery being transported in pieces by bullock carts or ponies . . . They [the rural population] now refuse to eat hand-milled rice in spite of medical advice."

\*\* During recent years the parboiling of rice has received some attention in the United States as well as in other Western rice-growing countries. Preliminary experiments in parboiling varieties that are grown on a commercial scale in the United States are reported by J. W. Jones and J. W. Taylor in *Effect of Parboiling Rough Rice on Milling Quality* (U.S. Dept. Agr., Circ. 340, February 1935).

food, presumably because it retains valuable vitamins which are lost from polished rice. Vitamin B<sub>1</sub>, being water-soluble, diffuses into the endosperm in the process of soaking. Moreover, parboiled rice may be preserved longer than polished rice and does not sour readily after cooking. This characteristic partially accounts for its demand on plantations in Malaya, Ceylon, and elsewhere; plantation coolies, working long hours without interruption, find that using parboiled rice previously prepared is more practicable than cooking rice fresh for the midday meal.

Parboiled rice is sufficiently important to account for 12-15 per cent of the total exports of rice and rice products from Burma. In British Malaya, it accounts for four-fifths of the output of local mills in Province Wellesley and three-fourths in Penang. Because of the vitamin-bearing qualities of parboiled rice, officials tend to encourage its use as a safeguard against beriberi.<sup>4</sup>

#### MILLS AND THEIR DISTRIBUTION<sup>5</sup>

Statistics concerning size, location, and output of rice mills in Monsoon Asia are neither abundant nor notably illuminating. This is not surprising in view of the facts that economic statistics in general are full of gaps, and that a "rice mill" may range from a farmer's hand-operated "woodpecker," which merely removes hulls, to a large power-driven establishment employing many laborers and equipped with machines that hull, skin, polish, and coat the rice.

Available information is too fragmentary to warrant a survey of the rice-milling industry country by country. Yet a few contrasts and tendencies deserve mention. It is clear, for example, that rice milling in Monsoon Asia is characteris-

<sup>4</sup> Recently a process has been developed, known as "rice conversion," which purports to permit the milling of rice to make it white in appearance while preserving its vitamin content. See S. O. Landry, "White 'Brown' Rice," *Rice Journal* (New Orleans), February 1940, XLIII, 2-3. This process seems to be an improvement over parboiling that may have considerable significance to the rice industry, especially if it overcomes the main consumer objections to parboiled rice.

<sup>5</sup> See footnote, p. 65.

tically a small-scale industry in a degree not found in Occidental countries. It is clear also that within Monsoon Asia large rice mills loom more important in the industry throughout the Indo-Chinese Peninsula and the Netherlands Indies than in India, China, the Japanese Empire, or the Philippine Islands. Thus a tabulation of the world's so-called large commercial rice mills about a decade ago<sup>6</sup> listed a total of 596, with almost two-thirds of them outside of Monsoon Asia in countries producing only about 5 per cent of the world's rice. Within Monsoon Asia, there were only 41 in Japan, India, and China, but 165 in Java, Thailand, Malaya, and Burma. Within the latter group, the largest commercial rice mills are generally found in the important export-shipping centers in and around Rangoon, Bangkok, and Saigon.

If the many types of rice mills are classified as primitive mills limited to hulling, semiprimitive mills that carry the process further, small modern mills fully equipped, and large modern mills, it seems clear that not only the large but also the small modern ones are more prevalent in the newer rice regions than in India, Japan, and China.

The smaller modern mills have tended to displace both the mills of primitive type and the large modern mills, at least in the rice-exporting countries. The smaller mills possess certain economic advantages over the larger ones. They are situated close to the source of raw materials. Their overhead costs are low since their organization is simple and they can be, and generally are, owned and managed by local native residents. Their closer contact with growers permits more uniformity and better quality in raw materials, and frequently better prices to cultivators for relatively small parcels of paddy of certain grades. On the other hand, these small mills often lack working capital, are unable to finance growers who need help, and are at a serious disadvantage in borrowing money. The large mills at the ports, owned princi-

<sup>6</sup> "The World's Rice Milling Industry," *Rice Journal* (Lake Charles, La.), July 1931, XXXIV, 15.



pally by foreign firms,<sup>7</sup> have all the advantages that ample financial resources provide.

Paralleling the competition between types of mills, milling capacity in the export areas has for some years greatly exceeded the requirements of the trade, and new and more modern mills of medium capacity are constantly being erected. Many mills can operate for only a few months in the year. Decentralization, as well as gradual elimination of the primitive mills, occurs as transport becomes easier. Burma illustrates the development. In 1912 there were only 245 mills employing more than ten persons, in 1929 there were 677, and in the interval the number of mills in Rangoon declined drastically, and presumably also the amount of hand milling throughout the country. The newer interior mills have capacities ranging from 10 to 75 tons of paddy per day, in contrast with the larger older mills that are able to handle from 200 to 500 tons. Similar tendencies seem in evidence in Thailand, French Indo-China, the Netherlands Indies, and Malaya.

As the newer small but modernized interior mills spread, changes follow in marketing procedures and in type of rice consumed. Producers tend to abandon home milling, to market more paddy, to purchase and consume more rice cleaned or polished. In Japan, however, growers continue to remove the hulls from their paddy on their farms or locally, and to send brown rice to market.

#### ASPECTS OF LOCAL MARKETING<sup>8</sup>

Throughout the rice-growing regions of Monsoon Asia, farmers usually retain the poorest part of their harvested

<sup>7</sup> These are often Chinese companies, but in Burma a European combination in Rangoon, known as the Bullenger Pool, is the chief factor in the European trade. This buying and selling combination, which consists primarily of the four largest rice millers in Burma, was formed in 1921 and has been credited with milling one-third of Burma's exportable surplus. During the depression of the 1930's, it was able to increase its share of the business but also came under scrutiny for unfairly exercising monopoly powers. A government investigation found "no case . . . for governmental interference," though there were several vigorous dissenting opinions to the Committee's findings. See *Burma, Interim Report . . . .*, pp. 17-36, esp. p. 27.

<sup>8</sup> See footnote, p. 65.

paddy crop, and mill it by simple methods for home consumption. The rest, and commonly the best part of the crop, is sold. The relative proportions of paddy milled and consumed on the farm and paddy marketed no doubt vary from country to country, region to region, and even from farm to farm, but cannot be ascertained with any precision. The practice of selling brown rice rather than paddy from the farm, as is customary in the relatively advanced economy of Japan, is apparently exceptional.

That portion of the farmer's paddy harvest which constitutes his cash crop is purchased by traveling agents of large mills located at distant milling centers; by local millers; by dealers, merchants, or brokers who merely buy paddy from farmers and sell to millers;<sup>9</sup> or by retail shopkeepers who in turn sell to millers. The greater bulk of the purchasing is perhaps by local millers except in the export areas, where purchases by agents of large mills and by brokers are more important. In Burma and Indo-China the mill agents are the more common type of buyer, whereas in Thailand the independent dealers working on their own capital are more common. Throughout the Indo-Chinese Peninsula and adjacent islands (the Philippines and the Netherlands Indies), the rice trade is predominantly in the hands of Chinese merchants.

Japanese rice farmers sell their brown rice, usually packed in straw bags weighing one picul (133.3 lbs.) each, to local or country brokers who in turn sell to wholesalers and city brokers. Middlemen in the urban areas supply the retail merchants. City brokers frequently finance country brokers, or local representatives in the growing areas, and these in turn often finance the growers by advancing money on the crop to be grown. Imports of both colonial and foreign rice are mostly handled by the large wholesalers in the cities who

<sup>9</sup> In some places these dealers buy paddy during the post-harvest season of heavy farm marketings and store it, selling it later to millers during the season of slack movement to market.

also deal in domestic rice. They usually own mills and warehouses, and finance themselves.

In marketing the Asiatic rice crop, the functions of assembling the paddy and transporting it to the points of milling are performed largely by the buyers, though sometimes by the producers themselves. Transport from farm to first point of assembly is mostly by very primitive means—cart and bullock, or even on the backs of men. Trucks are not unknown but are rarely used. Longer hauls of larger quantities are generally by river and canal, since water transport is the cheapest and often the only available way. Haulage by rail, however, plays a relatively more important role in Japan and India.

The necessary bases for really efficient marketing of the Asiatic rice crop are at present largely lacking. For example, agreement on quantities involved in a transaction is basic for any bargaining on price. But, despite numerous attempts at establishing standards, many of them official, no generally accepted basis for trading exists throughout most of the rice-growing world, even in so elementary a matter as the weights and measures of a country. There are few grade standards for rice comparable with the government standards for wheat found in most Western wheat-growing countries. The buyer of paddy, for example, must learn to know as best he can from experience the quality of rice grown from one region to another and by many individual cultivators.

In the general absence of marketing standards, trading necessarily becomes a highly individualistic matter. Trading risks are therefore large. Since there must always be compensation for risk taking when the risks are an incidental and unwelcome feature of business, the spread between producers' and retailers' prices tends to be wide. Given the inherently unfavorable situation of producers, it is commonly believed that the high costs of distribution bear most heavily upon producers who are least favorably situated for shifting the burden to others.

By temperament and organization the rice growers of Monsoon Asia are poorly equipped for marketing their crops. They stand generally in an unfavorable position to exert bargaining power. Their facilities for storage are crude; and, more often than not, their obligations are such that they must dispose of their crops soon after harvest. In general, their financial condition is chronically bad. Wherever the paddy buyer is the agent or employee of the miller, it is common practice to advance money to growers and to take liens on their crops. Or the landlord may advance the necessary money and supplies. A considerable amount of the rice land under cultivation belongs to large property owners who sublet it to small cultivators for a variable proportion of the crop. These tenants are usually without sufficient operating capital and must therefore borrow. The original advance, plus a high (sometimes usurious) rate of interest, must be paid off out of the crop raised.<sup>10</sup>

In one way or another, the greater portion of the rice crop of Monsoon Asia is mortgaged even before it is planted. Growers are obliged to dispose of the bulk of their output soon after it is harvested in order to meet their financial obligations. Such debts are frequently owed to the Chinese merchants or millers' agents, who until fairly recently were practically the only operators of the milling business of Thailand, Indo-China, Malaya, the Philippines, and the Netherlands Indies.

Institutions for financing the planting, growing, harvesting, and marketing of the rice crop are still generally inadequate. Co-operative marketing and credit associations, usually under government supervision, have been organized in most countries, but they have made relatively slow progress and benefits have not been widely extended. Other assistance has been provided in several countries through the establishment of schemes for stabilizing prices, but state aid is con-

<sup>10</sup> Similar conditions tend to prevail in parts of the world where hoo crops like cotton and tobacco are grown, but are less common in the production of wheat and other grains.

fronted with all the complex problems involved in the transition from a self-sufficing to a commercial economy. The transition is particularly difficult when the marketing of paddy is on such a basis that the grower frequently does not know the price he receives for his crop, the rate of interest he pays on borrowings, the charges that are made for the supplies advanced him by his creditor, whether his rice is of premium or discount grade, or perhaps even the weight of the paddy he is selling.

Opportunities for exploitation of producers by middlemen seem to be numerous, especially in the more remote districts where competitive bidding for the paddy surplus may not be well developed. When the economic situation of producers grows sufficiently bad, as in the depression of the 1930's, middlemen seem naturally to become the target of political attacks. This is particularly true where millers and traders are of foreign nationality.

Middlemen occupy a stronger position than growers; yet paddy buyers and millers themselves are engaged in a highly speculative occupation. Their risks are substantial and unavoidable. This is probably less true of the many small millers who buy paddy and sell cleaned rice locally than of the dealers and of the large millers; but even the local millers face the problem of changing differentials between paddy prices and cleaned-rice prices.

In most of the important Western agricultural countries, commodity exchanges, located in large central markets, serve both to facilitate trading in grains and to distribute the risks to those willing and best able to assume them. Rice, however, is a commodity not thus served by exchanges. In the Orient, organized and formal exchanges generally have little part in the process of distribution.<sup>11</sup> Because of the absence of uni-

<sup>11</sup> In addition to the system of rice exchanges in Japan (see below), the Mogul Street rice market at Rangoon in Burma carries on considerable speculation, the upper limit for futures being about four months; settlement rates for each month are fixed by the Rice Merchants' Association. Elsewhere in southeastern Asia, the Chinese merchants usually arrange informal meeting places where transactions are effected. In Manila, for example,

form trading practices, a lack of communication and of other facilities necessary for the functioning of a more advanced type of trading, futures markets are exceptional. Rice millers, therefore, ordinarily cannot shift speculative risks as millers of wheat commonly do in several countries, by means of hedging operations.

In Japan, the rice industry is somewhat better organized than elsewhere in the Far East. The Japanese government has long interested itself in marketing and financing the farmer's crop as well as in matters relating to the production of rice. Rice exchanges, similar to the grain exchanges of the United States and Canada, were organized in all of the important cities of Japan, and speculation in rice was widespread and on a large scale. But all commodity exchanges are now monopolized by the government, and speculation has been practically prohibited. These refinements, until fairly recently, meant little to the grower, and benefited chiefly those involved in marketing the rice crop. The small-scale rice cultivator typical of Japan continued to be at a disadvantage in bargaining with rice dealers and brokers, since, lacking the capital necessary for storage, he was usually under pressure to dispose of his crop promptly. In later years, however, the Japanese grower has fared somewhat better as a result of changes in the method of stabilizing prices by government control authorities (see chapter viii, pp. 174-77).

Whether or not the high cost of distribution bears more heavily upon producers than upon consumers, it seems probable that it could be appreciably lowered by improving the machinery of marketing so as to reduce the risks of trading. This approach toward increasing prices to producers and reducing prices to consumers seems more basic than the politi-

the Tutuban Rice Exchange admits only Chinese to membership, and transactions are kept secret. The organization of an open rice exchange in Manila has frequently been proposed. Although Filipinos and others have been extended the privileges of trading within the premises of the Tutuban Rice Exchange, they hesitate to use them in the absence of definite trading rules permitting operators to know the details of each transaction. Recent government action, however, has tended to reduce the importance of the Chinese merchants in the marketing of rice, especially in the Philippine Islands, Thailand, and British Malaya.

cally more acceptable one of attacking middlemen as recipients of excessive profits. Profits of middlemen are only one factor in the spread between the price the consumer pays for rice and the price the grower receives for his paddy in the field. All services that link grower with ultimate consumer are included in this wide margin, and most of them involve risk taking.

Growing recognition of the need for improved marketing has been one reason leading to government intervention in the affairs of the rice industry in Monsoon Asia (see chapter viii). The grower's position, however, has not as yet been materially improved. Although under fire, rice dealers and brokers continue to hold the better position except where government has monopolized the trade or entered into the competition.

#### MILL GRADES AND PRODUCTS<sup>12</sup>

The primitive circumstances in which most paddy cultivators continue to live are hardly conducive to informed selling or to an early appreciation of the importance of standards in marketing. After paddy has reached the large assembling places or milling centers and is in the hands of merchants, however, greater adherence to specified trading standards appears. The distributive phase of the marketing process, from mill to consumer, is relatively more efficient than the assembling of paddy from growers. The commodity traded is more carefully classified; but even here current practices leave much to be desired, and there appear to be great opportunities for improvement. With so many different types of mills operating with varying degrees of skill on a great number of varieties of paddy, an infinite number of grades of milled rice are produced. Many of these will be closely similar at one time, but perhaps widely dissimilar at another. Except for Japan, grading seems to have been developed further in the export countries than elsewhere.

<sup>12</sup> See footnote, p. 65.

In Burma, there are many grades of whole-grain rice, fewer of broken rice, "boiled" rice, and byproducts such as bran or meal. Only relatively few of the many grades, however, are sufficiently important from a volume standpoint to be recognized by the trade. Among the highest commercial grades are Europe No. 1, No. 2, and No. 3, the first containing not more than 15 and the last not more than 30 per cent of broken grains. These qualities, as the names suggest, are in demand, along with smaller amounts of still higher grades, chiefly in Europe and other Occidental markets. A grade called Straits Quality (not more than 35-40 per cent brokens) is demanded chiefly by the Straits Settlements and Cuba. Small Mills Specials, one of the most commonly milled grades and the quality mainly dealt in for futures trading, is in large demand in Oriental markets, especially India and Java. This grade may contain up to 42 per cent of brokens, but the kernels must be of sizes not smaller than No. 2, and the proportion of red grains allowed is small.<sup>18</sup> The lowest Burmese grade (aside from those predominantly of broken kernels) is Big Mills Specials, chiefly a product of the large European mills at the ports. Like Small Mills Specials, it may contain 42 per cent of brokens, but the size of kernel may vary, more red rice is permitted, and it is produced from somewhat poorer paddy.

The grading system of the leading rice-exporting country is a fairly advanced one. Among the net-importing countries only the Japanese system is comparable with that of Burma. In Japan, cleaned rice is classified in five commercial grades, with a further classification by area of production. Grades are not identical on the different rice exchanges, but quality standards are generally high. Published price quotations

<sup>18</sup> There are usually about 3 sizes of kernel involved in the various grades of cleaned rice (the largest size being No. 1) and 4-6 sizes in the grading of broken rice. "Red" rice is a variety which matures early and shatters badly in the field, thus tending to crowd out other preferred types unless steps are taken to prevent it. Red rice is usually regarded as a weed in cultivation, and its presence in paddy lowers the value of the grower's crops. However, in parts of Monsoon Asia, certain varieties of red rice are highly regarded and carry no discount.



usually refer to the highest, middle, and lowest grades in the standard classifications.

In Thailand, cleaned rice is subdivided by the trade into five principal grades, as follows, with the maximum allowable percentages of broken kernels in parentheses: Super (5 per cent), Special (15 per cent), Ordinary No. 1 (25 per cent), Ordinary No. 2 (50 per cent), and Ordinary No. 3 (75 per cent). The first two Ordinary grades are the qualities consumed locally.<sup>14</sup> The Ordinary types (often referred to as Garden Rice) constitute the bulk of paddy deliveries to mills. Rice with more than 75 per cent of brokens is classified into four grades, and the byproducts into white meal and cargo meal. Standards are promulgated by agreement among the rice merchants, who deposit samples with the Bangkok International Chamber of Commerce; the allowable percentages of brokens within grades are somewhat flexible from year to year. All five of the principal grades are exported, but identity is not always preserved. At Singapore and Hong Kong, for example, rice from Thailand is often mixed with cheaper rices from Rangoon and Saigon and sold as rice from Thailand.

Grades are perhaps as numerous but are less standardized in Indo-China. Most of the export business is done in a few grades of broken rice and three principal qualities of white rice: No. 1 European (25 per cent brokens), No. 2 Japan (40 per cent brokens), No. 3 Java (50 per cent brokens). Grade designations were once indicative of the sources of demand. No. 1 European is superior to the Burmese Straits Quality, but inferior to the Burmese Europe No. 2 or to Ordinary No. 1 of Thailand. A large proportion of the rice exported from Indo-China loses identity because of the practice of Chinese merchants of shipping rice to Hong Kong, where it is commonly mixed with rice from Burma or Thailand. Efforts to standardize grades and to market through large export associations have met with little success.

<sup>14</sup> In northern Thailand, however, there is appreciable consumption of glutinous rice.

The Philippine Islands are probably typical of the status of grading in rice-importing countries. A program for standardizing grades, weights, and measures was instituted after the establishment of the National Rice and Corn Corporation in 1936. Previously, grading practices were not far advanced. There were in fact no strictly established grades, but the Chinese merchants had evolved rough classifications understood by the trade and by consumers, under the terms Superior, First Grade, Second Grade, and Third Grade. The Second Grade accounted for about three-fifths of all sales.

Similarly in the Netherlands Indies, cleaned rice is not graded precisely, but is branded or sold under the "mark" of a specific mill. The output of certain mills tends to become recognized as of a given quality, and transactions in the rice of other mills are frequently based upon agreement that the rice involved is of a quality "equal to" that of some established miller's mark.

#### STORAGE PRACTICES

Rice storage is not the spectacular function in the marketing process that the storage of wheat has become with the development of concentrated domestic and overseas markets. In the rice world there is no counterpart to the extensive systems of grain elevators such as are found in the wheat-growing districts of North America and at shipping and overseas receiving ports elsewhere. Nor is there any system of handling rice comparable to the bulk handling of wheat, where whole ships are loaded by gravity from grain elevators and unloaded by suction at receiving ports into other elevators for temporary storage preceding distribution. Rice is mainly transported in sacks and loaded and unloaded by man power.

Both wheat and rice harvests in any particular country are of fairly short duration, but wheat marketings tend to be more protracted than rice marketings. In a wheat-exporting country supplies are assembled after the harvest and stored at relatively few points. Shipments are made to overseas mar-

kets as orders are received, and this movement, though seasonal, is generally spread over the year. The distribution of rice in the Far East tends to be more definitely concentrated in the months immediately following the harvest.

Rice stocks are commonly held in many hands: by growers for the needs of the family, and by numerous intermediaries and distributors scattered throughout the market. Such holdings are necessarily small, and are intended generally to meet requirements only until the next harvest. Except where governments have intervened in order to influence a rice-price situation, rice stocks do not ordinarily become concentrated, nor are they carried over for more than one season. Hence annual production of rice tends to correspond closely with annual utilization. Storage of supplies in excess of current consumption requirements is far from comparable with the accumulations of surpluses that have occurred in the wheat world during recent years.

In fact, Japan is about the only Oriental country which has followed a regular practice of storing considerable quantities of rice. Under ideal conditions of storing, ventilating, and fumigating, and with more favorable climatic conditions than prevail in countries to the south, the Japanese government authorities supervise the maintenance of fairly large rice stocks.<sup>28</sup> The rice thus stored is brown rice. Normally the carryover at the close of a season is equivalent to one month's or six weeks' consumption, but at the end of the bumper crop year 1933-34 it was approximately twice as great. The Japanese authorities consider that a surplus of something less than one month's consumption is sufficient for price control, although as a matter of practice the stock necessary is apparently about twice as great.

Outside of Japan, natural conditions are less favorable for storage. All grains keep well under certain conditions, among which dryness is one of the most important. But it is impossible in most of Monsoon Asia to provide, except at high cost,

<sup>28</sup> See pp. 172-73.

the conditions desirable for completely satisfactory grain storage. When no special precautions are taken or when they are impracticable, rice is best stored as paddy, i.e., in the husk, because in this form the husks provide protective packing material which also permits ventilation.<sup>16</sup> Stored under the conditions generally prevailing in Monsoon Asia, paddy generates less heat than rice, retains its flavor better, and is less subject to pests.<sup>17</sup>

If most rice growers and consumers did not live under rather primitive conditions with limited materials at their command, airtight storage of rice rather than of paddy would be preferable. This would have the great advantage of occupying less room and reducing the weight involved—considerations important in transportation as well as warehousing. Perhaps even more important to Asiatics with generally poor diets is the effect of storage on the nutritional qualities of the grain.

Storage of rice is a crucial factor in adequate nutrition with respect to vitamin B<sub>1</sub> amongst rice-eating peoples. It has been established that rice can be stored without its husk with as good if not better results than those obtained with rice stored with its husk on. To succeed with the former method, however, there must be control of the moisture content of the grain, and it must be kept in airtight containers, or, better still, in an atmosphere of carbon dioxide.<sup>18</sup>

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<sup>16</sup> Under ordinary conditions of local storage, rice is scarcely edible after 6-8 months, and usually husked rice can be kept for only 3 or 4 months unless special precautions are taken. However, native Malayan planters are said to store sufficient for their personal needs for one or two years (Grist, *An Outline of Malayan Agriculture*, p. 131).

<sup>17</sup> The most common insect pests of stored grain, rice and wheat alike, are the weevil and the caterpillar of the grain moth. The rice weevil, which multiplies most rapidly under damp conditions, is particularly dangerous to husked rice and limits the amount that can be stored during the rainy season. Similarly, with wheat "the main cause determining damage by insects is the presence of moisture above an allowable maximum" (S. J. Duly, *Grain*, London, 1928, p. 143). The caterpillar is of much less importance to paddy and rice than the weevil. Rats also do much damage to stored grains, but storage places can be constructed that are largely ratproof, and there are ways, such as trapping and poisoning, of dealing with such pests. In Burma, however, rats appear to do the most damage, perhaps consuming "altogether nearly 500,000 tons of paddy a year" (Furnivall, *An Introduction to the Political Economy of Burma*, p. 33).

<sup>18</sup> B. S. Platt, "Rice and Its Importance for Human Nutrition," in Great Britain Economic Advisory Council, Committee on Nutrition in the Colonial Empire, *Nutrition in the Colonial Empire*, First Report, Pt. I (Cmd. 6050, 1939), pp. 196-99. These conclusions are based largely upon many years of work by two Japanese investigators, M. Kondô and T.

Although airtight storage possesses marked advantages over granary storage of rice and farm storage of paddy, under present conditions this method does not seem practicable, or perhaps necessary, and is very little used. The nutritional problem remains, however, particularly in areas where absence of dietary diversification concentrates all attention upon preserving the nutritional values inherent in the foods consumed.

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Okamura, who studied the physical properties, germinating power, chemical content, and vitamin B content of rice and demonstrated that in so far as vitamin B is concerned "storage in straw bags in a granary is possible without serious loss up to about two years; but under such storage it has been found . . . . that after one year in a straw bag the taste of rice was undesirable, after two years taste, smell and colour were very bad and the rice could scarcely be eaten . . . ." (Platt, p. 192).

## CHAPTER V

### EXPORTS AND THE IMPORT MARKETS

Five countries of Monsoon Asia—Burma, French Indo-China, Thailand, Chosen, and Taiwan—produce an exportable surplus of rice which enters into international trade. Between two-thirds and three-fourths of the gross exports of these five net-exporting countries goes to net-importing countries of Monsoon Asia—India, China, Japan, British Malaya, Ceylon, the Netherlands Indies, and the Philippine Islands. The other fourth to a third of all exports are destined for markets outside the Far East, chiefly Europe<sup>1</sup> (see Map 6, p. 87).

Aggregate production of the five net-exporting countries constitutes only a small fraction of total rice supplies, but these countries are responsible for almost 95 per cent of all exports of Monsoon Asia. The countries of greatest population—China, India, and Japan—are normally the chief importers as well as the leading producers of rice. Of all the net importers, only India and British Malaya customarily export or re-export quantities of rice fairly substantial in relation to their gross imports; there is a re-export trade at Singapore, and India ships some of her own rice from certain surplus regions to Ceylon, East Africa, and elsewhere, while importing from Burma into rice-deficit areas.

Among the five net-exporting countries of Monsoon Asia, Burma is most important by a wide margin, shipping close to 3 million tons annually during recent years (Table 2, p. 28). Indo-China, Thailand, and Chosen have each shipped from 1 to 1.3 million tons; Taiwan only .6 million. The chief net-

<sup>1</sup> The only important "long" trade in the overseas movement is between the Indo-Chinese Peninsula and Europe. Because of the geographical relationship between growing regions and consuming markets, rice in international trade creates a smaller demand upon ocean tonnage and world trading facilities generally than does a crop like maize or perhaps even barley which is exported in considerably smaller volume than is rice. See V. D. Wickizer, "Shipping and Freight Rates in the Overseas Grain Trade," *WHEAT STUDIES*, October 1938, XV, 76-77.

importing country in recent years has been Japan, which has absorbed, on the average, about 1.7 million tons. India follows with net imports of 1.3 million tons; Ceylon and Malaya with .5 to .6 million; the Netherlands Indies and China<sup>2</sup> with .2 to .3 million; and the Philippines with only about 50 thousand tons. The non-Asiatic markets, taken as a group, somewhat outrank the Japanese; of these, France, Germany, the United Kingdom, Holland, and Cuba led in importance before the current World War.

The present chapter is concerned chiefly with the changing flow of exports from the net-exporting countries of Monsoon Asia—the shifting relative importance of each as indicated by annual statistics of exports since 1920; and the developments in the principal importing countries that have caused some to increase and others to reduce their takings of Asiatic rice, with repercussions differing among the several exporters.

#### GENERAL CHARACTERISTICS OF THE TRADE

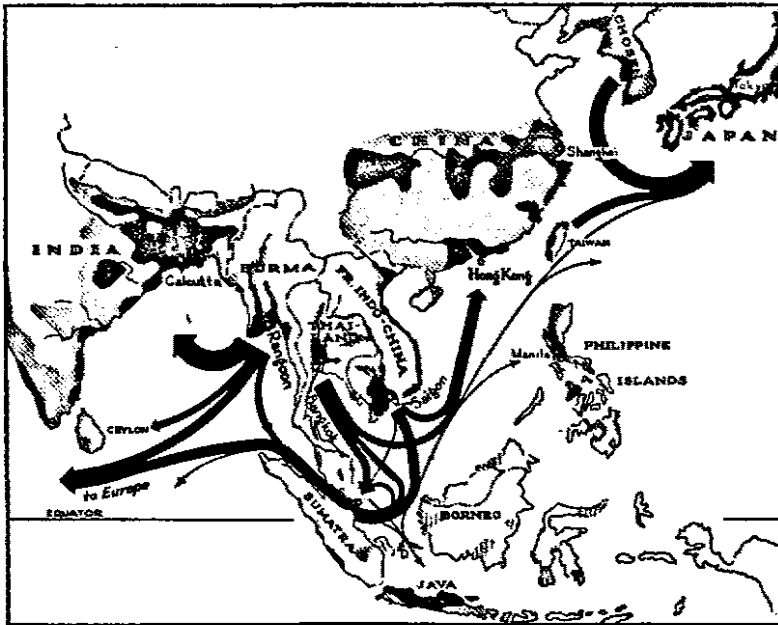
The rice that moves from the Asiatic exporting countries is mostly cleaned rice (including brokens) if it originates in the Indo-Chinese Peninsula, but is predominantly brown rice if it originates in Chosen or Taiwan and moves (as practically all of these exports do) to Japan. Very little paddy is now shipped from any exporting country. Despite its superior keeping qualities, it is bulky in relation to value of final product and therefore expensive to transport. All of the statistics subsequently considered are expressed in terms of cleaned rice. There is a small trade in rice flour and rice bran or meal; the flour, since it is used for human consumption, is included in the export statistics of cleaned rice, but exports of meal or bran, amounting to around half a million tons annually, are excluded.

Practically all of the shipments from the Indo-Chinese Peninsula move out of the three ports of Rangoon in Burma,

<sup>2</sup> The bulk of the rice imported into China is first imported into the British possession, Hong Kong, and thence re-exported.

Bangkok in Thailand, and Saigon in Indo-China. This suggests the localization of rice surpluses at least in Lower rather than Upper Burma, and in Cochin China and Cambodia rather than Tonkin or Annam in Indo-China. Map 6 pro-

MAP 6.—DIRECTION AND RELATIVE VOLUME OF RICE TRADE IN MONSOON ASIA DURING THE 1930's



vides a general indication of the direction and relative volume of rice trade during the 1930's. If this map had been constructed on the basis of trade in the early part of the decade, the movement to Europe would have appeared relatively lighter and that to China heavier. If constructed on the basis of the later 1930's, the flow of exports to China would appear smaller and that to Europe larger. Since the war the movement to Europe has been drastically reduced, but shipments from the Indo-Chinese export area to Japan have been greatly enlarged.



Rangoon and Saigon are ports accessible to large ocean-going vessels, but at Bangkok only relatively small vessels can cross the river bar. The larger ones must anchor at Koh Sichang Island 19 miles away and receive their cargoes from lighters loaded at Bangkok. Saigon and Bangkok are (or were) ports of call for a large number of small vessels (tramp steamers) of many nationalities. Competition for cargo was keen. Rangoon, however, lies further off the main trade routes and is normally served mostly by regularly established cargo lines belonging to one or more of the several shipping conferences. Thus ocean freight rates from Rangoon were less clearly determined by unlimited competition, though presumably they were kept closely enough in line with more competitive rates from Bangkok and Saigon to permit Burma to compete in the world rice markets.

Export duties on rice—an important source of revenue—have been levied at all three ports. At Rangoon: “One important advantage is the freedom from export duty on gunny bags exported outside the Indian Empire, and the lower freights on gunnies enjoyed by Rangoon against both Saigon and Bangkok.”<sup>8</sup> Practically all exported rice is shipped in bags rather than in bulk.

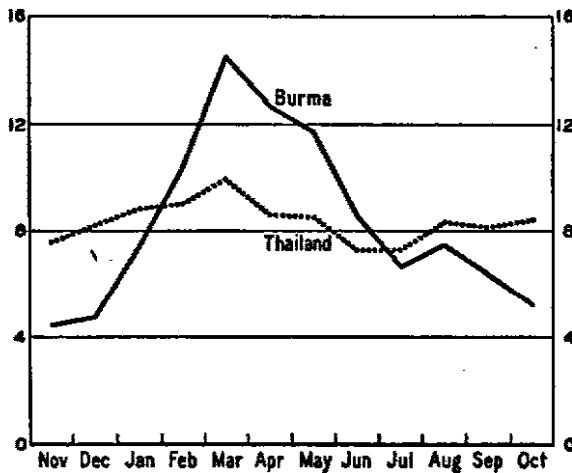
The flow of rice exports, at least from the Indo-Chinese Peninsula, is commonly described as highly seasonal, with heavy concentration in the dry winter months just after harvest (January–April) and light shipments after the onset of the monsoon rains in May–June. This impression is broadly confirmed for Burma by the data in Chart 4. Both Burmese and Thai monthly exports tend to reach their peaks in March, rising progressively from November. The four months of heaviest concentration appear to be February–May in Burma, January–April in Thailand. The three months of smallest exports are October–December in Burma, but June, July, and November in Thailand.

A heavy post-harvest concentration would be expected in

<sup>8</sup> E. H. Solomon, “Minute of Dissent,” in Burma, *Interim Report* . . . . , p. 69.

view of the general lack of storage space and the deterioration in quality of rice carried into the humid season. Consequently the relatively flat seasonal curve for Thailand seems somewhat surprising, assuming adequacy of data. Possibly the explanation lies in the smaller proportion of total exports shipped outside the Asiatic area, as compared with Burma.

CHART 4.—SEASONALITY IN THE RICE EXPORTS OF BURMA AND THAILAND\*  
(Per cent of average annual exports)



\* Data, from official sources listed for each country in "Statistical Notes," cover the period April 1937 to March 1940 for Burma, and April 1927 to March 1938 for Thailand.

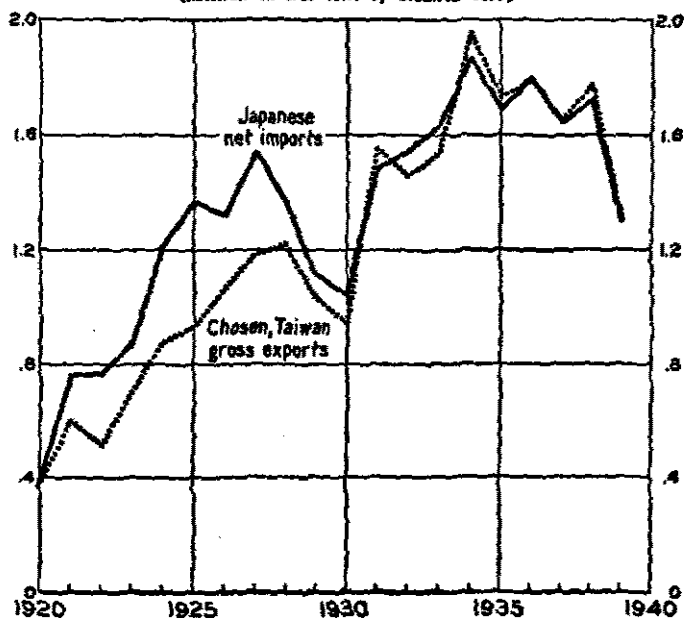
Because of damage to the grain when shipped under closed-hatch conditions during the monsoon, non-Asiatic buyers in particular tend to concentrate their purchases, and shipments are made during the first five months of the year before the rains set in. Thus there is reason to believe that the shipments outside Monsoon Asia are more highly seasonal than shipments within the region. The close proximity of the Malayan market for Thai rice, the timing of harvests in both Thailand and Malaya, the type of transportation facilities available which probably means numerous shipments of small lots from Bangkok—all are factors which possibly help explain the dif-

ferences in the seasonal movement of shipments from the exporting countries.

#### TRADE OF THE JAPANESE EMPIRE

Two of the five net-exporting countries of Monsoon Asia, Chosen and Taiwan, ship their rice almost exclusively to Japan Proper. The broad features of this trade since 1920 appear in Chart 5.<sup>4</sup> The solid line represents the *net rice im-*

CHART 5.—RICE TRADE OF THE JAPANESE EMPIRE, ANNUALLY, 1920-39\*  
(Million metric tons of cleaned rice)



\* Data from Appendix Table V.

<sup>4</sup> ports of Japan by calendar years; the dotted line, the *gross rice exports* of Chosen and Taiwan.

<sup>4</sup> During 1940, Japanese imports from foreign sources increased enormously owing to the 1939 crop failure in Chosen. Although data are no longer available, trade reports suggest that the increased takings of Japan from the export countries of the Indo-Chinese Peninsula temporarily have offset the shrinkage of the European market since the outbreak of the war in Europe. Early in 1941 Japanese imports from foreign sources were estimated to be at the rate of about 1.5 million tons annually.

Japan has provided an expanding market for rice over the past two decades. Only in the earliest years of the world depression, 1929 and 1930, were net imports substantially curtailed, and restrictive import policy may have contributed to this. Domestic output, though increasing regularly (partly under governmental stimulus since 1921), has failed to keep pace with total domestic requirements. Expansion of Japanese needs has provided a widening outlet for the two colonies, where production has been encouraged by governmental devices in furtherance of a general policy of Empire self-sufficiency in rice.

The success of this policy, implemented partly by governmental control of imports through tariff adjustments or prohibition, is suggested by the chart. Prior to about 1928, the exports of Chosen and Taiwan were insufficient to fill Japanese import requirements, and substantial imports from non-Empire sources were necessary. The principal sources of such foreign imports were naturally Thailand, Indo-China, and Burma, though some rice was brought from the United States.<sup>5</sup>

Since about 1928, the exports of the two colonies have fully or nearly sufficed to fill Japanese import requirements, and the Japanese market has usually been closed to other rice exporters. When, however, there are exceptionally short rice crops in the colonies (as in Chosen in 1939), or when the Japanese crop itself is subnormal without an offsetting large crop in the colonies, the Japanese market may temporarily regain some of its lost importance for the exporters of the Indo-Chinese Peninsula. Not as yet has a situation clearly emerged in which the crops of the colonies so far exceed Japanese import requirements that substantial export outlets must be sought in other markets; nor does it seem that such developments are probable in view of the Japanese policy for the

<sup>5</sup> By virtue of special trade arrangements, Thailand and California have enjoyed certain advantages in the Japanese market not possessed by Burma and Indo-China. The committee appointed to inquire into the rice and paddy trade of Burma recommended in 1931 that "the Government of India should take all possible steps to secure to Burma also the right to import" rice into Japan (Burma, *Interim Report* . . . . p. 9).

development of food resources of the Empire, and the fall in rice consumption in the colonies accompanying the expansion of exports to the mother country (see pp. 209-16).

#### SHRINKAGE OF OTHER ASIATIC MARKETS

In the course of the past decade and a half, the exporting countries of the Indo-Chinese Peninsula have lost not only practically all of the Japanese market, but substantial portions of the markets of China, the Netherlands Indies, and the Philippine Islands. The facts may be summarized in terms of the change in average annual net rice imports of these countries between 1924-28 and 1936-38, as in the following tabulation, in thousand tons:

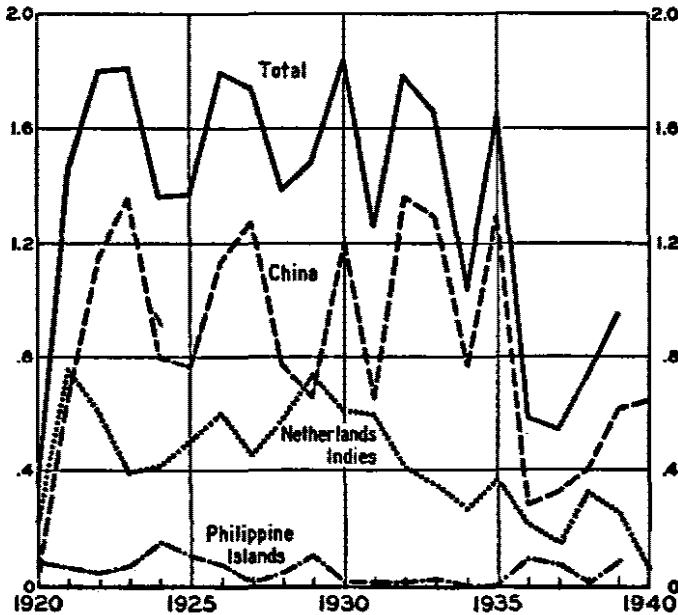
Country	1924-28	1936-38	Change
China .....	944	338	-606
Netherlands Indies .....	509	225	-284
Philippines .....	75	58	-17
<b>Total .....</b>	<b>1,528</b>	<b>621</b>	<b>-907</b>

If the lost Japanese market is counted as having once absorbed about 300 thousand tons of rice annually from the exporters of the Indo-Chinese Peninsula, it is clear that outlets in Monsoon Asia could formerly be counted upon to take about 1,200 thousand tons more rice than has been taken in recent years. This quantity is the equivalent of more than a fifth of the average gross exports of Burma, Thailand, and Indo-China in 1924-28.

Shrinkage of the Japanese outlet began in 1929 and was almost complete by 1934. Chart 6 indicates that shrinkage of other specified Asiatic outlets for exports was more or less gradual until 1935. The early decline in Philippine imports of rice was of relatively little significance, since these were never large. Second in time was the narrowing of the Netherlands Indies market, which began about 1930 and has continued without significant interruption for a decade. Within the Netherlands Indies, the shrinkage was about equally im-

portant in Java and Madura on the one hand and the Outer Provinces on the other. Java and Madura, but not the Outer Provinces, had closely approached a net-export status by 1939.<sup>e</sup>

CHART 6.—NET RICE IMPORTS OF SHRINKING ASIATIC MARKETS, 1920-40\*  
(Million metric tons of cleaned rice)



\* Data from Appendix Table IV.

Yet even with these shrinkages of outlets (Japan, the Philippine Islands, and the Netherlands Indies), the losses up to 1935 were not strikingly large. When in 1936 and thereafter the important Chinese outlet narrowed sharply, the position of the net-exporting countries was much more seriously affected. Chinese net imports (not including those of the

<sup>e</sup> Average annual net rice imports of Java and Madura in the years 1929 and 1930 were 290 thousand tons, as against a net export of 10 thousand in 1937 and a net import of 14 thousand in 1938. Net imports of the Outer Provinces were 383 thousand tons in 1929-30, and about 230 thousand in 1937-38.

British possession of Hong Kong<sup>7</sup>) had ranged erratically between 650 and 1,350 thousand tons yearly from 1921 to 1935, but fell to the range of about 300-400 thousand in 1936-39.

These export outlets narrowed in large part in reflection of national policies directed partly toward defense of balances of international payments and domestic currencies, partly toward attainment of self-sufficiency in food. In some instances curtailment of rice imports involved reduction of rice consumption per capita, but in others it did not (see below, chapter x).

The shrinkage of Asiatic markets bore unequally upon the three exporting countries of the Indo-Chinese Peninsula. Burma was perhaps least affected, because her trade had always been in large degree directed elsewhere. Burmese exports normally moved mainly to India, Ceylon, Malaya, and non-Asiatic countries mostly in Europe.<sup>8</sup> The Indian and Ceylonese markets, indeed, have long been practically monopolized by Burma, owing to her geographical location with resulting advantages in ocean freight rates, and perhaps also her membership in the British Empire. Partly because these two outlets were effectively beyond their reach, Thailand and Indo-China bore the major impact of the shrinkage of the Japanese, Philippine, Netherlands Indies, and Chinese markets. As demand from these sources dried up, their only alternative outlets became British Malaya and the non-Asiatic markets, principally in Europe.

In the competition for the remaining buyers, Thailand

<sup>7</sup> The great bulk of the rice imported into China came first to Hong Kong, where it was regraded, frequently mixed, and sometimes milled again before re-exportation. Indo-China was long the major source of these imports, with Thailand second and in recent years gaining in relative importance. In 1936, 1938, and 1939 Chinese imports came more from Thailand than from Indo-China. The quantity of rice retained for consumption in Hong Kong has ranged from 120 to 180 thousand tons annually, about a tenth to a fifth of Chinese imports before their slump in 1936.

<sup>8</sup> The percentage distribution of rice exports from Burma in 1926-30 was as follows: India, 34; Ceylon, 11; British Malaya, 8; non-Asia, 30; China and Hong Kong, 6; the Netherlands Indies, 6; the Japanese Empire, 5. In 1937 and 1938, about 6 per cent of the Burmese exports went to the last three markets.

appears to have had the advantage in British Malaya and probably some non-European countries such as Cuba. Freight differentials to Singapore apparently favor Saigon over Bangkok,<sup>9</sup> but preference and purchasing power in the Malayan market seem to favor the higher-quality Thai rice. In Europe, however, Indo-China enjoyed the relative advantage of membership in an empire, and when her important Chinese outlet narrowed, France and some of the French colonies greatly enlarged their takings of Indo-Chinese rice.<sup>10</sup> Thus the percentage distribution of exports by destinations from Indo-China, on the average in 1926-30 and in 1936-37, compared as follows:

Destination	1926-30	1936-37
Asia .....	69	26
France and colonies.....	17	63
Other non-Asia .....	14	11
Total .....	100	100

The proportion absorbed by China and Hong Kong fell from 43 to 18 per cent, and that absorbed by other Asiatic markets from 26 to 8 per cent. Indo-China thus lost much of her most important outlet when the Chinese market contracted (not even maintaining her former dominance there against Thailand), could not compete effectively with Burma in the expanding Indian and Ceylonese markets, or with Burma and Thailand in the contracting market of the Netherlands Indies or the expanding market of Malaya, found little room for exports in non-Asiatic regions other than France and her colonies, and could only turn to the mother country. The uncertain quality of Indo-Chinese rice, made worse by marketing practices not conducive to the establishment of recognized grades, pre-

<sup>9</sup> Burma, *Interim Report* . . . . , p. 8.

<sup>10</sup> French grain growers, like the Japanese rice producers (p. 172), opposed the importation of colonial rice. Marketing of their own surpluses as feed and industrial raw material was made more difficult by the competition of enlarged imports of Indo-Chinese rice. Yielding to pressure from domestic grain growers, the French government placed an import duty on the colony's rice and abolished its exemption from colonial export duty; then later attempted to compensate by subsidizing rice exports to other countries.

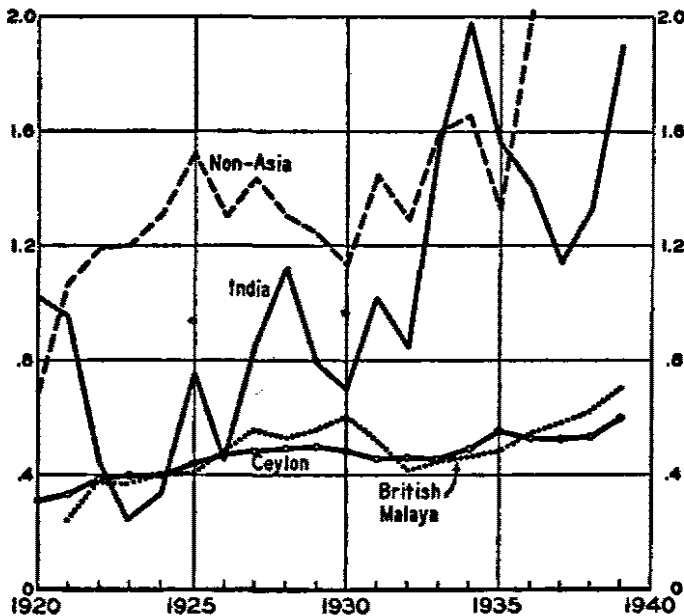


sumably contributed to this country's relative difficulties in marketing her export surplus. Thailand, while probably better able to compete in the Asiatic markets remaining accessible to her, had no mother country to which she might turn.

#### EXPANDING OUTLETS FOR EXPORTS

The expanding outlets for exports—judged solely by increase of takings without reference to the character of their demand—are India, Malaya, Ceylon, and non-Asiatic coun-

CHART 7.—EXPANDING OUTLETS FOR ASIATIC RICE EXPORTS, 1920-39\*  
(Million metric tons of cleaned rice)



\* Data from Appendix Tables IV and VI.

tries mainly in Europe. Evidence on the increase of rice takings by these markets is summarized in Chart 7. A further summary of approximate changes between 1924-28 and

1936-38 is given in the following tabulation, in thousand tons:

Market	1924-28	1936-38	Change
India .....	702	1,290	+ 588
Ceylon .....	456	533	+ 77
British Malaya .....	476	586	+ 110
Non-Asia .....	1,372	1,700*	+ 328
<b>Total .....</b>	<b>3,006</b>	<b>4,109</b>	<b>+1,103</b>

\* For years 1936-37, with 1937 partly estimated.

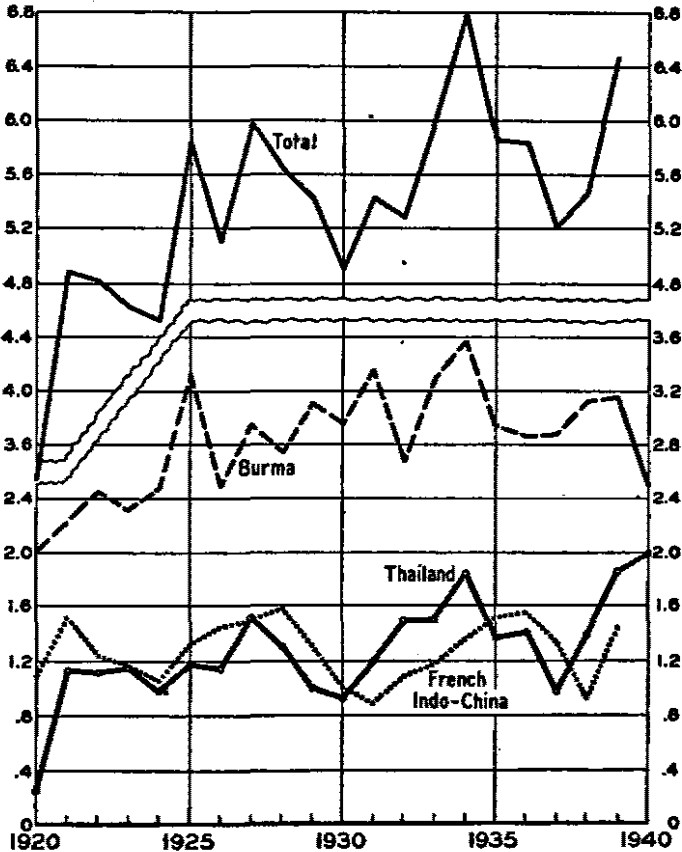
On the basis of this tabulation, it seems safe to infer that the four expanding outlets increased their takings from the three major rice exporters by approximately the same gross quantity as the contracting outlets reduced their takings. The inference tends to be confirmed by the fact that, as between the two specified periods 1924-28 and 1936-38, the total gross exports of rice from the three major exporters increased very little, only from 5,409 to 5,495 thousand tons.

If, however, one considers the whole period from 1920 to 1939, the exports of the three major exporters show a more evident tendency toward enlargement. This is indicated by Chart 8 (p. 98). Burmese exports increased rather consistently until the middle 1930's, probably in part because of proximity to and natural semimonopoly of the expanding markets of India and Ceylon. Exports from Thailand increased only moderately until the depression years when they began a more rapid expansion. Those from Indo-China have barely changed their general level in the past two decades.

The expansion of outlets in India, Ceylon, and Malaya may reasonably be regarded mainly as an expression of normal economic tendencies. Such tendencies rest upon increase of population and specialization of domestic industries which involve some degree of declining relative importance of domestic rice production. It remains possible, however, that Indian imports would have been smaller in the 1930's if her rice crops had been more nearly normal (see below, p. 220).

CHART 8.—RICE EXPORTS OF BURMA, THAILAND, FRENCH INDO-CHINA,  
AND TOTAL, 1920-40\*

(Million metric tons of cleaned rice)



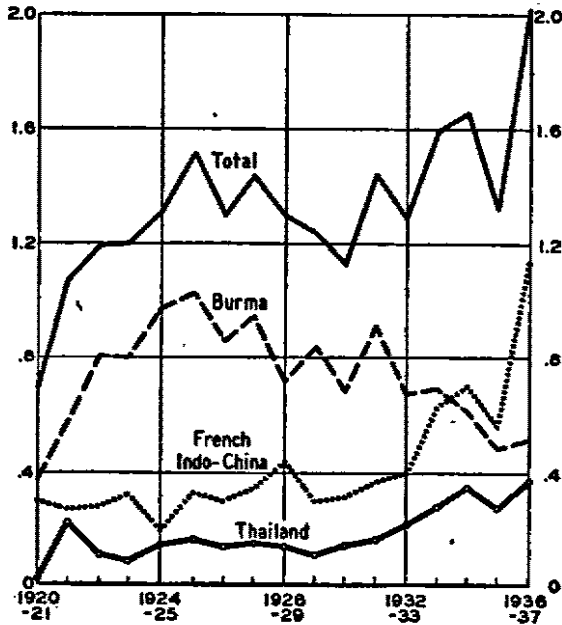
\* Data from Appendix Table IV.

Expansion of the non-Asiatic market, however, was of a different character. As Chart 9 suggests, no expansion would have occurred in the absence of heavy shipments from Indo-China to France and other French colonies after 1932. The rice imported into France under artificial stimulus was used largely for industrial purposes and feed rather than as food.

From 1924, Burmese exports to non-Asia declined fairly steadily, and exports from Thailand increased only moderately.

CHART 9.—RICE EXPORTS OF THE THREE MAJOR EXPORTERS TO NON-ASIATIC MARKETS, 1920-21 TO 1936-37\*

(Million metric tons of cleaned rice)



\* Data from Appendix Table VI.

The total volume of rice exports (gross) from all the five net exporters of Monsoon Asia has been held at a remarkably high (and generally rising) level in the past two decades. The contrast with world net exports of wheat is striking,<sup>11</sup>

<sup>11</sup> "Compared to the [trade] developments of other agricultural products . . . , rice exhibits some very marked peculiarities. Volumes, after the slump of 1929 and 1930, recovered, but very heavy reductions in export prices had to be accepted." L. B. Bacon and F. C. Schloemer, *World Trade in Agricultural Products: Its Growth; Its Crisis; and the New Trade Policies* (International Institute of Agriculture, Roma, 1940), p. 101.

as indicated by the following index numbers for successive 3-year periods.

	Period	Rice	Wheat*
	1921-23 .....	100	100
	1924-26 .....	113	103
	1927-29 .....	124	107
	1930-32 .....	121	101
	1933-35 .....	147	72
	1936-38 .....	135	81

\* August-July crop years, 1921-22 and following.

Rice exports increased more rapidly than wheat exports in the predepression period up to about 1930, declined relatively less on impact of world depression, and in the final 3-year period stood moderately above their immediate predepression level while wheat exports fell by nearly a fourth. With rice, enough import markets expanded to offset those that contracted; with wheat, policies of self-sufficiency were much more general and more restrictive upon world trade.

## CHAPTER VI

### RICE IN ASIATIC DIETS

In a somewhat arbitrary statistical sense, the enormous rice crop of Monsoon Asia, as it leaves the threshing floor in the form of paddy,<sup>1</sup> divides into two streams—paddy for seed, and paddy for milling. The proportion used for seed is notably small. In Japan, where unit yields are high, seed use is apparently only a little over 1 per cent of the crop;<sup>2</sup> in China, with lower yields, it may run to 4 per cent;<sup>3</sup> and it may be moderately higher in countries where yields per hectare are still lower, especially where broadcast sowing is practiced. The custom of sowing in seedbeds and transplanting to fields (p. 51) keeps seed use of paddy at a low level. Apparently little paddy as such is used for animal feed, though this is by no means clear.

The paddy not reserved for seed may, again somewhat arbitrarily, be divided into hulls and brown rice. The hulls are used for various purposes, but little can be said about those left on the farm as the result of home milling. They are not suitable for use as stock feed or as a soil improver, but they have some use as fuel and as an adulterant for animal feed. Hulls from commercial milling are used for fuel in the mills themselves or wasted; they are beginning to be used<sup>4</sup> as a source of cellulose in making rayon, linoleum, and various packing and insulating materials, and as material

<sup>1</sup> The straw of rice, a residue of the harvesting and threshing processes, is used in various ways. For Chinese farms, Buck has estimated that 46 per cent of the rice straw goes for feed or fodder, 32 per cent for fuel, and 11 per cent for industrial uses. Straw is commonly used for thatching peasants' roofs, as a packing material, and to make mats, sacks, ropes, and baskets. See *Land Utilization in China*, pp. 238-39.

<sup>2</sup> Tsuneta Yano and Kyoichi Shirasaki, *Nippon: A Charted Survey of Japan, 1936*, trans. by Z. T. Iwadô (Tokyo, 1936), p. 92.

<sup>3</sup> Buck, *op. cit.*, p. 236. The proportion of paddy used for seed, measured in terms of polished rice, is given as 7 per cent in China (China Ministry of Economic Affairs, National Agricultural Research Bureau, "A Study of the Consumption of Staple Food Products in Rural China," *Crop Reports*, Oct. 15, 1938, VI, 114).

<sup>4</sup> C. Stampa, "Utilization of Rice Husks," *International Review of Agriculture* (International Institute of Agriculture, Rome), February 1941, XXXII, 62-66 T.

from which furfural and wood alcohol can be distilled. Of the total weight of the crop of paddy excluding seed, the hulls constitute a large fraction, perhaps in the neighborhood of 20–25 per cent in Monsoon Asia as a whole, though ratios of hull weight to paddy weight seem to vary substantially with type and variety. If the whole paddy crop of Monsoon Asia weighs 140 or 150 million tons, there must be somewhere between 30 and 40 million tons of hulls to be disposed of annually.

Brown rice is unquestionably used mainly as human food, after more or less milling to bring it to or toward the cleaned and polished forms. The residues of milling are broken rice, meal, and bran including the embryo. It is impossible to estimate closely what proportion of the total weight of the brown rice goes respectively into human consumption as brown rice, cleaned rice, polished rice, broken brown rice, broken clean or polished rice, or rice meal or flour; or what proportion, in the form either of whole brown rice, broken brown rice, broken white rice, meal, or bran goes for nonfood uses. The nonfood uses are mainly for cattle feed; brewing, distilling, and vinegar manufacture if one wishes to call these nonfood uses; and starch making.<sup>8</sup> It seems reasonably safe to assume, however, that nonfood uses of brown rice (mainly the milling residues of brown rice) cannot exceed 10 per cent of all the brown rice potentially available from the paddy crop (excluding seed) in Monsoon Asia as a whole. This follows because fully polished rice kernels weigh only about 10 per cent less than the brown kernels, and because much of the rice milled in the Orient is not brought to the fully polished state.

Perhaps the proportion of brown rice used for nonfood purposes except seed is a little larger in Japan than in most places, for here 5 per cent of the whole crop goes for brewing

<sup>8</sup> Rice starch is preferred to other starches for many industrial purposes because its particles are very fine, making the starch smoother and improving its adhesive power. See S. P. Aiyer, *The Preparation of Starch and Dextrin from Broken Rice* (Burma Dept. Agr., Bull. 33, 1937).

*sake* and other liquors,<sup>6</sup> and use of rice starch for adhesives and sizing of textiles might reasonably be expected to be higher in Japan than in other countries. Cheaper rices are usually so employed for most industrial purposes—foreign rather than domestic rice being used when available. In certain other areas where rice is practically the only cereal crop and there are animals to be fed and other needs for starchy raw materials available locally, the nonfood uses of brown rice may also be exceptionally large. Some of the southern provinces of China are of this type; in Kwangsi as the most extreme example, it is estimated that 10 per cent of the polished rice goes for feed, and 12 per cent for uses other than food and seed.<sup>7</sup>

Attention is focused here, however, upon the food use of rice. Even in the regions where rice may be highly polished before consumption and where there may be strikingly heavy use of polished-rice equivalent for feed or industry, it is difficult to imagine that less than 80 per cent of the brown-rice supply<sup>8</sup> is used for human food. In regions—probably more numerous and populous—where rice is eaten only partially milled, the use of brown rice for human food may run as high as 95 per cent of the brown-rice supply, or even somewhat higher. Brown rice in Monsoon Asia, and in the world as a whole, is certainly a food grain to an extent not true even of wheat in the world as a whole, and is probably a food grain to an extent not true even of wheat in Monsoon Asia.

In the discussion that follows, data on per capita rice consumption, so far as they are not our own, sometimes refer simply to “rice” and sometimes to “polished rice”; our own

<sup>6</sup> According to data published by the Japanese Department of Finance (*Financial and Economic Annual of Japan, 1937*, p. 113, and *ibid.*, 1938, p. 125), the production of *sake* has tended to decline, while the production of beer has tended to increase. In the fiscal year 1927-28, 9.8 million hectoliters of *sake* were made in Japan and 1.4 million hectoliters of beer; by 1937-38 the production of *sake* had declined to 8.4 million hectoliters and the output of beer increased to 2.3 million hectoliters. From a nutrition standpoint, this development should be favorable in that the substitution of barley and hops, from which beer is made, for rice used in the manufacture of *sake* gives greater diversification in the diet.

<sup>7</sup> China, *Crop Reports*, Oct. 15, 1938, VI, 118.

<sup>8</sup> Here is meant the paddy crop, minus seed, minus exports or plus imports of rice as paddy, statistically converted into brown rice.



calculations refer to cleaned rice but do not imply that cleaned rice is what is actually consumed. Nor is it possible always to be certain whether per capita data refer to rice (not paddy) used for all purposes, or for all purposes except seed, or only for household consumption by humans. In view of the inevitable ambiguities in the data, we have sought to emphasize only contrasts of a magnitude that must reflect real rather than purely statistical differences in the position of rice in national or regional diets.

#### COMPOSITION OF DIETS

An outstanding general feature of Asiatic national diets, especially as compared with those of advanced Occidental nations, is their extremely heavy weighting with the group of foods comprising the cereals and the starchy roots and tubers. Bennett has estimated that these foodstuffs provide 80–90 per cent of all food calories in each of the eleven countries of Monsoon Asia except Japan, where the proportion may be 70–80 per cent. Corresponding figures for the United States, Canada, Australia, New Zealand, the United Kingdom, Switzerland, and Sweden were only 30–40 per cent.<sup>9</sup>

Heavy dependence upon calories derived from cereals and potatoes seems explicable mainly in terms of per capita real income, or productivity of labor. "Cereal-potato" calories are cheap calories in terms either of money or of labor, and tend to be consumed heavily where poverty prevails. Real incomes are low in Monsoon Asia.<sup>10</sup> In estimating average real income per capita of the occupied population in most countries of the world, Clark,<sup>11</sup> for example, places those areas where Bennett found low ratios of cereal-potato calories to total calories at or near the head of his list, and shows their incomes to range from 600 to 1,400 "international units." The coun-

<sup>9</sup> Bennett, "International Contrasts in Food Consumption," map on p. 366.

<sup>10</sup> In family budgets of laboring classes in the Orient, four-fifths or more of the family income is commonly required to cover outlay for food composed mainly of the cheapest types. In the Occident, the proportion of the income spent for food is commonly less than half, and more expensive types of food are within reach.

<sup>11</sup> Colin Clark, *The Conditions of Economic Progress* (London, 1940), p. 54.

tries wherein Bennett found high ratios of cereal-potato calories, on the other hand, had low per capita real incomes according to Clark. Thus Japan and perhaps the Philippines fell low in his list, in the range 300–400 international units; and China, India, the Netherlands Indies, and the “rest of Asia” fell at the lowest level, below 200 international units. The higher level of real income in Japan as compared with other Asiatic countries presumably explains why cereal-potato calories are somewhat less important there. But the difference is not great, and one may reasonably assume that practically all regions of Monsoon Asia, if divided say into blocks containing 10–20 million people each, derive close to 80 per cent of their food calories from cereals and starchy roots and tubers.

Wherever cereal-potato calories contribute around 80 per cent of all food calories, little room is left in national diets for the other groups of foodstuffs—animal products (meat, lard, dairy products, fish, poultry and poultry products), sugars, vegetable oils, fruits, nuts, pulses (typically, dried beans and peas and their products), or vegetables other than pulses and starchy roots. Just as national diets in Monsoon Asia are heavily weighted with calories from the cereals and the starchy roots and tubers, so they are lightly weighted with all other foodstuffs as a group.

With respect to this group of non-cereal-potato foodstuffs, however, the contrasts of Monsoon Asia with advanced Occidental nations vary from component to component. Especially striking is the contrast in consumption of animal products: these supply 30–40 per cent of total food calories in advanced Occidental countries, but only 1–10 per cent in Monsoon Asia (the Punjab region of India being apparently exceptional).<sup>22</sup> The contrast prevails with respect to the several types of animal products except fish, which is more important than meat particularly near the ocean, and in much

<sup>22</sup> H. Lindstedt, “Food Consumption Habits in the Far East,” *International Review of Agriculture*, September 1938, XXIX, 403–04 E.

of Monsoon Asia is also a more important source of food calories than in the Occident. Despite the relative importance of fish, all animal products taken together are so little consumed that protein of animal origin is extremely scanty in Asiatic as compared with Occidental diets. The protein in Oriental diets is derived chiefly from the cereals; but it is drawn also from the pulses, which in general contribute a higher proportion of the food calories in the Orient than in most Occidental countries. Low consumption of animal products also implies low consumption of animal fats; and, despite indigenous cultivation of coconuts and other oilseeds, consumption of vegetable fats in the Orient is not sufficiently large to raise the level of total fat consumption per capita at all close to the levels in advanced Occidental nations.

Sugar consumption is also small, though not to such a striking extent in comparison with Occidental countries as the consumption of animal products, animal proteins, or fats of all kinds. Less marked, but still present, is the lower level of consumption of fruits, nuts, and vegetables except the pulses and the starchy roots and tubers.

Although the cereals and the starchy roots and tubers as a group (and therefore the carbohydrates) contribute far larger proportions of total food calories in Monsoon Asia than in advanced Occidental countries, this is apparently not generally true of the starchy roots and tubers themselves. In Monsoon Asia, these are mostly cassava, taro, sweet potatoes, and yams, and only to a small degree the white potatoes so prominent in some national diets especially in central and northwestern Europe.

Apparently the roots and tubers vary a good deal in dietary importance from place to place in Monsoon Asia. They seem to be far more important in Java as a whole than in other countries, and more important in eastern than in western Java. They are of considerably less significance in India than in Japan (where they may contribute 8-10 per cent of total calories), or (probably) in Japan than in Taiwan. In

China, it is estimated that per capita consumption of this group of foodstuffs falls to 20–30 pounds annually in the provinces of Shensi, Szechwan, and Kweichow, but rises to 160–220 pounds in Kwangtung, Fukien, and Suiyuan;<sup>13</sup> the higher figure, however, would probably not yield more than 6–10 per cent of the annual calorie intake. Except in Java, or locally in some other countries especially in isolated places,<sup>14</sup> it thus seems probable that the calorie contribution of starchy roots and tubers is smaller, both absolutely and relatively, throughout Monsoon Asia than in many Occidental countries.

The relative prominence of cereals and starchy roots and tubers in Oriental as compared with Occidental diets is due therefore to prominence of the cereals as sources of food calories. As Lindstedt observed, the cereals in the Orient truly “deserve the name ‘the staff of life’, forming 70–80 per cent. of the total amount of calories consumed, *i.e.*, a percentage about twice that in Western diets in which as a rule only one third or even less is supplied by cereals and cereal products.”<sup>15</sup>

Table 4 (p. 108) summarizes evidence on the proportions of total calories derived from the cereals in the several regions of Monsoon Asia, distinguishing between ratios uncovered by “sample surveys” of food consumption necessarily limited to small populations, and “global estimates” based broadly upon analysis of national or regional data pertaining to food production, exports, and imports. In general,

<sup>13</sup> China, *Crop Reports*, Oct. 15, 1938, VI, 115.

<sup>14</sup> Richard Archbold, writing of a valley of 60,000 people never before seen by white men in New Guinea, pictures “fencing and ditching and beautiful cultivation” and describes sweet potatoes as the main crop, with “taro, spinach, cucumbers, and means also . . . grown” and “bananas and tobacco . . . in the compounds.” Since no cereal crop is mentioned, sweet potatoes and taro must loom large in the diet. See “Unknown New Guinea,” *National Geographic Magazine* (Washington, D.C.), March 1941, LXXIX, 315–44, esp. pp. 329, 333.

<sup>15</sup> Lindstedt, *op. cit.*, p. 406 E. The statement is not applicable, however, to European countries other than the Scandinavian, Germany, Holland, Switzerland, Austria, and the British Isles, or to non-European countries other than the United States and the British dominions. Elsewhere, so-called Western countries have diets consisting more than a third of cereal calories.

TABLE 4.—PROPORTION OF TOTAL FOOD CALORIES DERIVED FROM CEREALS IN COUNTRIES OR REGIONS OF MONSOON ASIA\*

Country or Region	Occupation	Ratio	Author-ity	Country or Region	Occupation	Ratio	Author-ity
Japan .....	.....	71	"	French Indo-China .....	.....	..	..
China .....	Farmers	83	"	Annam .....	.....	90	†
Northern part .....	Farmers	82	"	Burma .....	.....	..	..
Southern part .....	Farmers	84	"	Rangoon .....	Laborers	78	°
† .....	Farmers	78	°	Java .....	} Farmers Peasants Laborers	65	"
South China .....	Day laborers	82	"	Grisee .....		75	°
North China .....	Middle class	83	°	Koetwinangoen .....		68	°
Shanghai .....	Laborers	77	°	.....		68	°
Peiping .....	Middle class	85	"	India .....	.....	..	..
Nanking .....	Middle class	76	"	Punjab .....	Farmers	78	"
Philippines .....	.....	..	..	British Provinces .....	.....	80	"
Ilocos .....	Farmers	88	"	Madras Presidency .....	.....	78	]
Calabanga .....	Laborers	79	"				

\* Global estimates except where occupation is specified; otherwise sample surveys. Data are lacking for Chosen, Taiwan, Thailand, British Malaya, and Ceylon.

† E. C. Grey, *The Food of Japan* (League of Nations, Health Organisation, C.H. 681, Geneva, May 1928), p. 27.

‡ J. L. Buck, *Land Utilization in China: Statistics* (Nanking, 1937), p. 78.

° Primary sources of data reported by H. Lindstedt, "Food Consumption Habits in the Far East," *International Review of Agriculture* (International Institute of Agriculture, Rome), September 1938, XXI, 406 E, and "Food Consumption Habits in China," *ibid.*, August 1939, XXX, 373 E.

° H. C. Lava, *Levels of Living in the Ilocos Region, Philippines* (unpublished Ph.D. thesis, Stanford University, Calif., 1939), pp. 46, 52.

° F. O. Santos, "Studies on the Plane of Nutrition of Families of Laborers in Calabanga, Camarines Sur," *Philippine Agriculturist* (Univ. Philippines), February 1939, XXVII, 755-64.

† Pierre Gourou, *L'Utilisation du sol en Indochine française* (Centre d'études de politique étrangère, Travaux des groupes d'études, Publication XIV, Paris, 1939), p. 192.

° A. M. P. A. Scheffema, *The Food Consumption of the Native Inhabitants of Java and Madura* (National Council for the Netherlands and the Netherlands Indies of the Institute of Pacific Relations, Batavia, 1936).

° Samuel Van Valkenburg, "Agricultural Regions of Asia. Part IX, Java," *Economic Geography*, January 1936, XII, 34.

° "India's Food Problem," *Economist* (London), Dec. 26, 1935, pp. 627-28.

† W. R. Aykroyd, "Nutrition in India," in League of Nations, Health Organisation, *Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene*, C.H. 1235 (b) (Geneva, April 1937), p. 48.

as Lindstedt states, the range is 70-80 per cent. But in places the proportions seem to run even higher. Only the observations that fall below 70 per cent, however, seem to deserve comment. These apply to middle-class families in Shanghai, and to Java.

The low figure for Shanghai seems explicable on the ground that it applies to a relatively high-income group. Dependence of such a group upon cheap cereal calories would presumably be moderately low merely because of an income status that permitted larger use of foods more expensive than the cereals and the starchy roots or tubers. The low figures for Java are not explicable in terms of income, but in terms of the special prominence of cheap calories from starchy roots and tubers described above. It will be observed that Japan falls relatively low in the range, and the figure might have run even lower on a basis of calculation that excluded from food consumption not only "unavoidable waste," but also avoidable but actual wastes and actual feed use of foods potentially edible.

Major deficiencies in the diets of Monsoon Asia are suggested by the foregoing observations on dietary components. Proteins are likely to be deficient in quantity by Occidental standards; or if adequate in total, the protein intake may consist too little of animal protein. The fat-soluble vitamins A and D would seem likely to fall short of Occidental standards, although pro-vitamin A may be obtained from vegetables,<sup>16</sup> and in many of the warmer regions exposure of the body to sunlight may minimize the need for vitamin D in food. To the extent that cereals are consumed after high milling, and consequent removal of most of the B-complex of vitamins stored in the bran coat,<sup>17</sup> ingestion of this vita-

<sup>16</sup> In this connection, W. R. Aykroyd observes ("Nutrition in India," in League of Nations, Health Organisation, *Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene*, C.H. 1235, b, Geneva, April 1937, p. 66): "The carotene content of red-palm oil is equivalent to the vitamin A content of a good sample of cod-liver oil. . . . There seems to be considerable possibilities in red-palm oil as a cheap source of vitamin A in Eastern countries."

<sup>17</sup> Apparently about 50 per cent of the thiamin in the rice kernel is found in the

min complex might be expected to fall below the proportions needed for proper carbohydrate metabolism. Expert opinions concerning deficiency diseases and the "state of nutrition," however, are summarized below (pp. 128-32).

#### LEVEL OF CALORIE INTAKE

A second conspicuous feature of food consumption in Monsoon Asia is the relatively low average level of consumption of food calories per capita. Certain contrasts based either on global estimates or (in the case of China) on sample surveys involving large numbers of people may be summarized as follows, in terms of "intake" of calories per capita per day.

Country	Calories	Country	Calories
United Kingdom*	3,246	Japan <sup>f</sup>	2,732
United States <sup>b</sup>	3,150	China <sup>f</sup>	2,534
Canada <sup>c</sup>	3,140	British India <sup>b</sup>	2,300
Italy <sup>d</sup>	2,918	Madras Presidency <sup>e</sup>	2,068
Germany <sup>e</sup>	2,825	Java <sup>f</sup>	2,000

\* J. B. Orr, *Food, Health and Income* (London, 1936), p. 19.

<sup>b</sup> Calculated from data in pounds per capita as given by J. P. Cavin, "Consumption of Agricultural Products," *Agricultural Situation* (U.S. Dept. Agr., Bur. Agr. Econ.), January 1939, XXIII, 13-15.

<sup>c</sup> Unpublished estimates by W. R. Stott, based on food production and trade.

<sup>d</sup> *Proceedings of the International Congress for Studies on Population* (Rome, 1934), II, 457-95.

<sup>e</sup> Hans von der Decken, *Entwicklung der Selbstversorgung Deutschlands mit landwirtschaftlichen Erzeugnissen* (Berichte über Landwirtschaft, N. F., Sonderheft 138, Berlin, 1938), p. 56.

<sup>f</sup> E. C. Grey, *The Food of Japan* (League of Nations, Health Organisation, C.H. 681, Geneva, May 1928), p. 29.

<sup>g</sup> J. L. Buck, *Land Utilization in China: Statistics* (Nanking, 1937), p. 73.

<sup>h</sup> "India's Food Problem," *Economist* (London), Dec. 26, 1936, pp. 627-28.

<sup>i</sup> W. R. Aykroyd, "Nutrition in India," in League of Nations, Health Organisation, *Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene*, C.H. 1235 (b) (Geneva, April 1937), p. 49.

<sup>j</sup> A. M. P. A. Scheltema, *The Food Consumption of the Native Inhabitants of Java and Madura* (National Council for the Netherlands and the Netherlands Indies of the Institute of Pacific Relations, Batavia, 1936), p. 43.

No estimate pertaining to an Asiatic population runs as high as the lowest estimate for a Western population. The

embryo; see R. A. [Itson], "A Note on the Distribution of Vitamin B<sub>1</sub> (Thiamin) in the Rice Grain," *Malayan Agricultural Journal*, March 1941, XXIX, 127-28. Presumably the great bulk of the balance lies in the pericarp, testa, and aleurone layer, and not in the endosperm. The embryo of rice, lying at one end of the kernel and covering only 2 per cent of the area, is readily removed even by crude milling methods.

contrast would be still sharper if the various estimates were strictly comparable one with the other. In particular, strict comparability would increase the estimate for Germany, which is an attempt to measure food ingested rather than food purchased or food available before loss or diversion in the process of distribution. It would reduce the estimate for Japan, which does not exclude some potential food that actually goes for nonfood uses. Despite statistical inaccuracies, the generally low level of calorie intake in Oriental countries seems credibly demonstrated.

The explanations are numerous. The Oriental populations include larger proportions of young children whose calorie intake is low, in general accordance with their body weight. The basal metabolism<sup>178</sup> of Orientals is perhaps lower than that of Occidentals.<sup>18</sup> The environment of the Oriental populations is warmer, requiring lower output of heat from the body. The full-grown Oriental is smaller in body than the full-grown Occidental; commonly, the western European adult male is taken as weighing between 65 and 70 kilograms, whereas Orientals seem to range between 50 and 65 kilograms. There is a larger element of sheer waste of food in the Occidental than in the Oriental estimates. Various segments of the Oriental populations undoubtedly undergo periods of hunger, more or less protracted, in a degree not found among correspondingly large segments of the Occidental populations.<sup>18a</sup>

<sup>178</sup> The irreducible minimum of energy necessary to keep the body going when at rest and without food. See also H. C. Sherman, *Chemistry of Food and Nutrition* (5th ed., New York, 1937), pp. 169 ff.

<sup>18</sup> The evidence seems not to be altogether clear. Thus C. D. Miller and F. G. Benedict say: "When comparisons are made with American prediction standards, race *per se* has been shown in several studies to be a pronounced factor affecting metabolism. . . . Thus far no explanation of these variations in high and low metabolism has been available other than that they are caused by racial differences. It was hoped that the data secured in Hawaii [from five different racial groups] would throw more definite light on this perplexing problem. . . ."

"The question of whether or not there is an uncontaminated racial factor influencing basal metabolism can not be concluded from the results obtained in Hawaii." See *Basal Metabolism of Normal Young Men and Women of Various Races in Hawaii and Basal Metabolism of Samoan Men* (Univ. Hawaii Research Pubs. 15, 1937), pp. 27-28.

<sup>18a</sup> For example, even in Java where conditions are more favorable than in most other densely populated parts of Monsoon Asia, A. M. P. A. Scheltema (*The Food Consumption*



Finally, there is a reasonable presumption that, whether for climatic or other reasons, bodily activity is less in the Orient than in the Occident. The demonstrable differences in body size, the probable differences in bodily activity, and the greater prevalence of "short rations" alone would seem to explain adequately enough the contrasts between Occidental and Oriental calorie intake suggested by the tabulation.

Certain of these factors presumably give rise, within Monsoon Asia, to differences in the average level of total food-calorie intake from region to region. Japan, northern China, Chosen, and northwestern India are on the average colder than other parts of the area. The characteristic agricultural operations in the south and southeast of Monsoon Asia, where winter crops are little grown (pp. 43-47), would seem likely to involve less physical activity in the winter season, and on the average for the year, than in the northwest, north, and northeast. One gains the impression also that size of the human body is smaller in Java, the Indo-Chinese Peninsula, the Philippines, and southern and eastern India than in the rest of India, China (particularly the north), and perhaps Japan. Deniker says that ". . . the true home of low-stature populations is Indo-China, Japan, and the Malay Archipelago. In the remaining portion of Asia this low stature is only met with again in Western Siberia, and among the tribes called Kols and Dravidians in India."<sup>19</sup> Lindstedt, citing authorities, points out that the average weight of adult males in North China amounts only to about 60 kilograms, in South China, Japan, Burma, Annam, Java to 50-55, and in India to only 50-60 kilograms.<sup>20</sup> The International Labour Office has reported average weights of Chinese adult males

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*of the Native Inhabitants of Java and Madura*, National Council for the Netherlands and the Netherland Indies of the Institute of Pacific Relations, Batavia, 1936, p. 37) observes: "In most parts of Java there is a so-called 'patjeklik' or period of scarcity just before the new rice harvest. This is a typical phenomenon of diets consisting principally of cereals."

<sup>19</sup> J. Deniker, *The Races of Man: An Outline of Anthropology and Ethnography* (London, 1901), p. 30.

<sup>20</sup> "Food Consumption Habits in the Far East," pp. 403-03 E.

(Shanghai) as 55 kilograms, of Japanese, 51, and of Malayans, 50.<sup>21</sup> Takahira's 77 "normal" adult male subjects averaged 53.5 kilograms in weight.<sup>22</sup>

One might infer that Monsoon Asia falls into three zones with respect to food-calorie intake per capita. The zone of lowest intake might include Java, British Malaya, French Indo-China, Thailand, the Philippines, Ceylon, and eastern and southern India from Assam through Bengal, Bihar and Orissa, and the Madras Presidency. The zone of medium intake might cover Japan, Chosen, Taiwan, China south of the Yangtze, and the rest of India except for the Punjab and the Frontier Provinces. The zone of highest intake might include these northwestern provinces of India and China north of the Yangtze. How large the differences in average daily calorie intake per capita between the three zones might be is of course conjectural; but guesses of 2,000 in the first, 2,300 in the second, and 2,600 in the third might not be absurd or much at variance with the meager statistical information. In any event, probable regional differences in levels of per capita food-calorie intake are of some significance in interpreting data pertaining to regional differences in per capita utilization of rice.

#### REGIONAL CONTRASTS IN PER CAPITA RICE CONSUMPTION

Unlike levels of per capita consumption of total food calories, cereal-potato calories, or cereal calories, levels of per capita consumption of rice (or rice calories) vary widely from region to region of Monsoon Asia. Per capita consumption either of food calories or of cereal calories is moderately uniform from place to place; but per capita consumption of rice calories is not. The facts, so far as we are able to ascer-

<sup>21</sup> International Labour Office, *Workers' Nutrition and Social Policy* (Studies and Reports, Ser. B, No. 23, Geneva, 1936), pp. 29, 30 n.

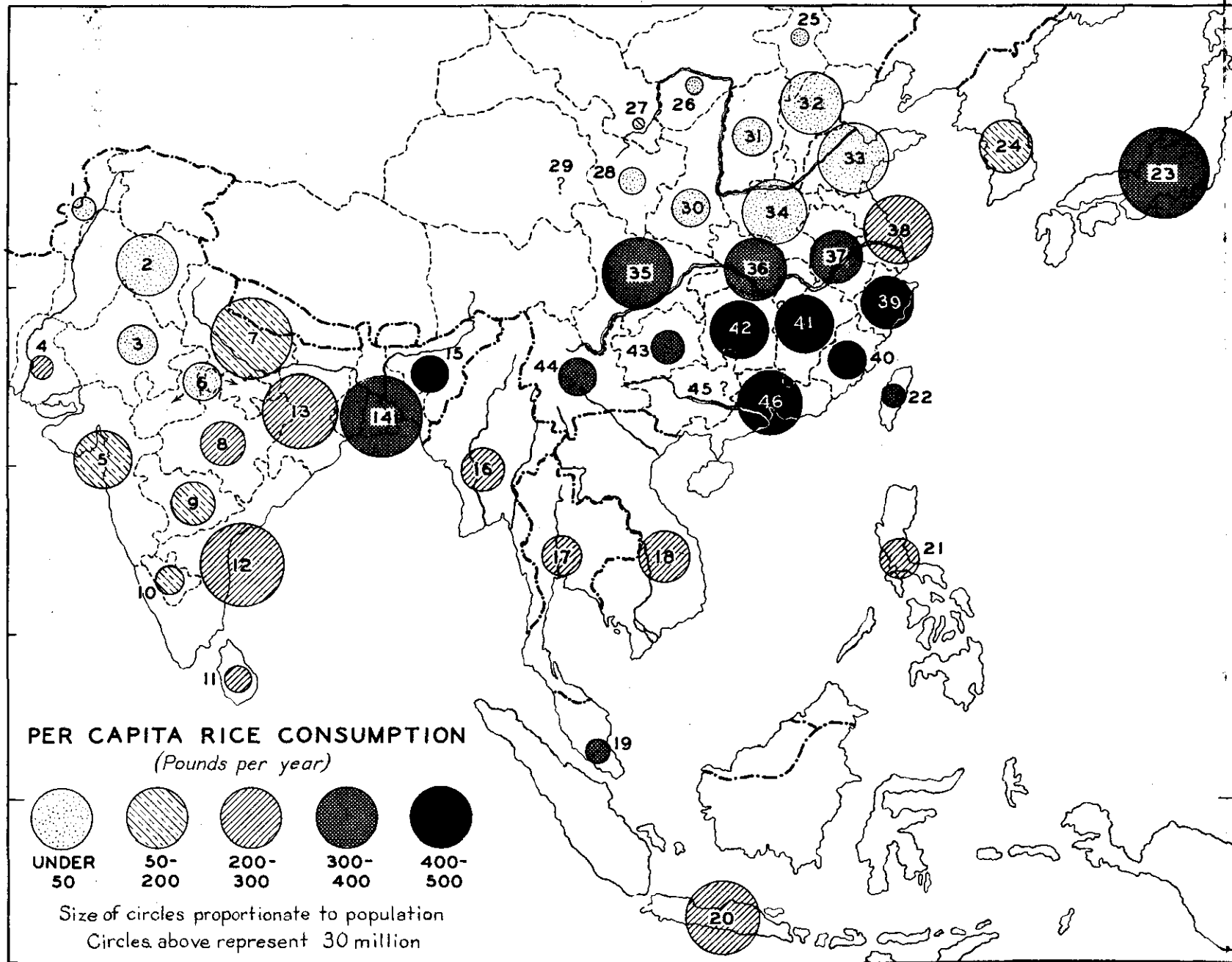
<sup>22</sup> Hideo Takahira, "The Basal Metabolism of Normal Japanese Men and Women," in Tadasu Saiki, *Progress of the Science of Nutrition in Japan* (League of Nations, Health Organisation, C.H. 523, Geneva, December 1926), p. 13.

tain them from imperfect evidence,<sup>23</sup> are summarized in Map 7.

The heaviest per capita consumption of rice is localized in southeastern China, in the provinces of Chekiang, Kiangsi, Hunan, Fukien, Kwangtung, and Kwangsi; and in Assam province of India. Here the estimates of per capita consumption range from 400 to 458 pounds per year. If allowance were made for imports from foreign sources, the province of Bengal might fall into this category.<sup>24</sup> Such high levels of consumption imply that rice provides more than 75 per cent of all food calories throughout these provinces, and therefore that other cereals play only a trifling role in the diet. The use of the land—based fundamentally on climate—determines the preponderance of rice. Thus the Chinese region coincides closely with Buck's "double cropping rice area" and "rice tea area" (Map 2, p. 32); practically all of the land under cultivation for food crops is paddy land, commonly double cropped to rice. Neither nonrice upland food crops, nor nonrice winter crops, are common. In Assam and Bengal also the food crops consist almost entirely of rice grown in paddies, though here double cropping to rice is less prevalent; neither nonrice upland crops nor winter crops of any sort are common.

<sup>23</sup> Data for Chinese provinces are from China, *Crop Reports*, Oct. 15, 1938, VI, 115, and purport to measure per capita consumption of polished rice, apparently excluding from "consumption" rice used for seed, feed, and industrial purposes. Data for Indian provinces are official statistics of production in terms of cleaned rice per capita. For all other countries, the data represent production plus net imports or minus net exports per capita, expressed as cleaned rice (Appendix Table VII). Obviously, strict comparability is not assured by such methods of estimation. The periods of years to which the data apply ought to be identical, but are only approximately so (about 1925-35). Rice is not everywhere eaten as cleaned rice; "consumption" ought not to include rice used for seed, feed, and industrial purposes but does in some instances; and, with respect to the Indian provinces, allowance ought to be made, but is not, for imports into some from domestic and foreign sources, and for exports from others. The estimates of Bengal, Madras, the United Provinces, Bihar and Orissa, and Bombay in particular must run somewhat too low because these provinces absorb rice from Burma. There is not, however, much movement of rice from one province to another within India.

<sup>24</sup> Bengal, Bihar and Orissa, the United Provinces, Madras, and Bombay appear to be the principal rice-importing provinces of India. So far as can be judged, allowance for these imports in calculating per capita rice consumption would be unlikely to change the position of any province except Bengal in the ranges shown in the map.



**KEY TO REGIONS**

- INDIA**
1. NORTHWEST FRONTIER
  2. PUNJAB
  3. RAJPUTANA
  4. SIND
  5. BOMBAY
  6. CENT. INDIAN STATES
  7. UNITED PROVINCES
  8. CENTRAL PROVINCES
  9. HYDERABAD
  10. MYSORE
  11. CEYLON
  12. MADRAS
  13. BIHAR & ORISSA
  14. BENGAL
  15. ASSAM
  16. BURMA
  17. THAILAND
  18. FRENCH INDO-CHINA
  19. BRITISH MALAYA
  20. JAVA & MADURA
  21. PHILIPPINE ISLANDS
  22. TAIWAN
  23. JAPAN
  24. CHOSEN
- CHINA**
25. CHAHAR
  26. SUIYUAN
  27. NINGSIA
  28. KANSU
  29. CHINGHAI
  30. SHENSI
  31. SHANSI
  32. HOPEI
  33. SHANTUNG
  34. HONAN
  35. SZECHUAN
  36. HUPEH
  37. ANHWAI
  38. KIANGSU
  39. CHEKIANG
  40. FUKIEN
  41. KIANGSI
  42. HUNAN
  43. KWEICHOW
  44. YUNNAN
  45. KWANGSI
  46. KWANTUNG

MAP 7.—APPARENT PER CAPITA RICE CONSUMPTION IN 46 REGIONS OF MONSOON ASIA\*

\* Based on data described in footnote 23, p. 114.

On the other hand, per capita consumption of rice falls below 10 pounds per year, and is accordingly only a negligible constituent of the diet, in wide regions of northern China (Chahar, Suiyuan, Hopeh, Shantung, Shansi, Kansu, and Chinghai provinces) and northwestern India (North-West Frontier, Punjab, Rajputana, and Central India provinces). Here the cereals as a group are of much the same importance as in the regions where per capita consumption of rice is notably high; but climate precludes cultivation of rice, and the cereal fraction of the diet is drawn from other grains. For similar reasons rice is of little importance also in certain provinces adjacent to these—Ningsia, Shensi, and Honan in China; the United Provinces, Bombay, Hyderabad, and Mysore in India. In none of these does per capita rice consumption reach 100 pounds annually on the average for whole provinces; and this figure would not represent as much as 20 per cent of all food calories consumed.

Even on so imperfect a map, the transition is rather sharply marked from regions where rice is an important constituent of the diet to those where it is of minor importance. For example, the data for all the provinces of China along and south of the Yangtze indicate levels of per capita rice consumption ranging from 271 pounds annually (Kiangsu) to 458 pounds (Hunan), while the figures for all the northern provinces range from zero to only 77 pounds. In India, figures for the southern and eastern provinces range from 221 to 405 pounds, whereas in other provinces with the exception of Sind<sup>28</sup> the range is from zero to 98 pounds. The prevalence of subsistence agriculture involving production of the crops best suited to natural conditions, and consumption of locally grown food, could hardly be more clearly emphasized. The only region of the forty-six considered in which per capita rice consumption falls above 100 pounds but below 200 is Chosen, where the level is 125 pounds.

<sup>28</sup> Sind is a geographical exception because its agricultural output is artificially determined by large-scale irrigation projects set down in the midst of a desert along the Indus River. Ningsia in northwestern China stands in somewhat the same category.

Indeed, if it were possible to refine the map, the geographical contrast in cereal-consumption habits would doubtless emerge even more clearly. In Chosen would appear some districts where rice consumption is negligible (the northern part) and others where it much exceeds the average of 125 pounds per capita for the whole country. In China, the southern parts of Kiangsu, Anhwei, and Hupeh would show considerably higher per capita levels of rice consumption than 271, 313, and 332 pounds respectively; and the extreme northern parts of these provinces would show much lower levels. In Bombay and Mysore in India, a high level of rice consumption would appear along the coast, a very low level in the interior. In Java, where the average is about 200 pounds per capita, the level would be considerably higher in the west, considerably lower in the east.

Instances need not be multiplied. It is clear that some justification exists for dividing the population of Monsoon Asia into "rice eaters" and "nonrice eaters"—all being "cereal eaters." If the classification is made using populations of the provinces mapped and the basis that nonrice eaters derive less than 25 per cent of their total food calories from rice, while rice eaters derive more than 40 per cent from rice, then some 310 million people are nonrice eaters and 630 million are rice eaters. If the division is made on the basis that nonrice eaters derive less than 10 per cent of their calories from rice, "mixed-cereal eaters" from 10 to 60 per cent from rice, and rice eaters more than 60 per cent from rice, then there are about 190 million nonrice eaters, 375 million mixed-cereal eaters, and 375 million rice eaters. But in the mixed-cereal group there would be only about 120 million deriving less than 40 per cent of their food calories from rice, and 255 million deriving 40–60 per cent. In general, where calories from rice exceed 40 per cent of *total* calories, more than half of the *cereal* calories must be derived from rice; hence rice is the dominant cereal foodstuff.

The cereals other than rice consumed by the nonrice eaters

and the mixed-cereal eaters differ from region to region. The following tabulation indicates which two of the nonrice cereals lead in per capita consumption, and in what order, respectively in regions where rice is a negligible component of the cereal fraction of the diet, where it is a minor component, and where it is the major component.

Combination*	Rice negligible (0-10) <sup>b</sup>	Rice minor (10-25) <sup>b</sup>	Rice major (40-60) <sup>b</sup>
A. Millets,° oats...	{ Chahar Suiyuan }	.....	.....
B. Millets,° wheat..	{ Shansi Shantung Honan Rajputana Central India }	{ Ningsia Bombay° Hyderabad }	Central Prov- inces
C. Millets,° maize..	Hopeh	Mysore	Madras°
D. Millets,° barley..	.....	Chosen	.....
E. Wheat, millets°..	{ Kansu Punjab Shensi }	.....	{ Anhwei Sind }
F. Wheat, maize ...	North-West Frontier	.....	Kiangsu
G. Wheat, barley ...	.....	United Prov- inces°	.....
H. Maize, wheat....	.....	.....	{ Bihar and Orissa° Philippines Java French Indo- China }
L Barley, wheat...	Chinghai	.....	.....

\* Including only the two leading nonrice cereals. In some regions several other cereals are consumed. The degree of importance cannot be indicated.

<sup>b</sup> Approximate percentages of rice calories to total food calories.

° Including grain sorghums.

<sup>d</sup> Inclusion of net rice imports in calculations of per capita rice consumption might cause these provinces to show higher ratios of rice calories to total calories than are stated at the head of the columns.

In the 13 regions where rice is of negligible importance, the millets (including sorghums) are most commonly the dominant sources of food calories, wheat the next most important. Barley is the leading source of food calories only in

one province of extreme western China. Oats is nowhere the leading source, but is the secondary source in two provinces of northern China. Maize also is nowhere the leading source of food calories on the average for the regions considered, but is the secondary source in Hopeh province of northeastern China and may locally be a primary source in several regions. In general, this suggests that the millets and sorghums are the most prolific *summer-sown* grain crops in the regions of Monsoon Asia where the moisture supplies are too scanty for rice, and that wheat is the most prolific *winter-sown* crop.

The pattern of consumption is similar in the six regions where rice is of more than negligible importance yet not of major importance. Either the millets and sorghums or wheat leads among the nonrice cereals in all six. Barley assumes a place secondary to the millets in Chosen and to wheat in the United Provinces of India; and corn is secondary to wheat in Mysore.

If one assumes that the dominant cereal in consumption is satisfactorily represented in the tabulation above for the two groups of regions called "rice negligible" and "rice minor," it would appear that the nonrice eaters and the mixed-cereal eaters could be further classified as either millet eaters, wheat eaters, or barley eaters. Of the barley eaters there would be about 2 million, of the wheat eaters 100 million, and of the millet eaters about 208 million. No such basis of classification can be altogether satisfactory, but it serves to emphasize an aspect of food consumption often underemphasized—the importance of the millets and sorghums in the food of Monsoon Asia, particularly central India and northern China.

In the nine regions where rice is the major cereal food, the position of maize becomes more prominent. It is the most important secondary cereal in Bihar and Orissa in India, the Philippines, Java, and Indo-China, and the second most important in Madras (following millets) and Kiangsu (following wheat). Maize thus emerges as a relatively important



secondary cereal in moister and warmer parts of Monsoon Asia. In the drier parts of these nine areas, the millets and wheat remain the most important secondary cereal foods, while oats and barley practically disappear.

Even in some of the regions where rice provides more than 60 per cent of the food calories and therefore almost all of the cereal calories, some consumption of other cereals occurs. Appreciable amounts of both wheat and barley are consumed in Japan, but very little corn. Wheat appears to be the principal secondary cereal in Hupeh, Hunan, Kiangsi, Chekiang, and Fukien provinces of China, all lying in the northeastern part of the rice belt; corn occupies this position in Szechwan, Yunnan, Kweichow, and Kwangsi provinces in the southern and eastern parts; and millets (by a narrow margin over wheat) in Kwangtung on the extreme south. Wheat may be the principal secondary cereal in Bengal in India, maize in Assam, millets in Burma (reflecting the relatively dry agricultural region in upper Burma) and Ceylon, and probably maize in Thailand, Malaya, and Taiwan.

Regional correspondence between per capita production and per capita human consumption of the several cereals, though marked, is of course not perfect throughout Monsoon Asia. Per capita production of rice exceeds per capita consumption in the rice-exporting regions, of which Chosen, Taiwan, Burma, Thailand, and Indo-China can be named with certainty. On the other hand, per capita consumption must exceed per capita production in the net-importing regions, whether countries or provinces.

Apparently not much rice (aside from milling offals) is used for animal feed in any region, so that this factor little disturbs relationships between per capita production and consumption. This is true also of wheat. But in varying degrees the millets and sorghums, maize, barley, and oats are used as feedstuffs. In China as a whole, conspicuously large fractions of the kaoliang and barley crops are used for other purposes than human food or seed, some 54 and 56 per cent

respectively. In general, information bearing upon the utilization of the several cereal crops throughout Monsoon Asia is notably defective; but enough is known to justify the assertion that correspondence between per capita production and per capita human consumption by regions is likely to be closer with regard to rice and wheat than with regard to the other cereals.

Levels of per capita rice consumption differ both from one rice-surplus region to another, and from one rice-deficit region to another. Such levels (pounds per year of cleaned rice) are as follows:

Net exporters	Net importers		
Chosen .....	125	Java.....	199
French Indo-China.....	242	Philippines .....	250
Thailand.....	275	Ceylon .....	277
Burma.....	288	Japan .....	328
Taiwan .....	299	British Malaya .....	378

In larger degree these differences are explained by natural environment, which determines what cereals can best be grown locally. But in some degree economic and political circumstances must be important influences. Thus the relatively low level in Chosen represents economic pressure to export a cash crop as well as the fact that much agricultural land is too dry for rice production. In varying degree such pressure must be felt by all the exporters; and perhaps this helps to explain why the general level of per capita rice consumption is somewhat low in the net-exporting countries. The relatively low level in Java no doubt reflects not only the domestic production and consumption, especially of maize, but also pressure, implemented by policy, to restrain both output and export of major export crops (rubber, sugar) and also imports of rice that might be purchased with the proceeds of these exports. We are unable to offer clear-cut explanations of the many striking differences suggested by the tabulation above—why, for example, per capita rice consumption seems to be 100 pounds per year higher in British Malaya than in Ceylon,

when neither seems to consume much of other cereals<sup>26</sup> and both seem to depend about equally upon cereals for food calories. But the probability that a part is played, not only by natural environment, but also by economic circumstances, seems to deserve emphasis.

#### PREFERENCES AND HOUSEHOLD USES

Either rice or wheat is almost certainly the preferred cereal food in all regions of Monsoon Asia. Almost certainly neither wheat nor rice is preferred above all other foods. The question whether or where rice is preferred above wheat or wheat above rice as the cereal food is a highly debatable one which deserves more analysis than can be given to it on the basis of available evidence.

The broad probability that rice and wheat are preferred throughout Monsoon Asia—preferred in the sense that, if income levels permitted, other cereals would practically disappear from diets—is suggested in many ways. In China as a whole, polished rice and wheat are estimated to be used for animal feed only to the extent of 4 and 5 per cent respectively; the several types of millets, 7–9 per cent; buckwheat, 14 per cent; corn, 19 per cent; oats and kaoliang, 20 per cent; barley, 34 per cent.<sup>27</sup> Mukerjee classifies the cereals of India as “superior” (rice and wheat) and “inferior” (barley, maize, jowar, and bajra [millets]).<sup>28</sup> As shown earlier, other cereals than wheat and rice tend to bulk large in per capita consumption only in regions where neither rice nor wheat thrives well. It is not the inferior cereals, but rice and wheat, that are imported in significant quantities. Gamble’s inquiry at Peiping shows clearly that corn and millet flour and millet grain, prominent in the food expenditures of low-income families, practically disappear from the expenditures of high-

<sup>26</sup> This inference, however, is not securely based because of the lack of production statistics of nonrice cereals and starchy roots and tubers in Ceylon. It is possible that these play a considerably more important role in Ceylon than in Malaya.

<sup>27</sup> China, *Crop Reports*, Oct. 15, 1938, VI, 114.

<sup>28</sup> Radhakamal Mukerjee, *Food Planning for Four Hundred Millions* (London, 1938), p. 20.

income families, where wheat flour and rice are almost the only cereals used.<sup>20</sup> The familiar traditional reverence shown by the Japanese for rice, but not for any other cereal, is an indication of its position of preference.<sup>20</sup>

The preferred cereals, rice and wheat, nevertheless cannot be singled out as preferred among all foods in the sense that they would be the only foods eaten if freedom of choice were complete. This would controvert what is probably a general principle, that bodily requirements for proteins, vitamins, and minerals, not present in adequate amount in the cereals, would impel any people to include some other foods in a freely chosen diet. It would also controvert another widely observed aspect of human behavior—that variety in the diet tends to be sought when income permits. The place of the cereals in both Occidental and Oriental diets, as measured by the proportion of all food calories which they supply, seems rather generally to fall with increase of per capita income either of the same group over a period of time or between different income groups at a given time. As income rises, other more expensive foods squeeze the cereals not out, but down; they retain a minor place even in the highest-income groups. It is fair to say that these other foods are in a sense preferred over cereals.

What the other foods may be no doubt differs from one population group to another. Sugar, for example, though important in the United States, appears to be much less important even in high-income groups in the Orient, and so also with milk which, it is often asserted, Orientals dislike. In Gamble's inquiry, expenditure per "cost consumption unit"<sup>21</sup>

<sup>20</sup> S. D. Gamble, *How Chinese Families Live in Peiping* (New York, 1933), p. 79.

<sup>21</sup> "There is something of almost fanatical superstition in the reverence in which the Japanese hold rice. Next to the Emperor, rice is of all things on earth most sacred in the eyes of the Japanese. Money can be squandered by the prodigal and he will be forgiven, but there is no forgiveness for anybody who wilfully throws away a handful of rice. The first lesson in table etiquette given to the Japanese child is to treat rice with the utmost veneration" (J. A. Rabbit, "Rice in the Cultural Life of the Japanese People," in *Transactions of the Asiatic Society of Japan*, 2d ser., Vol. XIX, Tokyo, December 1940, p. 191).

<sup>22</sup> Approximately per adult male.

per year on cereal foodstuffs about doubled from the \$10-\$20 monthly income group to the \$100-\$125 group; and expenditures on vegetable foodstuffs, which included sweet potatoes and condiments (among them sesamum oil, lard, and sugar) a little more than doubled. But expenditures on meat increased more than ninefold, and expenditures on fruits, more than fifteenfold.<sup>28</sup> Although these data are given in monetary terms, they obviously mean that low-income families obtained a larger fraction of their food calories from cereals, and a smaller fraction from noncereals, than did the high-income groups.

The phenomenon of decline in the *proportion* of food calories derived from cereals in the diets of Monsoon Asia would thus be expected to appear eventually, though perhaps not immediately, if per capita real income should increase. Low real income is at present a factor tending to hold down the total absolute number of food calories consumed, and the number of cereal calories as well. Since a large improvement of real income could hardly occur rapidly, the initial effect of an improvement in real income conceivably might be to raise the level of total food calories and total cereal calories perhaps even more, so that the proportion of cereal calories might rise for a time. Chart 10 (p. 124) suggests the probable order (purely hypothetical) of developments. With continuing increase in real income per capita, one would expect cereal calories to decline both absolutely and relatively. At some early stage in the process, the preferred cereals, rice and wheat, would probably begin to displace the inferior cereals and to rise in per capita consumption. At some later stage, after the preferred cereals had practically displaced the inferior ones, the preferred cereals themselves would probably tend to be displaced by noncereal foods.

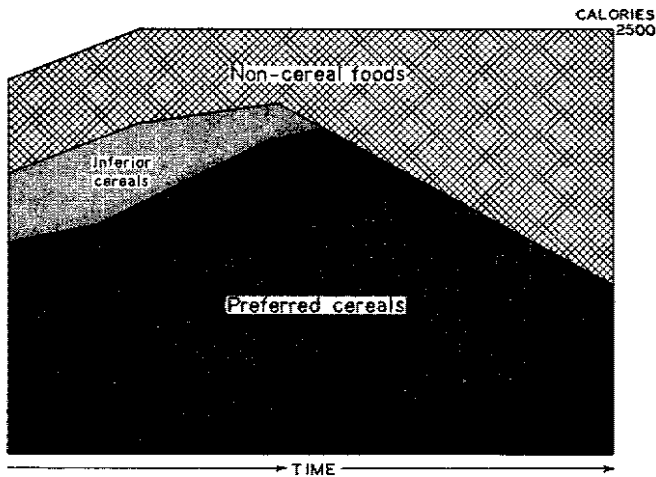
In as much as one can seldom appraise with reasonable accuracy the actual trends of either real income per capita, total food calories, noncereal calories, inferior-cereal calories,

<sup>28</sup> Gamble, *op. cit.*, Table 17, on p. 324.

or preferred-cereal calories, the chances of misinterpreting developments are substantial.

On the question of relative preference for rice as against wheat, very little that is conclusive can be said. The geographical location of places where populations consume a

CHART 10.—HYPOTHETICAL EFFECT OF A LONG-TERM INCREASE IN LEVEL OF PER CAPITA REAL INCOME ON THE COMPOSITION OF ASIATIC DIETS



good deal of both, or where either rice or wheat is either the principal or the secondary cereal in consumption, are fairly clear. These (see the tabulation on p. 117) seem to be the United Provinces and Sind in India; Kiangsu and Anhwei provinces in China; and practically all the urban centers along the coasts of Monsoon Asia. We find no specific evidence suggesting whether wheat would displace rice or rice would displace wheat in rural consumption under circumstances of higher real income permitting greater freedom of choice.

As to urban consumption, Gamble's study at Peiping suggests that with increases of income wheat flour rises faster in consumption than rice in the lower brackets of income, rice

faster than wheat in the higher brackets. Thus at the income level of \$50 per month, expenditures per cost consumption unit were about twice as large on wheat flour as on rice; at the \$100 level, about 50 per cent larger; at the \$200 level, practically the same; and at the \$300 level, some 20 per cent smaller.<sup>23</sup> This might reasonably be taken as indicating a stronger preference for rice than for wheat in the particular population studied; but it is an imperfect indication because, as Gamble points out, the proportion of families coming from South China and long accustomed to rice was larger in the high-income groups than in the low-income groups. Miller's study of Japanese families in Hawaii shows that the proportion of rice calories to total cereal calories (and the nonrice-cereal calories must have been mostly wheat) changed very little from one income group to another, though the highest-income group used proportionally a little less rice than the second highest. This study, however, showed that Japanese in Hawaii used wheat appreciably more than Japanese in Japan.<sup>24</sup>

Our impressions, not well substantiated, are that preference for rice as against wheat may remain marked among income groups able to purchase either if those groups have long been accustomed to rice; and that preference for wheat may remain marked in groups of equally high income but long accustomed to wheat. Wheat might reasonably be expected to make some inroads upon rice among the rice eaters, but not to become the major cereal; similarly, rice might be expected to make some inroads upon wheat among the wheat eaters, but not to become the major cereal. Among high-income rice eaters, the place of the two preferred cereals in the diet might remain more important than among wheat eaters of equally high incomes. These impressions are stated with reference to changes that might occur with generally rising levels of living within two or three generations, not a

<sup>23</sup> Gamble, *op. cit.*, p. 79.

<sup>24</sup> C. D. Miller, *A Study of the Dietary and Value of Living of 44 Japanese Families in Hawaii* (Univ. Hawaii Bull., Vol. XVIII, No. 2, December 1938), p. 24.

millennium. They are also stated on the assumption that no large changes in the relative prices of the two preferred cereals are probable.<sup>25</sup>

The possibility that a rice-wheat combination of cereals might retain a more prominent place in the diets of high-income rice eaters than a wheat-rice combination in the diets of high-income wheat eaters is suggested by household usage among the well-to-do. Where rice is the principal cereal in the diet, it tends to be the central item of food around which the meal is planned. Rice is seldom eaten by itself because its flavor is essentially mild. For this same reason, however, it makes an ideal base for combination with more highly flavored food substances. In the diet of the poor, the dish of mediocre-quality rice, boiled or steamed,<sup>26</sup> may be supplemented by a bit of fish or bean curd, some legume, or hot condiment. As the scale of income is ascended the rice becomes of better quality, and variety of vegetables, condiments, meats, poultry, and sea foods increases; but the basic plan of the meal remains unchanged. Not only more expensive supplementary foods, but different methods of food preparation appear; an example is baking, which is rare among rural consumers in Oriental countries, because of the cost of fuel

<sup>25</sup> Surprise is often expressed that rice maintains so important a place in the world's diet despite the fact that the price per pound of wheat is generally below the price of rice. See O. E. Baker, "The Potential Supply of Wheat," *Economic Geography*, March 1925, I, 17 n.; and E. W. Zimmermann, *World Resources and Industries* (New York, 1933), p. 234. These writers compare prices of the two grains as they are registered on grain exchanges. Yano and Shirasaki, *op. cit.*, p. 97, remark that "the Japanese people live on the staple food which is the most expensive of all cereals."

Prices per pound of the two grains as grain on the exchanges, however, cannot fairly be compared; they cannot reflect final "table" costs to ultimate consumers. Rice is almost always quoted in terms of cleaned or brown rice, and even the latter has only 10 per cent of its weight to lose before consumption in households, while wheat grain has 20-30 per cent to lose. Rice has little additional cost of conversion and distribution to bear, wheat considerable. When a bowl of rice and a batch of noodles or a loaf of bread are ready to eat, the differential between the two cereals in final cost at the table per 1,000 calories has probably narrowed appreciably, disappeared, or been reversed. Probably most rice eaters can ordinarily eat rice more cheaply than they could eat wheat products.

<sup>26</sup> Rice throughout the Orient is generally boiled or steamed and, without undergoing further change, is eaten shortly after preparation. Wheat in the Orient, while not widely consumed as leavened bread, is commonly eaten as unleavened flatbread or biscuits (often cold, hours after cooking) and as noodles or steamed dumplings.



and lack of facilities. Although rice becomes relatively less important in the diet of the high-income groups, it seldom becomes completely incidental to the meal.

Wheaten products, on the other hand, may become peripheral or incidental in elaborate Occidental meals, reduced to such uses as an ingredient of soups, gravies, and sweet pastries. It seems probable that wheat is more easily and more largely dislodged from a diet wherein it was initially prominent. A cheap wheat-dominant diet is likely to consist principally of soup as the noncereal element, with bread either leavened or unleavened as the principal source of calories. The soup appears as the main dish of a meal, the bread as a supplement. It seems easy and natural, as purchasing power rises and the composition of the diet changes, first to thicken and then to supplement the soup with meat and vegetables, bread becoming increasingly peripheral. Even in sandwiches, the filler tends to become the major item, the bread only incidental; and toast is commonly more a carrier for a spread than an item eaten for its own sake. But where rice is the dominant item of the diet, it forms the main dish around which other foodstuffs are added as circumstances permit; and diversification of the diet may involve retention of rice as the central dish, with multiplication of sauces, vegetables, meats, and so on, and of preliminary and final courses tending to diminish its importance but not to dislodge it from a central position.

If this reasoning is sound, it is difficult to see how wheat can make much headway in displacing rice from the diets of Orientals long accustomed to consume it. For them, a loaf of bread is not a real alternative for a bowl of rice. Greater diversification of Oriental diets would probably involve in some places additional use of wheaten products along with other foods more expensive than the cereals, with reduction of per capita rice consumption; in other places, additional use of rice along with other foods, with reduction of per capita wheat consumption; in still other places, additional use of either rice

or wheat or both, with reduction in per capita consumption of the inferior cereals.

#### STATE OF NUTRITION

By Occidental standards of "optimum" or even "minimum" requirements for nutrition, surveys of food consumption or analyses of food supplies show that Oriental diets are deficient both in total calories, and in animal proteins, fats, and several of the vitamins and minerals. Comparison of actual food intake in relation to "standards" is one way of suggesting deficiencies in nutritional status. Another way, not always leading to the same conclusions, is to subject samples of the population to clinical examination, and thus to determine the prevalence of disease or poor health attributable to food-consumption practices. Expert knowledge of nutritional science is required in either method of appraisal, so that it would be presumptuous for economists to attempt to say what adverse effects of dietary practice upon the populations of Monsoon Asia are actually observed or are properly to be inferred from their dietary usage or their physical status. We therefore limit ourselves to quotations.

An Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene was held at Bandung in Java on August 3-13, 1937. In its final recommendations, this group stated that the "available evidence suggests that under-nourishment and malnutrition is widespread and that much impairment of physical development and general health, low vitality and actual disease result from insufficient and improper diet."<sup>27</sup> It recommended in general the establishment of institutions and training of personnel for study of nutritional problems, but specifically emphasized only the desirability of discouraging consumption of highly milled rice and encouraging consumption of home-produced rice: "It deplores the

<sup>27</sup> League of Nations, Health Organisation, *Report of the Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene, Held at Bandoeng (Java), August 3rd to 13th, 1937*, A. 19. 1937. III (Geneva, September 8, 1937), p. 67.

increasing tendency of urban and rural populations in the East to consume highly milled rice."<sup>82</sup>

As one scans the "Preparatory Papers" for this Conference, submitted by the several participating governments, somewhat more specific diagnoses appear. For India, Aykroyd<sup>83</sup> "found that some 15% of these [4,000 school children] showed either stomatitis due to vitamin B<sub>2</sub> deficiency, xerophthalmia, or a follicular keratosis of the skin. . . ." He noted "a higher incidence of deficiency disease . . . among children of the poorer classes in the towns than in poor village children," probably because "the poor in the towns eat milled rice, while the villager usually eats millet, or rice in the home-pounded state." Feeding experiments with skimmed milk on children showed that "consumption of milk improved the general condition, health and appearance of the children, and reduced the frequency of minor ailments." Blood examinations showed that "the hæmoglobin content of the blood of Indian children is some 20% or more below European standards . . . mild anæmia resulting from the consumption of a diet poor in iron." Also: "Preliminary clinical experiments suggest that a large proportion of the population may be in a state of 'vitamin C sub-nutrition', . . ." "Overt scurvy does not . . . appear to be common. . . . The prevalence of food-deficiency diseases, such as beriberi, peripheral neuritis in pregnant women, the anæmias of pregnancy, keratomalacia, etc., is also proof that the diet of large sections of the population is grossly defective. . . . one observes in Indian hospitals a variety of obscure degenerative conditions which are probably related to malnutrition." In the north, however, "the 'state of nutrition' . . . appears to be on the whole good," though "diseases associated with vitamin D deficiency—rickets and osteomalacia—are met with; these are less common or absent in other parts of India." Aykroyd concludes with the statement: "The account of the problem of nutrition in South India given here is probably, in

<sup>82</sup> *Ibid.*, p. 68.

<sup>83</sup> *Op. cit.*, pp. 51-54.

general, applicable to other countries in the East—e.g., Ceylon, Siam, Java, etc.”

As for China, the “Preparatory Papers”<sup>40</sup> state that deficiency “diseases are very prevalent . . . . Xerophthalmia is common among factory workers . . . . and soldiers . . . . Urinary calculus, in which vitamin A deficiency is an important etiological factor, . . . . is quite common in the South. . . . Rickets and osteomalacia are commonly met with . . . .” at Peiping. “Beriberi is prevalent in South China, where polished rice is the staple food. Scurvy and pellagra are comparatively rare . . . .” Lindstedt’s remarks harmonize with these except that he states that neither rickets nor osteomalacia “is frequent in China”<sup>41</sup> despite low intake of vitamin D, of which the animal foodstuffs are rich sources.

“In Japan, malnutrition is responsible for eye diseases, beriberi, scurvy, Möller-Barlow’s disease, rickets, ‘Mehlnährschaden’ (Czerny-Keller) and underweight. The prevalence of beriberi is due to rice being the main item of food in Japanese diet. However, cases of this disease have decreased in recent years in places where standard rice (seven-tenths pounded and without the use of sand) is commonly consumed.”<sup>42</sup>

Of the Netherlands Indies<sup>43</sup> it is said:

Scarcity of food as a result of seasonal influences (in Middle and East Java and the eastern end of the archipelago) is manifested, amongst other things, by an increased mortality from infectious diseases. . . . Kidney and bladder stones are very frequent, but their connection . . . especially with a shortage of vitamin A in the food, is contested.

Beriberi . . . . is still a potential danger, though epidemic outbreaks are rare. . . .

Xerophthalmia, keratomalacia and hemeralopia are met with in many places . . . . It is not improbable that a hypovitaminosis A is very

<sup>40</sup> League of Nations, Health Organisation, *Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene*, C.H. 1235 (f) (Geneva, May 1937), pp. 55–56.

<sup>41</sup> H. Lindstedt, “Food Consumption Habits in China,” *International Review of Agriculture*, August 1939, XXX, 372 E.

<sup>42</sup> League of Nations, Health Organisation, *Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene*, C.H. 1235 (g) (Geneva, May 1937), p. 27.

<sup>43</sup> *Ibid.*, C.H. 1235 (j) (Geneva, June 1937), pp. 133, 135–36.

common; by many it is considered the most important deficiency disease at present occurring in the Netherlands Indies. . . . Scurvy and rickets are unknown among the rural population. . . .

The excellent condition of the teeth among the native folk is striking. Pellagra is seen sporadically . . . , [but even] in the maize-eating regions, endemic pellagra is unknown.

#### To quote the report on the Philippines:<sup>44</sup>

There is no doubt that the Filipinos are suffering from the effects of inadequate nutrition . . . . Even among the well-to-do people, under-nutrition and malnutrition occur . . . . The high incidence and mortality from beriberi, the lack of resistance . . . . to infectious diseases . . . . the high percentage of dental caries throughout the country, the early ageing and short duration of life . . . . and the high incidence and mortality from tuberculosis are all strong indications of definite nutritional deficiency . . . .

#### The report for Ceylon<sup>45</sup> states that the diet

is liable to have three special defects—viz., (1) that it is defective in proteins of high biological value; (2) that there is a deficiency of the important vitamin A, and (3) that there is a deficiency of minerals, particularly of the mineral calcium. . . . .  
 . . . . a large percentage of blindness . . . . is due to keratomalacia and xerophthalmia, resulting from vitamin A deficiency. . . .

The wide prevalence of dental defects, irregular development of teeth, etc., have been attributed to defective nutrition. . . . .

As regards the more well-known deficiency diseases, like scurvy, beriberi and pellagra, they are not known to occur in this country, except in unusual circumstances. True cases of rickets do occur but rarely . . . .

Of Burma,<sup>46</sup> it was said that the "outstanding feature of beri-beri in Burma is its incidence amongst the Hindu labourers in the larger towns, large groups of whom use an almost exclusive rice diet." Goiter was mentioned as "widely prevalent in certain areas," but no other deficiency disease received attention. The report for Thailand<sup>47</sup> states that

<sup>44</sup> *Ibid.*, C.H. 1235 (e) (Geneva, April 1937), pp. 20, 22.

<sup>45</sup> *Ibid.*, C.H. 1235 (d) (Geneva, April 1937), pp. 45, 47.

<sup>46</sup> C. A. Bosman, "Note on Public Health Organisation in Burma," in League of Nations, Health Organisation, *Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene*, C.H. 1235 (e) (Geneva, March 15, 1937), pp. 25-26.

<sup>47</sup> League of Nations, Health Organisation, *Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene*, C.H. 1235 (h) (Geneva, May 1937), p. 37.

there "is thus no question of lack of food here in any part of the country, even in times of depression. The problem as seen to-day is mainly one of ignorance in food values and a certain amount of prejudice due to local habits"; but the specific effects of this ignorance and prejudice receive no comment. The report for Indo-China<sup>48</sup> mentions "quantitative deficiency" particularly among Annamites, and observes that the "most common deficiency disease, and the only one of general importance, is beriberi." The report for Malaya<sup>49</sup> remarks briefly that while "beriberi, xerophthalmia and other marked deficiency diseases are still reported in statistics, the matter seems to spread farther than the end-points of actual definable diseases. Stamina appears to be lower than in Europe . . ."

It will be observed that sheer insufficiency of food calories (an aspect of undernourishment rather than of malnourishment) is frequently mentioned as common in these summaries; that almost all of them refer to widespread prevalence of beriberi, though not in northern India and northern China; that reference is commonly made also to xerophthalmia and other diseases reflecting deficiency of vitamin A; that poor stamina, obscure degenerative disease, lack of resistance, or low vitality commonly receive comment; that scurvy and pellagra are usually said not to be common; and that substantial incidence of rickets and osteomalacia—results of deficiency of vitamin D—is suggested principally in Japan, northern China, and northern India. One has, rather curiously, the impression of prevalence of dental defects in some places (Ceylon, Philippines) but not in others (Netherlands Indies). Curiously also, the effect upon populations of a conspicuous feature of Oriental diets, the meager intake of animal protein, is not emphasized or indeed made clear.

<sup>48</sup> League of Nations, Health Organisation, *Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene*, C.H. 1235 (Geneva, March 15, 1937), pp. 92-93.

<sup>49</sup> *Ibid.*, C.H. 1235 (c) (Geneva, May 1937), p. 26.

## CHAPTER VII

### PRICE FACTORS, CHANGES, AND RELATIONSHIPS

There is no international market for rice comparable with the international wheat market of western Europe, where a great number of types and grades of wheat from many different sources regularly compete with one another, as well as with other grains. The rice trade is less highly commercialized. Hence one cannot expect to find for rice as detailed and precise a record as exists for wheat, with regard either to prices or to the particular types, varieties, and grades to which prices refer. Lacking a full record of price facts, one cannot expect to present for rice a coherent set of explanations that account for the facts. Yet the record of rice prices during the past two decades warrants discussion, and leads to a few conclusions of interest and significance.

#### RICE AND OTHER GRAIN PRICES

Like any other grain, rice, as it is bought and sold on grain exchanges, is not a homogeneous commodity with a single price at any moment. The price ranges of the several grains, though overlapping, may nevertheless be differentiated one from the other by selection of the price of a particular type or grade of each as reasonably representative of the range of prices of the several types or grades exchanged. In this sense one may properly speak of the price of rice and compare it with the price of wheat, maize, or any other grain.

Rice, as grain, at least if quoted in terms of cleaned or of brown rice and not of paddy, appears in many markets to be consistently the most expensive of the cereals per 100 pounds. This was the situation in the British grain market, where all grains were imported free of duty before 1933 (see Chart 12, p. 136); it was also true in northern China under substantially the same conditions of free trade. There are no

data to indicate whether or not the same relative premium position of cleaned rice over other grains would hold under all circumstances of free trade—as for example in a market (if any existed) from which a surplus of rice was exported but to which other grains were imported; or in a free-trade import market like Singapore, close to a rice-surplus region but far from regions with surpluses of other grains. In such markets, given the presence of trade in other grains, rice might not enjoy a premium position over wheat, perhaps not even over one or another of the inferior cereals.

If in a grain-deficit country tariffs or other import controls are imposed differentiating against or in favor of rice as compared with other grains, the price relationships may of course differ from what they would be without controls. Thus in France, wheat has been kept much more expensive than rice, in furtherance of protection to domestic wheatgrowers, coupled with a policy of absorption of the rice surplus of French Indo-China. On the other hand, rice in Japan has presumably been held at a higher premium over wheat than a free-trade system would have permitted.

Within Monsoon Asia, if the inferior cereals come into competition at all, they seem everywhere to be cheaper than either rice or wheat. As to rice and wheat, it seems reasonably clear that cleaned rice must normally be more expensive per 100 pounds in the wheat-surplus and rice-deficit regions of northwestern India and northern China, in Japan, and probably also in Chosen and Taiwan. In the first two of these regions, rice must be brought from considerable distances and must bear the costs of transportation, whereas wheat is locally produced. In the Japanese Empire, the protective system helps to keep rice at a premium.

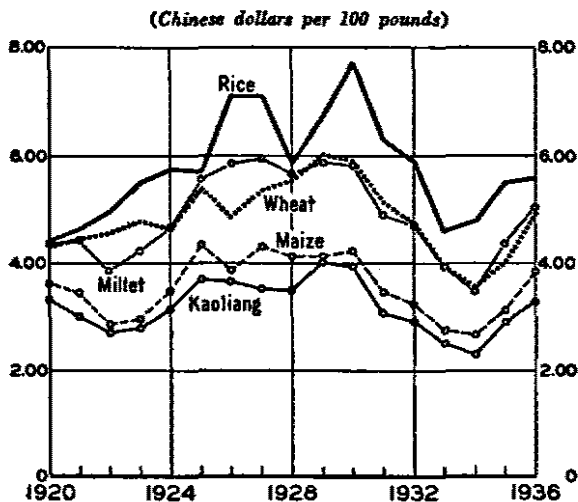
Elsewhere, however, there is next to no competition between the two grains in the form of grain. In southern China, the Philippines, the Netherlands Indies, the Indo-Chinese Peninsula, Ceylon, and eastern India, such competition as exists is between rice produced within the region and wheat



flour imported from more distant sources of supply, largely Australia and North America. Price comparisons of rice with wheat flour are not feasible. A fair presumption may exist that wheat flour is ordinarily—but not invariably—more expensive than cleaned rice in these regions, because it is brought in from distant sources; but the price record is not available to test the presumption.

China is a region where most of the cereals compete. Chart 11 shows annual average prices per 100 pounds of five

CHART 11.—WHOLESALE GRAIN PRICES IN NORTH CHINA, ANNUALLY 1920-36\*



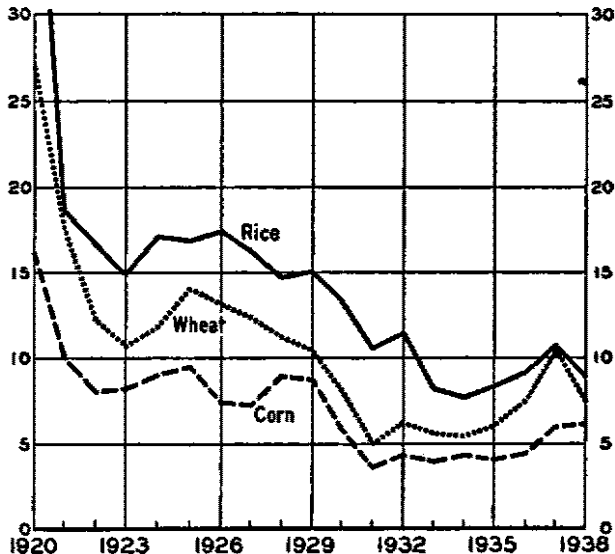
\* Data from Nankai Institute of Economics, *Nankai Index Numbers, 1936* (Nankai Univ., Tientsin, March 1937), pp. 9-10; converted from shih to weight units.

grains in that region from 1920-36. Rice commanded the highest price in every year, kaoliang and maize the lowest. Wheat and millet stood in an intermediate position, on the whole closer to rice than to maize and kaoliang; in 11 years of the 17, wheat prices were above millet prices, but the position was reversed in the other six years.

The spreads were not constant, but variable. This would

be expected in any market if only because supplies of the several grains either locally or world-wide do not bear constant relationships each to the other from year to year. Moreover, in the British import market, the price spreads between any two grains vary more or less from year to year, though (as Chart 12 shows) rice tends to exceed wheat in price, and

CHART 12.—AVERAGE PRICES OF CEREALS IMPORTED INTO THE UNITED KINGDOM, 1920-38\*  
(Shillings per cwt.)



\* As deduced from quantities and values given in Great Britain, *Accounts Relating to Trade and Navigation of the United Kingdom*.

wheat to exceed maize. If in any market, differential tariffs or other import controls are imposed, previously established price relationships will tend to be altered. Application of export subsidies may likewise affect price relationships in the exporting country, and perhaps also in the importing one.

In northern China, rice has often brought a price 25 per cent above that of wheat, and 75 per cent above that of maize. In the British market, the percentage differentials have ordi-

narily been smaller. Little is to be gained, however, by attempting to determine what differentials are normal for Monsoon Asia as a whole. If price records were available in Bombay, Calcutta, Singapore, Batavia, Rangoon, Hong Kong, and Manila, one would expect to find in the grain-price relationships not uniformity, but substantial differences—though with rice and wheat (or wheat-flour) prices tending to stand above the prices of other grains.

It seems probable that, over the past half-century or more, wheat has tended to become cheaper in relation to rice. On British markets, this is suggested by the following index numbers of prices (average for 1867-77 = 100):<sup>1</sup>

Period	Wheat			Rice	Ratio wheat to rice
	English Gazette	American	Average	Rangoon cargoes to arrive	
1867-77.....	100	100	100.0	100	1.00
1878-87.....	73	78	75.5	80	.94
1890-99.....	52	56	54.0	63	.86
1904-13.....	58	64	61.0	77	.79
1922-30.....	85	94	89.5	152	.59
1931-39.....	48	58	53.0	93	.57
1939.....	39	54	46.5	111	.42

It is suggested also by Chang's<sup>2</sup> study of prices in Kiangsu province of China (a rice-wheat region 130 miles from Shanghai), covering the 33-year period, 1894-1926. He found average annual increases of 3.4 per cent in the price of late rice (unhulled) and 3.3 per cent in that of white rice (polished), but only 2.9 per cent in that of wheat. Jasny's<sup>3</sup> investigations show that wheat prices have tended strongly to come nearer the price level of other grains excluding rice. Wheat seems therefore to be tending to become cheaper in

<sup>1</sup> The Editor of "The Statist," "Wholesale Prices in 1939," in *Journal of the Royal Statistical Society* (London), N.S., Vol. CIII, Part III, 1940, p. 356.

<sup>2</sup> L. L. Chang, *Farm Prices in Wuchin, Kiangsu, China* (China Ministry of Industry, Bur. Foreign Trade, Booklet Series 19, Shanghai, June 1932), p. 36.

<sup>3</sup> *Competition among Grains*, esp. pp. 186-92.

relation to other grains generally, rice included. If this tendency should continue, and wheat becomes cheaper in relation to rice in Monsoon Asia, wheat consumption may be expected to expand, especially at the expense of the inferior cereals.

#### DIFFERENTIALS IN RICE PRICES

The record of rice prices in the principal rice markets is so fragmentary that little can be said of "normal" relationships. As between identical grades in different markets, export prices must obviously be lower than c.i.f. duty-free import prices by at least the inclusive costs of transport,<sup>4</sup> in the absence of price support and export bounty in the exporting countries. The following tabulation shows Rangoon and London prices of Burma No. 2 rice, in gold francs per quintal, together with ocean freight costs in selected years:<sup>5</sup>

Year	Prices		Spread		
	London	Rangoon	Total	Freight*	Other
1927.....	36.11	28.68	7.43	3.72	3.71
1928.....	34.03	26.05	7.98	3.29	4.69
1929.....	32.72	25.59	7.13	3.05	4.08
Av. ....	34.29	26.77	7.51	3.35	4.16
1936.....	11.71	8.23	3.48	1.80	1.68
1937.....	13.72	8.83	4.89	2.93	1.96
1938.....	12.19	8.41	3.78	2.37	1.41
Av. ....	12.54	8.49	4.05	2.37	1.68

\* Burma-United Kingdom/Continent.

The total spread between import and export price averaged about 23 per cent of the import price in 1927-29, about 32 per cent at the lower price levels of 1936-38. Freight rates declined much less than import or export prices, while other

<sup>4</sup> Export prices of rice as quoted in the exporting countries include sacks but not export duties. Hence spreads between export and import prices cover the export duties as well as the more usual inclusive costs of transport.

<sup>5</sup> From International Institute of Agriculture, *International Yearbook of Agricultural Statistics, 1931-32 and 1936-39* (Rome, 1932, 1939).

elements in the spread, presumably including the profits of exporters, declined more than freights but proportionately less than rice prices. The spreads between export prices and import prices in nearer markets like Singapore, Hong Kong, and Ceylon would have been smaller than the London-Rangoon spread; but the available evidence is insufficient to establish either the general relationships or particular changes during the past two decades.

Appendix Table VIII (pp. 330-31) provides some limited evidence on price differentials in several markets of Monsoon Asia. In the import market of Singapore, what is known as "Siam No. 2" rice is consistently more expensive than those termed "Rangoon No. 1" or "Saigon No. 1," and Saigon No. 1 is usually though not invariably more expensive than Rangoon No. 1. In the import markets of Java, Rangoon rice is consistently more expensive than Saigon rice. The grades quoted are not specified, but both are probably lower than the qualities of foreign rice imported into Singapore. The general relationship is apparently that rice from Thailand occupies a premium position, that from Indo-China a discount position; this is probably a reflection both of the types of rice produced and of grading and marketing practices (see p. 80), and possibly also of consumer preference.

In Japan, as a reflection of well-defined consumer preference, domestic rice obtains premium prices; that from the colonies sells at a small discount as does rice from California; and rice from the major rice exporters of the Indo-Chinese Peninsula suffers the largest discount.

Within each of the exporting countries, the rice-price structure reflects millers' preferences for certain types of paddy and the milling results obtained. Price differentials between grades of the same variety of rice in large part reflect the content of broken kernels.<sup>9</sup> Other factors in judging quality

<sup>9</sup> The fact that Japanese types of rice can be milled without great breakage may be one reason for the Japanese practice of partial milling on the farm (p. 73). Conceivably this may also have something to do with the Japanese preference for Japanese types.

from a commercial standpoint are: color and uniformity of the grains; amount of foreign matter; percentage of unhulled, damaged, or chalky grains; mixture of other varieties; and general appearance.

Despite some pronounced preferences on the part of Oriental rice eaters, one finds little evidence of wide price differentials between types and varieties of rice on Asiatic markets. This is presumably attributable to the fact that where such preferences are strongest, radically different rices are seldom found in important volume in the same market. In the Occident, appearance and length of the grain seem to be the chief basis of consumer preference. Neither convenience or ease in cooking, nor flavor or texture, seems to loom so large.<sup>7</sup>

The typical Asiatic rice consumer is able to distinguish very sharply between different types of rice and apparently has strong preferences for some varieties over others. The basis for such highly developed preferences is not wholly clear. Why the Japanese prefer one flavor and the natives of Thailand another appears to be based partly upon taste that has been developed over generations. Rice varieties adapted to the soil and climatic conditions of one region probably possess flavor characteristics differing from those adapted to other regions. When conservatism is so strong in matters of taste and when the population tends to be immobile, the local consumer might well be inclined to regard rice grown in more distant regions and possessing different flavors as in some vague sense inferior. Furthermore, the extent to which rice is consumed in the Orient tends perhaps to develop discriminations beyond the comprehension of the typical Western consumer.

It is probably impossible, however, to determine the precise basis for preference in different localities. It is certainly

<sup>7</sup> Western consumers are not typical of rice eaters generally, and the dishes prepared from rice are usually quite different from those more common in the Orient. A tendency toward "mushing" when cooked, for example, is not objectionable in a rice pudding, whereas in curry and similar dishes maintenance of the whole grain throughout cooking and serving is much desired.

not wholly a chemical matter. Texture of the boiled product may be even more important. If one asks intelligent Japanese, Chinese, Filipinos, and Javanese why they dislike certain types of rice, they are not able to give a clean-cut answer. Usually they can do no better than to say that the rice in question is "coarse." Sometimes they add "and poor in flavor."<sup>8</sup>

Preferences based upon cooking properties vary. The Chinese, for example, generally prefer their rice firmer than do most Orientals, notably the Japanese, and they carry this preference with them wherever they migrate in southeastern Asia. The desirability of a "solid" or "soft" grain may depend upon the manner of eating the cooked product—whether it is consumed along with other foods or as part of a mixture with other foods or sauces. In the case of parboiled rice, both convenience of preparation and taste of the cooked product are factors involved in its use. Parboiled rice may be prepared the night before it is consumed and is palatable as a cold dish. It is particularly suitable to plantation conditions where time and facilities for cooking are commonly not available. Japan-type rice is also palatable when cold, but China-type rice on standing after the first cooking becomes dry.

The rice produced in Chosen and Taiwan was once quite different in quality and taste from that grown in Japan and therefore was less acceptable in the Japanese market. It was regarded with the same disfavor as rice grown in southeastern Asia. Japanese scientists succeeded in developing for the colonies varieties that now differ little from rice produced in Japan Proper. Inasmuch as the Japanese have long been under pressure to increase the rice output of the Empire, it is probable that in the development and introduction of im-

<sup>8</sup> One Japanese explanation of the Japanese preference has been that foreign rice "has a coarse skin of cells which contain protein, and do not break when the rice is boiled, thereby producing a tough and unpalatable food. . . . the cell skin of the Japanese product is soft and easily broken when boiled, and the protein content therefore produces a glutinous effect which makes this rice soft and more tasteful." See Ryoichi Ishii, *Population Pressure and Economic Life in Japan* (Chicago, 1937), p. 168. Hawaiians of Japanese blood have told one of the authors that, in their opinion, the prominent difference between Japan-type and China-type rice is not flavor or aroma, but relative softness and moistness of the Japan-type rice after cooking.

proved varieties much emphasis was placed upon high-yielding characteristics. In general, rices regarded as superior in flavor are not heavy yielders. Perhaps the strongly developed Japanese preference for Japan-grown rice has undergone modification during the course of the government's efforts, dating back to the Tokugawa Era (beginning of the seventeenth to the middle of the nineteenth centuries), to provide sufficient rice for its people. Rice was at one time at the root of practically all economic problems of the country, and government control measures were designed chiefly as protection against famine and military insecurity.

British Malaya is another area where differences in consumer preferences for rice are marked. The explanation seems to lie in the presence of large numbers of Chinese and Indians in the population. Both groups are comparatively recent arrivals, and their preferences differ from those of the native Malays. The Bengalese and the Javanese also discriminate sharply among different types of rice. It has been reported, for example, that Carolina rice grown in Calcutta could not be sold by any native dealer but had to be exported to London; that even famine could not induce the Bengalese to eat Burmese rice in Bihar in 1874;<sup>9</sup> and that Carolina rice grown in Java had to be exported to Holland.<sup>10</sup> Just how much reliance can be placed upon such reports is difficult to say at this distance, but it is hard to believe that starvation would be preferred to an unfamiliar or foreign rice.

However, reasons seem to exist for large premiums on highly favored types of rice, and heavy discounts on types not preferred. Yet most of the statistical evidence refers to price differentials between grades of a given variety that are based not upon consumer preference but upon the percentage of broken kernels in each grade. In order to perceive clearly whether or not consumer preference in fact gives rise to large

<sup>9</sup> J. van B. de Haan, "Waarom de Teelt van Carolina-Rijet in Britisch-Indië weinig Ingang vond," *Teysmannia* (Batavia), 1903, XIV, 235.

<sup>10</sup> W. R. T. de Haas, "Nogmaals Carolina-Padi," *ibid.*, p. 250.



price differentials, it would be necessary to have price quotations on each of several markets for high-grade rice (containing few brokens) of different types and varieties. Such positive evidence is not available. Fancy qualities and discount qualities are rarely quoted, but more important—and this may be considered a negative sort of evidence supporting the contention that taste preferences for rice are in fact very highly developed in Oriental countries—foreign rices held generally in disfavor in a particular region would not be imported to local markets except in an emergency, or for nonfood uses, and hence prices of such rices would not be quoted with regularity.

#### ELASTICITY OF DEMAND

The demand for rice for human consumption, though it cannot be characterized with precision, undoubtedly consists both of elastic and of inelastic elements.

As previously shown, the demand in the Japanese Empire is for home-grown rice of the Japanese type, rather round-grained and relatively nonvitreous. The colonies of Chosen and Taiwan produce a closely similar type of rice almost equally acceptable to the Japanese. California rice, similar in type, ranks next in acceptability in Japan. Least desired are the types from Burma, Thailand, and Indo-China. The demand of the Japanese Empire as a whole is probably inelastic in large degree, as judged by the small range in quantities consumed from year to year in Japan Proper, which seldom differ by as much as 5 per cent from one year to the next.<sup>11</sup> It may be more elastic in Chosen and Taiwan.

Quantitatively much more important is the local demand from the rest of Monsoon Asia. It is mainly for ordinary rice, not highly milled, and is probably in the main elastic in character. But a small demand, probably inelastic, exists

<sup>11</sup> See C. E. Campbell, *Factors Affecting the Price of Rice* (U.S. Dept. Agr., Tech. Bull. 297, April 1932), p. 47.

among upper-class and middle-class natives for medium and fancy qualities of rice; and the demand for imported rice into Malaya and Ceylon must be regarded as rather inelastic because imports show so little variation from year to year (Chart 7, p. 96).

The demand from non-Asiatic countries, chiefly Europe, for rice from Monsoon Asia is mixed in character. Considerable medium-grade and some fancy-grade rice is taken to serve a market presumably inelastic. But a good deal of poorer-quality rice was formerly and has recently been absorbed for industrial uses and animal feed, typically a very elastic type of demand.

In sum, the elastic elements appear to predominate in the demand for rice produced in Monsoon Asia. But, outside of the Japanese Empire, little demand exists for carrying stocks from one year to another (see p. 82). In general, the conditions of demand seem to be such that fluctuations in consumption of rice produced in Monsoon Asia would be expected to parallel fluctuations in crops rather closely, and that prices would move within rather narrow ranges so far as demand might affect the price changes.

#### VARIABILITY OF SUPPLY

The conditions of supply, on their part, are such that only moderate fluctuations in rice crops would be expected. Natural conditions, methods of cultivation, and the incentives of producers all contribute to stability of supply. The hazard of deficient moisture is in considerable degree obviated both by the natural abundance of rainfall in the major producing areas, and by the prevalence of irrigation. Acreage is likely to change little from year to year because so much rice is grown on paddy land not readily shifted to other uses, because it is so largely a subsistence crop produced on small holdings under primitive methods, and because enlargement of the paddy acreage is necessarily a slow process. If coefficients of variation of the world wheat crop excluding China

and the USSR and of the rice crop of Monsoon Asia excluding China are compared, the wheat crop—though itself more stable than many crop-production series—has a variation of 5.4 per cent over the period 1920–39, whereas the rice crop has a variation of only 3.0 per cent.<sup>23</sup> So much of the world's wheat crop is grown in subhumid and semiarid climates and thus subjected to a major hazard of yield, and acreage is so readily expanded (but less readily contracted) under mechanized farming, that this contrast between wheat and rice would be expected. In India, the coefficients of variation are 6.8 per cent for wheat, 5.5 per cent for rice. The less marked difference than in "world" crops is probably explained largely by the fact that irrigation of wheat is much more important in India than in the world as a whole. More than two-fifths of the Indian wheat crop is irrigated, but less than one-fourth of the rice crop.

Within Monsoon Asia, however, the degree of variability of rice production seems to differ appreciably from region to region. Charts 13 and 14 show trends and fluctuations in the rice crop of Monsoon Asia (excluding China) and in various parts of the area. In India as a whole and the two specified major parts of it, production has tended to remain at about an even level during the past two decades. So far as the statistics can be trusted,<sup>24</sup> the upward trend in total output, as Chart 14 shows, has come elsewhere—in all of the non-Indian regions except China, where the trend is unknown.

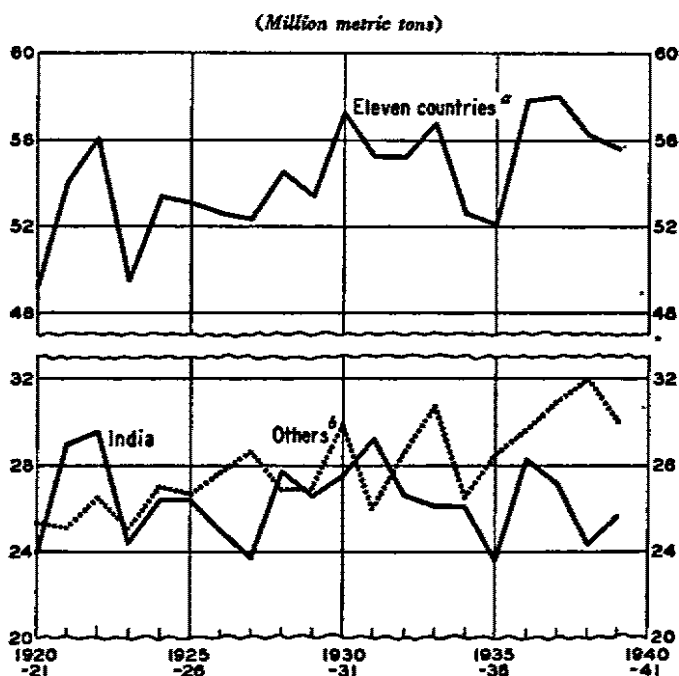
<sup>23</sup> If the rice crop of China and the wheat crops of China and the USSR could be included in the calculations, the results of such a comparison might be different. Some official estimates of the Chinese rice crop are available from 1931 to 1936, as follows, in million metric tons of cleaned rice:

1931 .....	26.7	1934 .....	26.1
1932 .....	33.0	1935 .....	32.0
1933 .....	32.2	1936 .....	32.0

The largest crop, that of 1932, was 26 per cent larger than the smallest crop of 1934 (a year of drought). In India, the percentage variation in the same years from smallest crop (1935) to largest (1931) was 24 per cent; in the Japanese Empire (1934 and 1933), 25 per cent; in the three major rice exporters (1931 and 1933), 17 per cent; and in other countries of Monsoon Asia as a group, 14 per cent between 1931 and 1936.

<sup>24</sup> For comment on the probable reliability of statistics of acreage, yield per acre, and production, see chapter ix, pp. 197–99.

CHART 13.—RICE PRODUCTION OF INDIA IN RELATION TO THE PRODUCTION OF OTHER COUNTRIES OF MONSOON ASIA (EX-CHINA), 1920-21 TO 1939-40\*



\* Data from Appendix Table II.

<sup>a</sup> Monsoon Asia, ex-China.

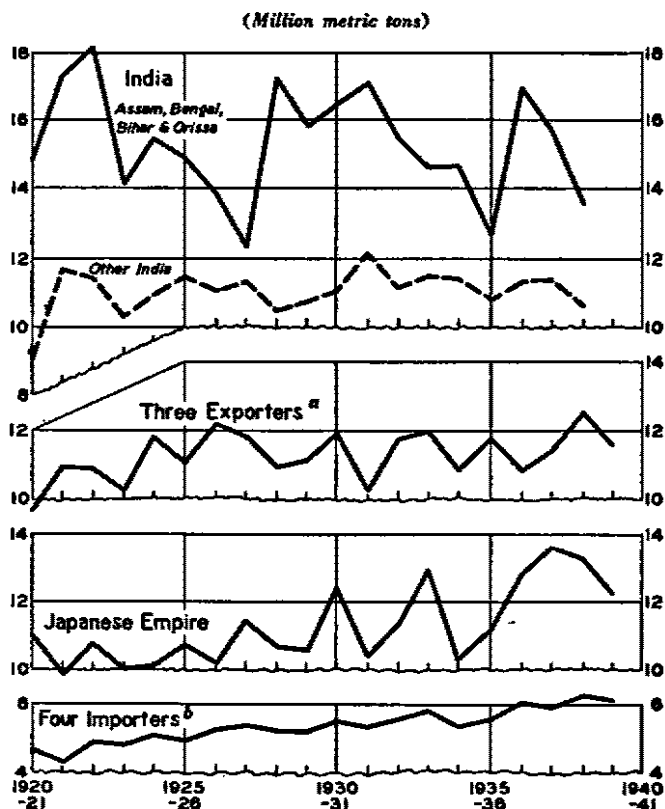
<sup>b</sup> Monsoon Asia, ex-China and ex-India.

Coefficients of variation of production, 1920-39, in the five regions shown in Chart 14, are as follows, in percentages:

Eastern India .....	8.4 per cent
Other India .....	4.2 per cent
Japanese Empire .....	6.0 per cent
3 exporters .....	4.4 per cent
4 importers .....	2.7 per cent

Variability appears to be greatest in northeastern India (Bengal, Assam, and Bihar and Orissa); in large degree the variations of rice output in this part of Monsoon Asia give rise to the fluctuations in aggregate output of the whole region,

CHART 14.—RICE PRODUCTION OF SELECTED GROUPS OF COUNTRIES OR PROVINCES IN MONSOON ASIA, 1920-21 TO 1939-40\*



\* Data from Appendix Table II and India Dept. Commercial Intelligence and Statistics, *Estimates of Area and Yield of Principal Crops in India*.

<sup>a</sup> Burma, Thailand, and French Indo-China.

<sup>b</sup> Ceylon, British Malaya, Netherlands Indies, and Philippine Islands.

China excluded. But, particularly in the past decade, the Japanese Empire has also contributed substantially to fluctuations in the Asiatic rice crop, while the crops of the three exporters, of "Other India," and especially of the four importers, have varied less.

These coefficients of variation of crops reflect several sets of influences, including changes in acreage, changes in yields,

and changes in statistical methods of estimating production; and manifold influences affect each of these. No effort can be made here to offer adequate explanation of the differences between the several coefficients. It is perhaps not surprising to find production more variable in northeastern India than in "Other India," since only about one-seventh of the rice acreage in the northeast is artificially irrigated, as against one-third in the rest of the country. On the other hand, the greater variability of output in the Japanese Empire than in the three exporting countries seems surprising, in view of the higher degree of intensity of cultivation, wider use of irrigation, and lesser exposure to hazards at least of flood in Japan Proper. Similarly, the much greater variability of output in the Japanese Empire than in the four importing countries (among which Java is much the largest producer) might not be expected in view of the differences in climate and methods of cultivation. But perhaps the Japanese Empire is the more exposed to hazards of drought, typhoons, and low temperatures. In any event, the qualifications necessary in the interpretation of such computations are sufficiently numerous to make definite conclusions unwarranted.

#### PRICE CHANGES SINCE 1920

One ultimate effect of demand and supply conditions for the rice of Monsoon Asia is that rice prices are somewhat less variable from year to year than wheat prices. This is shown by the following average annual percentage changes in the prices of each cereal in specified exporting countries over the 15-year period from 1925 to 1939:<sup>14</sup>

Rice	Wheat
Burma (Rangoon) . . . . . 12.6	Canada (Winnipeg) . . . . . 19.7
French Indo-China (Saigon) 15.6	Argentina (Buenos Aires) . . . 17.2
Thailand (Bangkok) . . . . . 16.3	Australia . . . . . 17.8

<sup>14</sup> Wheat prices for crop years 1924-25 to 1939-40 are taken from series regularly carried in *Wheat Studies*; rice prices are of representative export grades as in Appendix Table VIII (for Thailand 1925-36 only). All prices converted to the common basis of gold.

The most significant of the rice-price series, that for rice exported from Rangoon, shows the greatest stability of all; and it is much less variable than Winnipeg prices of Canadian wheat, also a very significant series.

Broad features of rice-price movements in Monsoon Asia since 1920 are summarized in Charts 15 and 16 (pp. 150, 151).<sup>25</sup> Index numbers of prices as quoted in the domestic currencies, and of these prices as converted to gold values, are shown in both charts, for three importing countries in Chart 15 and for three exporting countries in Chart 16.

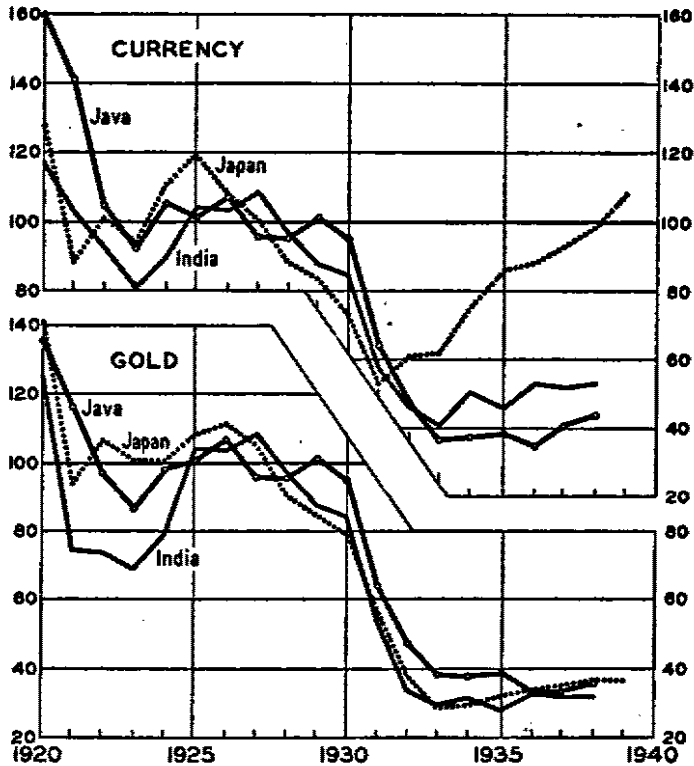
The diversity of price fluctuation shown by the currency prices warrants little comment. Among the three importers, Japanese currency prices deviated most from their gold equivalent, reaching their interwar low in 1931 rather than in one of the years 1934-36 as occurred elsewhere, and rising persistently after 1931 to a level (in 1937-39) not far from their average level of 1925-29. Conversely, currency depreciation was least marked in Java, where currency prices moved fairly closely in accord with their gold equivalent. Among the three exporters, Indo-Chinese currency prices deviated most widely from their gold equivalent, especially in 1929 and 1930 following depreciation of the French franc (to which the Indo-Chinese piaster was tied) in 1928, and again after 1936.

In view of the fact that Burma was a part of India up to 1937, with the same currency, holding the same relationship to British currency and without trade barriers between the two; it is interesting to observe that Calcutta prices moved in the opposite direction from Rangoon prices in nearly half of the years in the past two decades, and in several other years fluctuated either substantially more or substantially less though in the same direction. These developments pre-

<sup>25</sup> No attempt is made to take into account price developments following the outbreak of war in Europe. Shortage of shipping space, an unexpected deficit in the rice supply of the Japanese Empire, and attempts to build emergency stocks in several importing countries, all conspired to raise the export prices of rice to levels not attained since the late 1920's.

CHART 15.—CURRENCY AND GOLD PRICES OF RICE IN INDIA, JAVA, AND JAPAN, SINCE 1920\*

(Index numbers: 1925-29 = 100)



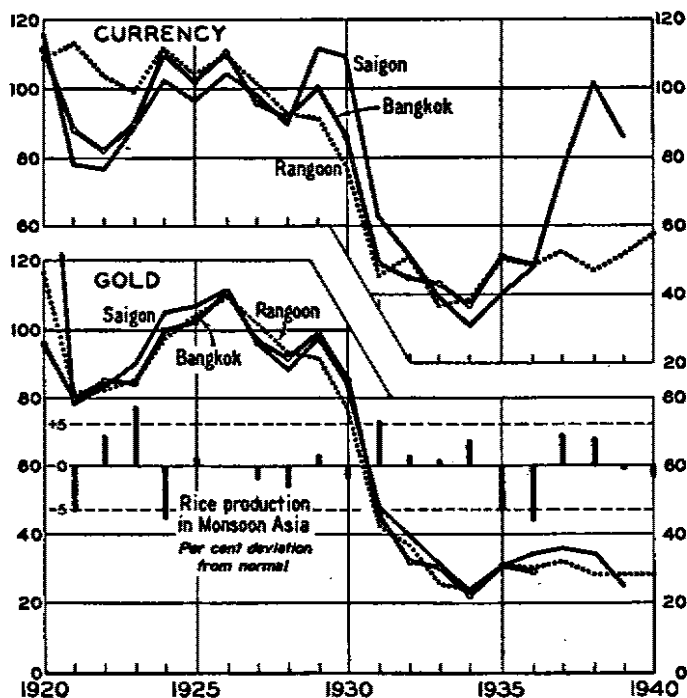
\* Based on data in Appendix Table IX.

sumably reflect changes in local supplies of particular grades or types of rice, much as the price of such a grade of wheat as No. 2 Hard Winter at Kansas City may at times move differently from the price of such a grade as No. 1 Dark Northern Spring at Minneapolis. But particularized information is not available concerning variations in the supplies respectively of Ballam No. 1 rice in India and Big Mills Specials in Burma.



CHART 16.—RICE PRICES IN BURMA, THAILAND, AND FRENCH INDO-CHINA IN RELATION TO VARIATIONS IN SUPPLY, 1920-40\*

(Index numbers: 1925-29 = 100)



\* Based on data from Appendix Tables II and VIII.

If attention is focused upon the movement of gold prices in the importing countries since 1925, conspicuous exceptional developments appear in the relatively high level maintained by Javanese prices in 1929-30 and also in 1933-35. The high levels of 1929-30 probably reflect the short Javanese crops in 1928 and 1929 (Chart 21, p. 198), and the relatively well-maintained levels of 1933-35 reflect price effects induced by introduction of an import-licensing system and tariff duties in 1933, plus the influence of the short crop of 1934. Import controls in the Netherlands Indies and Japan apparently helped to keep the level of domestic prices in

terms of gold from falling to as low a level, in the period 1933-39 as compared with 1925-29, as was true in the exporting countries. Gold prices of rice in the importing countries moved in 1933-39 at levels which were only 28-38 per cent of their 1925-29 levels. The arsenal of weapons available to combat price deflation and to protect domestic rice producers was, as usual, more ample for importing than for exporting countries.

If attention is focused upon the course of gold prices in exporting countries since 1925, perhaps the most conspicuous deviation from general rice-price trends is the failure of prices at Rangoon to rise between 1928 and 1929 along with prices at Bangkok and Saigon. This may also be explained by changes in the geographical distribution of crops. On the side of the exporters, Burma had a good crop for sale in 1929, a little larger than in 1928; while both Indo-China and Thailand had much smaller crops available for sale in 1929 than in 1928.<sup>16</sup> On the import side, the crop of India, Burma's chief market, was considerably larger in 1929 than in 1928, making for smaller demands upon Burma; the situation was reversed in certain markets naturally more readily open to Indo-China and Thailand, namely, Java, the Philippines, and Japan.

The course of gold prices of export rice over the whole period since 1920, however, differs little from one exporting country to another. In general, there was a sharp drop from 1920 to 1921, a moderate rise to 1926, a moderate decline to 1929, a very steep decline to 1934, and gradual stabilization thereafter at a level not much above the low of 1934. With differences as to degree of change, and particularly the timing of the peak in the middle 'twenties, this was also the general course of wheat prices in terms of gold,<sup>17</sup> or of gold

<sup>16</sup> Chart 21, p. 198. The crops there given as those of 1927-28 and 1928-29 may be regarded as available for sale in the calendar years 1928 and 1929.

<sup>17</sup> See Wickizer, "Rice and Wheat in World Agriculture and Consumption," p. 301.

prices of commodities generally in many countries of the world. The broader movements in rice prices (gold) therefore reflect not so much commodity developments within the rice situation itself, as general movements in world prices.

It is in fact difficult to perceive much apparent effect of changes in rice supplies upon rice prices (gold). This would be expected if demand is predominantly elastic and supply is moderately variable but not highly responsive to changes in rice prices. The bottom sections of Chart 16 (p. 151) show changes in the rice crop of Monsoon Asia ex-China, expressed as percentage deviations of crops from trend, in contrast with the course of rice prices in the exporting countries. Prices rose moderately between 1921 and 1922, although the crop for sale in 1921 was more than 5 per cent below "normal," while the crop for sale in 1922 was more than 3 per cent above. Similarly, the large change of crop between 1936 and 1937 brought only a very small increase in price, and a smaller change in crop between 1928 and 1929 that might have been expected to bring a reduction in prices was accompanied by increase in two markets and reduction in only one. On the other hand, it is possible that the large reduction in crop between 1923 and 1924 was a significant price influence, and the changes between 1930 and 1931 and 1934 and 1935 as well. The latter change, at least, was intensified by developments in China, where the crop available for 1935 was more than 20 per cent below the crop available for 1934.

The effect of change in supply upon price thus appears not to be of major importance, at least if "supply" is defined as the rice crop of Monsoon Asia excluding China, as that crop is estimated. Perhaps the estimates are grossly inaccurate. Perhaps crop changes would seem more systematically related to price changes if the Chinese crop could be counted as "supply." Perhaps a more systematic supply-price relationship would emerge if account could be taken of year-end stocks as part of the supply, though this seems improbable

because, outside of the Japanese Empire, year-end stocks seem quantitatively unimportant.<sup>15</sup>

Possibly, or indeed probably, certain segments of the rice supply influence price much more strongly than other segments. It may be that only those parts of the supply that are closest to trade channels, especially in the relatively few important regions where demand is inelastic in type, influence the export prices significantly. Perhaps it is rice supplies particularly in "key" markets<sup>16</sup> of Monsoon Asia, such as Malaya, Ceylon, Java, and the exporting countries, taken in connection with demand from Europe, that might reasonably be singled out as the most important in their bearing on price. In any event, rice output, at least of southeastern Monsoon Asia, seems to be absorbed every year without appreciable change in carryovers, whatever the supply situation, and whatever the distribution of output between exporting and importing countries. Cumulative carryovers, twice or three times as large as annual exports, though known in the wheat world, have thus far been unknown in Monsoon Asia, and seem unlikely even under the stress of war.

#### CHINA AS A "SHOCK ABSORBER"

During the 'twenties and early 'thirties, before governmental policies resulted in near-disappearance of China as a market for rice imports after 1935 (pp. 93-94), a belief persisted that Chinese import purchases tended to act as a stabilizing influence on Asiatic rice prices. The general view was current that China bought heavily when export prices were low, checking extreme price decline, and purchased little when prices were high, checking extreme price advance.

<sup>15</sup> See above, p. 82. In the exporting countries, usually not much more than the equivalent of one month's shipments are ever in the hands of the trade; these are merely working stocks. Carryovers at the end of a season, though not closely estimated, are apparently not much larger. For example, in Burma at the end of 1930 the carryover was "estimated at 150,000 tons, a figure only a little higher than usual" (Burma, *Interim Report* . . . . p. 16). It was less than 6 per cent of the exports of 1930.

<sup>16</sup> Cuba seems to be such a "key" market in the West. Competition from Asiatic rices, especially during months of favorable shipping conditions, affects the volume and distribution of United States exports, with repercussions on the price structure and the industry.

Thus Smits,<sup>18</sup> writing in 1929, found an inverse relationship between rice prices (Ballam rice at Calcutta, India) and Chinese net imports by calendar years, 1909-26. Such a relationship might more or less reasonably be expected in view of the probability that Chinese demand is characteristically elastic, although few would expect to observe a high degree of regularity in the relationship in view of the numerous influences that might well disturb it.

After a sharp rise to 1910 and an equally sharp drop to 1912, Chinese net imports rose steadily to 1916. Rice prices dropped between 1909 and 1910, rose sharply to 1913, then declined slightly to 1914. Thus developments accorded with the theory from 1909 to 1912 inclusive. But from 1914 to 1916 prices rose without apparent discouragement of imports. Net imports into China declined from 1916 to very low levels in 1919 and 1920. The decline from 1916 to the latter part of 1918 would not have been in response to rising prices, since prices fell; but the reduction of imports from the end of 1918 to 1919 and 1920 occurred when prices were rising. Thus the record yields a suggestion of an inverse relationship between price change and import change in this period, but exceptional behavior seems somewhat frequent.

A record of Chinese net imports annually from 1921 to 1935, in comparison with index numbers of export rice prices (gold) at Saigon and Rangoon, is given in Chart 17. Here there is little evidence of inverse relationship between price change and import change. If one compares year-to-year changes of Chinese net imports with year-to-year changes of Saigon rice prices, there are only 6 occasions out of 14 in which the direction of change in imports was opposite to the change in price—namely, 1923 to 1924, 1924 to 1925, 1926 to 1927, 1928 to 1929, 1929 to 1930, and 1931 to

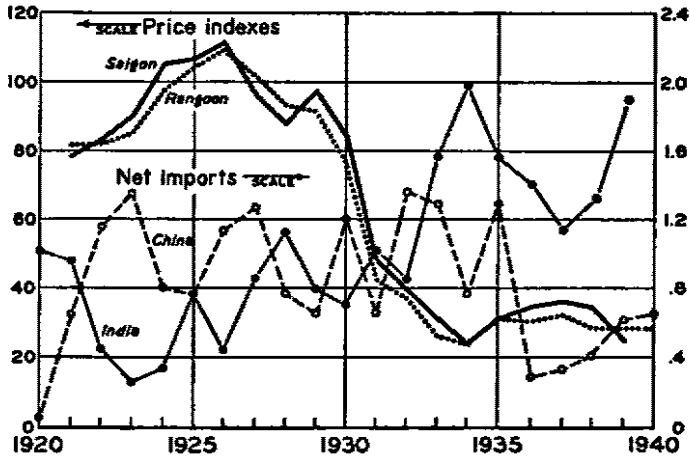
<sup>18</sup> M. B. Smits, *The Rice Situation* (Fourth Pacific Science Congress, Batavia-Bandoeng, Java, May-June 1929), pp. 60-61 and figure b opposite p. 60. The inverse relationship was not consistently apparent from 1909 to 1918 and was closest from 1918 to 1926.

1932. If the Rangoon prices are used as the basis for comparison, there are only 5 such occasions; the change of imports from 1928 to 1929 was in the same direction as the change in export price. The evidence of price-import relationship afforded by this chart is certainly unconvincing.

Nevertheless a definitive answer to the assertion that

CHART 17.—NET IMPORTS OF RICE INTO CHINA AND INDIA, AND GOLD PRICES OF RICE AT RANGOON AND SAIGON, 1920-40\*

(Index numbers: 1925-29 = 100; million metric tons)



\* Based on data from Appendix Tables IV and VIII.

Chinese rice purchases tend to stabilize rice prices may well require other evidence than that afforded by Chart 17.<sup>20</sup> Perhaps neither Saigon nor Rangoon export prices serve as a proper basis of comparison; a c.i.f. import price at Hong Kong (unfortunately not available) would theoretically serve the purpose better. It would be desirable also, for so large a country as China, to examine the particular points of import and to ascertain, by study of grain-rice relationships, whether

<sup>20</sup> It might be possible that such an effect tends to occur from week to week or month to month within years; but with this hypothesis we are not concerned here.

rice was imported as addition to rice supply or as substitute for some other grain. It would further be desirable to know whether or not large imports coincided with small Chinese rice crops, small imports with large rice crops. This is feasible only for the years 1932 to 1935 inclusive. Official estimates of Chinese rice crops (p. 145 n.) show small crops available for sale in 1932 and 1935, large crops in 1933 and 1934. The net imports were heavy in both years of small crops, small in one of the two years of large crops (1934), but large in one of the years of large crops.<sup>21</sup> Information concerning the geographical distribution of the rice crop within China, as well as its aggregate size, might help to explain some aspects of import behavior. Possibly shortage or abundance of rice crops in coastal rice-growing provinces would explain import fluctuations better than would crop fluctuations in the interior provinces. Finally, it would be desirable to ascertain whether or not internal political instability, and fluctuations in the price of silver, the basis of Chinese currency until recently, have affected the volume of rice imports.

For what it may be worth, a curve has been added to Chart 17, showing the annual fluctuations of net imports of rice into India. If China has a characteristically elastic demand and acts as a stabilizer of rice prices, it would seem reasonable to suppose that Indian demand might exercise a similar influ-

<sup>21</sup> The probable influence upon imports of fluctuations in the volume of domestic crops is minimized by some writers. Thus Friedrich Otto, in his "Correlation of Harvests with Importation of Cereals into China," *Chinese Economic Journal* (China Ministry of Industry, Bur. Foreign Trade, Shanghai), October 1934, XV, 392 ff., concludes that there is no correlation between quantity or quality of grain crops in China and the volume of cereal imports. Studying rice, wheat, and wheat flour during the period 1918-33, he finds an explanation for the increase in cereal imports between 1918 and 1931 in the abnormal growth of population in large cities without parallel development of agriculture in the environs of the cities; he credits the state of world markets as being the chief cause of increased imports thereafter; and he regards harvest results in the chief producing centers as the last and least influence on cereal imports. P. O. Nyhus, of the U.S. Department of Agriculture (quoted in "Wheat Crop in Important Areas of China below Normal," *Northwestern Miller*, Minneapolis, Nov. 23, 1932, p. 469), concludes that the "imports of foreign wheat at Shanghai during the past five years seem to bear very little relationship to . . . annual changes in the size of the crop in the lower Yangtze Delta . . ."

ence.<sup>23</sup> Curiously enough, a substantial degree of inverse correlation appears between Indian and Chinese net imports; except on only 2 occasions out of 14, year-to-year changes in Indian imports have been in the opposite direction from the Chinese. We find no basis for explaining this phenomenon.<sup>24</sup> What emerges is that changes in Indian net imports are apparently more closely related (inversely) to changes in export prices than are the changes in Chinese net imports. At least the year-to-year changes in Indian imports were in the opposite direction to price changes in 9 or 10 out of 14 occasions, as against 5 or 6 out of 14 for China.

Furthermore, there appears to be some tendency for Indian net imports to fluctuate inversely with the size of the Indian rice crop, which itself fluctuates mainly with crops in northeastern India (Charts 13 and 14, pp. 146, 147). Year-to-year changes in the crop of northeastern India were opposite to changes in Indian net imports on 10 occasions out of 14 in the period 1921-35. Thus the statistical evidence indicates an elastic demand for rice in India but fails to support the logical belief that Chinese demand is also elastic. Despite the lack of conclusive evidence, it would seem that Indian import demand, though probably elastic, may be less so than Chinese, and the hypothesis may be advanced that China tended before 1936 to act as a sort of residual recipient of rice available for export in Monsoon Asia, absorbing residues unclaimed elsewhere. But the inference and the hypothesis require much more analysis than can be offered here before their credibility can be taken as established.

#### PURCHASING POWER OF RICE

From such fragmentary evidence as is available, it appears that the drastic change in the level of rice prices, from the

<sup>23</sup> The behavior of Indian wheat exports suggests considerable elasticity of domestic demand for wheat; with crops of similar size, exports tend to be large when world wheat prices are high, and low when prices are low.

<sup>24</sup> One reason for hesitating to press explanation is that the Chinese net imports are for calendar years, the Indian for April-March years. It is not at all certain that the apparent inverse relationship would appear so clearly if the two series were strictly comparable.



middle 'twenties to the early 'thirties (Charts 15 and 16, pp. 150, 151), involved a rather general decline in the purchasing power of rice; and that during the 'thirties up to the outbreak of war in Europe, the level of purchasing power of rice, though improving, failed to recover to the position prevailing in the early 'twenties. Costs of living and costs of producing rice declined much less than the price of rice in the steep deflationary movement of 1929 to 1933 or 1934. This was also the case with prices of other agricultural products, both in Monsoon Asia and generally throughout the world, especially among countries customarily exporting agricultural products. The unfavorable position of rice growers, who faced much greater reductions in prices of their chief product than in prices of commodities purchased by them, inevitably generated pressures upon governments toward relief of the economic situation of farmers, the most numerous occupational group among Oriental populations.

Evidence concerning changes in the purchasing power of rice is at best somewhat sketchy. Indexes of wholesale prices in general are available only for five countries or cities within these countries, and in at least two cases are probably not representative for recent years. These are summarized in the following tabulation (average annual wholesale prices, as published by the League of Nations, 1929 = 100):

Year	India (Calcutta)	Netherlands Indies	French Indo-China (Saigon)	China (Shanghai)	Japan (Tokyo)
1919 .....	139	...	...	...	142
1924 .....	123	117	...	93	125
1929 .....	100	100	100	100	100
1934 .....	63	46	63	93	81
1939 .....	76	59	106	232	126

After at least doubling in several countries between 1913 and the years immediately following the World War, wholesale prices took varying courses downward until 1934-35, after which they rose in all five countries, though by widely different amounts. In China the cheapening of silver and in

Indo-China the depreciation of the French franc, to which Indo-Chinese currency was pegged, were influential in causing the wholesale price level to rise during the late 1920's, when prices in the other three countries continued to fall.

Drastic deflation in all countries during the world depression led to the adoption of different types of monetary policies. Their diverse effects are shown by contrasting the index numbers of 1939 with those of the common base year, 1929. Lowest prices were in the Netherlands Indies (59 per cent of the 1929 level), which adhered to gold although the guilder was devalued, while prices in Indo-China, Japan, and China all rose above the 1929 level, reflecting varying degrees of price inflation or currency depreciation. Chinese (Shanghai) price inflation was most marked, Japanese next. In India, prices rose more than in the Netherlands Indies, but less than in the other three countries.

When rice prices in each of these five countries are compared with wholesale prices generally, some approximation may be obtained of the purchasing power of rice. Index numbers of the purchasing power of rice (rice prices divided by wholesale price indexes based on 1924-26, with results expressed as index numbers) for selected years since the peak of rice prices in 1926 are as follows:

Year	India	Java	French Indo-China*	China <sup>b</sup>	Japan
1924-26 . . . .	100	100	100	...	100
1926 . . . . .	112	106	105	100	105
1931 . . . . .	96	98	63	66	79
1933 . . . . .	75	81	49	56	79
1936 . . . . .	93	81	64	66	102
1937 . . . . .	83	71	77	68	90
1938 . . . . .	89	82	88	62	90
1939 . . . . .	...	...	70	70	89

\* 1925-26 = 100.

<sup>b</sup> 1926 = 100.

In Japan, where government control is exercised over rice prices, the decline in purchasing power of rice was some 21

per cent in the worst years, but the recent level runs only 10 or 11 per cent below 1924-26. The decline in the worst years was apparently slightly less in Java and slightly more in India, and largest in Indo-China. In recent years, however, the purchasing power of rice in Java and China has tended to remain at relatively lower levels than in the other countries. One might expect that the level of rice purchasing power in the 1930's as compared with the 1920's would be lower in the rice-exporting countries than in the importing countries, and in so far as Indo-China is representative of exporting countries this is suggested by the data.<sup>24</sup> Since 1937 and the outbreak of the Sino-Japanese war, however, rice purchasing power in China has tended to drop below the low level of Indo-China. The possibility that statistical misrepresentation exists in these figures is so great that little is to be gained by attempting to carry the discussion further.<sup>25</sup>

Whatever their inaccuracies, the data indicate satisfactorily that the purchasing power of rice in some countries (probably all) of Monsoon Asia was substantially lower in the 1930's than in the 1920's. Distress among the numerous rice growers was general in the later decade. On the other hand, a reduction in the purchasing power of rice might be expected to be advantageous to rice consumers in so far as they were not producers as well. As will appear subsequently (chapters ix and x), per capita consumption of rice in most countries tended to fall to lower levels in the 1930's than in the 1920's. This may in some degree reflect the fact that producers of rice in rice-consuming regions outnumber non-

<sup>24</sup> The necessary data are not available for other rice-exporting countries, but various investigations in the early 1930's emphasize the discrepancy between the level of producers' prices and of commodities generally. See, for example, Burma, *Interim Report . . .*; and H. K. Lee, *Land Utilization and Rural Economy in Korea* (A Report in the International Research Series of the Institute of Pacific Relations, Shanghai, 1936), p. 266.

<sup>25</sup> In view of declining tendencies in per capita rice consumption (chapters ix and x) which may be attributable to factors other than any lessening of desire, it may seem paradoxical that the purchasing power of rice has not been better sustained. If India and China, both huge reservoirs of ineffectively expressed demand, are disregarded, however, the apparent inconsistency that suggests itself, when a general or composite view of the Asiatic rice situation is taken, largely disappears.

producing consumers of rice and were under pressure to market a greater proportion of their crops in order to maintain their purchasing power at depression price levels; but other factors complicate the analysis.

#### SEASONALITY OF RICE PRICES

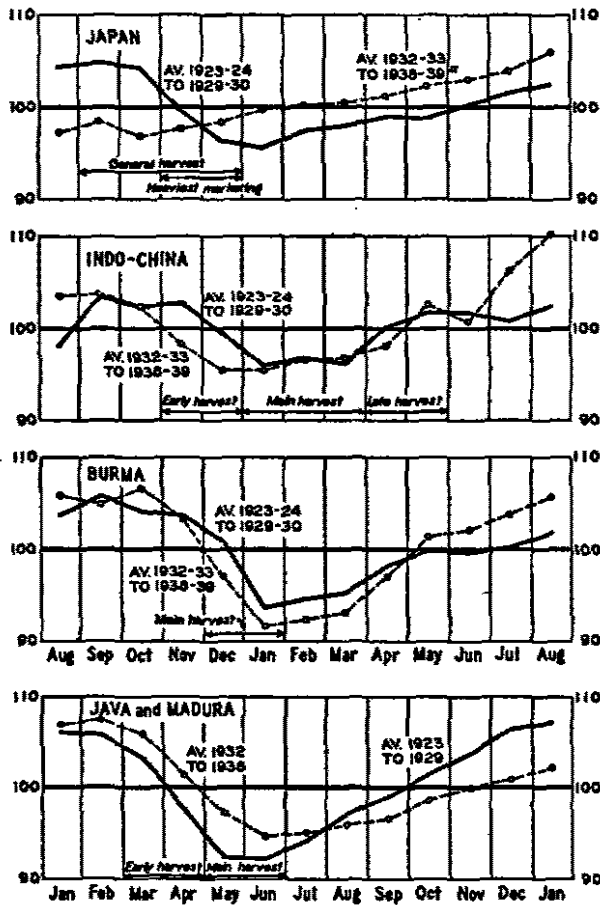
Important as reduction in the purchasing power of rice may have been in generating pressure toward governmental interventions in behalf of producers, the seasonal behavior of rice prices seems to have received even more attention. Possibly the effects of seasonal variations in rice prices are more readily identified with weakness of the cultivator's position; or governments may consider the remedy easier and more feasible politically than an attempt to manipulate the level of rice prices or purchasing power. The latter course might lead to government subsidies, currency manipulations, or other actions affecting smaller but more powerful groups of the population, whereas in attacking the problem of rice-price seasonality, speculators or alien merchants may conveniently be held responsible for a price behavior deemed contrary to the interests of growers.

Chart 18 illustrates the characteristic seasonal behavior of rice prices in four countries of Monsoon Asia. The lowest prices of the year are usually recorded during the two or three months including, and immediately following, the harvest. The decline from preharvest highs to main-harvest lows commonly exceeds 10 per cent but is less than 20 per cent. It is generally believed in the Orient that concentration of offerings is mainly responsible for this decline. Rice growers are generally poorly financed and unable to hold stocks. They borrow to carry on growing operations, and creditors expect repayment of loans as soon as the crop is harvested. Likewise, in some areas the government land taxes fall due during or immediately following the principal harvest.

Perhaps not too much credence ought to be accorded to the common Oriental view that it is dominantly the weak

CHART 18.—AVERAGE SEASONALITY IN RICE PRICES IN SELECTED COUNTRIES OF MONSOON ASIA\*

(Index numbers, yearly average = 100)



\* Monthly price data from official sources listed under each country in "Statistical Notes" (pp. 334-47); averaged for seven-year periods with the result expressed as a percentage of the average of all months, and without correction for trend.

\* Reflects price-control legislation passed in 1933 (see pp. 172, 176) and continuous upward trend of all prices with the currency depreciation of the 1930's.

financial position of growers and resulting postharvest concentration of offerings that causes the seasonal decline of rice prices from preharvest to main-harvest months. In Western

countries both the magnitude and the adverse effects upon farmers of seasonal fluctuations in wheat prices have probably been exaggerated,<sup>26</sup> and it has always been easy and politically convenient to argue that buyers victimize producers when producers are poor. Under a competitive system, however, it may be reasoned more soundly that seasonal fluctuations of prices mainly reflect merely the cost of carrying grain from one month to another. The situation in Monsoon Asia may well be that competition among buyers is not fully effective in many areas, in view of the system of credit extension from rice buyers to producers, and the producers' lack of familiarity with the course of price quotations on the principal markets (pp. 74-76). If this is true, something of a basis exists for regarding the seasonal fluctuations of rice prices as excessive and in some degree remediable. Whatever the true causes of these fluctuations, their existence has lent strong support to governmental interventions.

<sup>26</sup> See Holbrook Working, "The Post-Harvest Depression of Wheat Prices," *WHEAT STUDIES*, November 1929, VI, 1-40.

## CHAPTER VIII

### GOVERNMENT INTERVENTION AND PRICE-CONTROL SCHEMES

Governmental activities with respect to production, marketing, processing, and consumption of an important food commodity like rice, or to agriculture in general, may be undertaken with mixed objectives and may vary greatly in form and method from place to place and from time to time. Given the importance of rice in the economies of the countries of Monsoon Asia, some degree of governmental intervention in the rice industry seems almost inevitable.

Such intervention has often taken the mild form of assistance to growers—development of irrigation projects and flood-control systems, allotment of free lands or clearing of land suitable for rice, distribution of selected seed to improve yields, creation of financing and marketing organizations, or perhaps only government-sponsored technical advice or services of market information. Sometimes, particularly in the net-importing countries, governmental activity has leaned in the direction of protecting consumers against high rice prices through export and import controls, the creation of state-owned stocks for distribution, the licensing of middlemen and regulation of their margins, the supervision of weights, measures, grades, and so on.

Ambitions to become self-sufficient in rice, by reducing dependence on foreign imports and by stimulating domestic production, especially notable in the Occident during the past decade, have been apparent in the Orient as well. Sometimes efforts in this direction have been well organized and largely successful, as in the Japanese Empire. Sometimes they have been spasmodic, varying in intensity and effectiveness with the fortunes of other crops or industries and with the political outlook within the countries concerned, as in British Malaya.

Some rice importers, like the Philippine Islands and Java, find the ideal of self-sufficiency in rice attainable with moderate ease. Both the Outer Provinces of the Netherlands Indies and the Philippine Islands contain much undeveloped land which could be used for rice and presumably make these islands self-sufficient. The ideal may be attainable elsewhere, but in varying degrees the achievement may become uneconomic. British Malaya, for example, is a rice-deficiency country not so much because there is not enough land for rice growing as because the complex of land, labor, and capital appears to be more profitably employed if concentrated in other directions, such as producing rubber and tin for export. Its large immigrant population working on European-owned plantations is fed with imported rice. To a certain extent, the same comments apply to Ceylon, though here natural conditions appear to be less suitable to rice culture. China and India, with very little undeveloped agricultural area, would find attainment of self-sufficiency in rice a more difficult task. Among the exporters, of course, the question of self-sufficiency in rice is not involved. Here the problem is to secure for rice producers as satisfactory a level of income as can be obtained.

It is not feasible to review here all that the various governments of rice-producing countries have done in attempting to control the rice industry or to ameliorate the position of producers or consumers. Attention is focused particularly upon the best-developed system of control, that of the Japanese Empire, and upon the younger and derivative system of the Philippine Islands. In these two countries, a direct attack has been made upon the problem of stabilizing or elevating or otherwise controlling rice prices.

Not much need be said about governmental activities in the Netherlands Indies, and even less about the British possessions in Monsoon Asia—India, Burma, Malaya, and Ceylon. Here, and in the exporting countries of French Indo-China and Thailand, governmental policy toward the rice industry



has generally not extended much beyond encouraging improvement in the production process. In the early 1930's, this was often supplemented by currency manipulations that served clearly to support prices to producers though not so clearly to improve the purchasing power of their product.

#### UNFAVORABLE POSITION OF GROWERS

Even in the 1920's, the seasonal movement of rice prices that meant substantial price declines from preharvest to post-harvest months, and the general and perennial low-income levels of rice producers, proved more or less of a stimulus to governmental activity on behalf of farmers. But with the collapse of prices in the early 1930's and the accompanying decline in the purchasing power of rice, the chronic poverty among rice producers reached a stage sufficiently acute to call for intensified government activities.

Although very little specific evidence on costs of rice production is available (and would be difficult to interpret because rice-growing costs consist so largely of noncash items like family labor, home-grown seed, and animal labor), it seems certain that the decline of producers' prices must have far exceeded the decline in producers' out-of-pocket cash costs, including taxes. The margin remaining to producers for purchase of production or consumption goods must have narrowed greatly with the price decline and remained narrow for some years. Producers of rice<sup>1</sup> could do little shifting to other possibly more remunerative crops, and had no avenue of escape into industry. The impact of the rice-price decline must very commonly have been recorded in a reduction of cultivators' planes of living, already very low.

Observers of the problems of agriculture in Monsoon Asia are in remarkable agreement upon the generally disadvantageous position of the rice grower. A few quotations are pertinent.

<sup>1</sup> It should be emphasized that little rice is produced by capitalistic methods under the estate system in Monsoon Asia. See pp. 263-65.

The cultivation of rice has been continuously and universally carried on in Japan proper from very early times, but the methods of production and marketing, which were handed down by tradition, have not been much improved upon. . . . .

All who are informed on rural conditions know well how greatly in need of cash these farmers are. They put their rice on the market as soon as it is harvested, causing thereby a glut in the market, and consequently find that they must sell their products at a terrible discount. . . . .

more than half of the total amount of rice sold by cultivators is marketed from November to January. This fact alone would account fully for any great seasonal fluctuations in the price of rice. . . . .

The fact that so many farmers have to buy their own rice is contrary to the common belief that the farmer consumes the rice which he cultivates.<sup>2</sup>

. . . . On the average about 60 to 70 per cent of the total quantity of polished white rice marketed [in Wuchin, Kiangsu, China] is sold in the months of December to April . . . . In 1929, . . . . farmers in Nanking sold nearly all of their product at . . . . \$0.124 per *sheng* . . . . in September and October just after harvest time. Then in the next spring, having nothing to eat, they were forced in April and May to buy or borrow . . . . from the grain merchant at . . . . \$0.162 per *sheng*. . . . the price had risen 30 per cent. . . . in 1930 . . . . [two] units of products were only enough to pay one unit of debt . . . . interest is generally twenty to thirty per cent annually. . . . the poor become poorer and the rich richer . . . .<sup>3</sup>

For many years the plight of the [Filipino] tenant or small farmer has been the lot of the down-trodden. . . . For every peso that he borrows . . . he pays interest that is confiscatory, more than usurious. . . . For every sack of rice that he gets at ₱6 to ₱7, he pays in palay when the price is as low as from ₱1.20 to ₱1.50, or about five sacks of palay for a sack of rice. . . . Compelled by poverty to convert into ready cash his usually small share of the crop, he sells it at prices below production cost. . . . he goes deeper into debt with no hope for salvation.<sup>4</sup>

The cultivator [in India] working on tiny plots has to borrow, while the creditor pounces on any portion of the land he can secure. Even the very rights which the cultivator has in his land . . . stand in the way of an adjustment between labour supply and demand. For the cultiva-

<sup>2</sup> Seichi Tobata, "The Japanese Rice Control," in *Commodity Control in the Pacific Area, A Symposium on Recent Experience*, ed. by W. L. Holland (issued under the auspices of the Secretariat of the Institute of Pacific Relations, Stanford University, Calif., 1935), pp. 161-65.

<sup>3</sup> Chang, *Farm Prices in Wuchin, Kiangsu, China*, pp. 15-16.

<sup>4</sup> V. Buencamino, *Solving the Rice Problem* (Philippines, National Rice and Corn Corporation, 1937), pp. 2-3.

tor does not renounce those rights and go in search of employment in the industrial centres excepting in the last extremity. . . . The tendency of the non-agriculturist to take possession of the agriculturist's land is increasing in every province . . . ."<sup>5</sup>

. . . . [In Burma,] the tendency for a large tenant class to develop is unmistakable. . . . through extravagance or misfortunes much of the lands has passed into other hands; and erstwhile owner-cultivators have been reduced to the position of tenants on land previously held by themselves. In 1929 . . . nearly 45 per cent. of the total occupied area in Lower Burma was let to tenants on the basis almost entirely of fixed produce rents . . . .<sup>6</sup>

. . . . [In Chosen,] if we include the part-owners almost four out of every five Korean farmers are tenants. . . . The large proportion of tenancy in Korea has few parallels in the world.<sup>7</sup>

The desperately poverty-stricken position of farmers in many countries is properly indicated by these quotations; they point to the facts, though they perhaps do little to illuminate the basic causes. Wherever one looks, the same story is told—a story of poor rice growers, inefficient marketing machinery, usury, growing debt, loss of land ownership, and a certain hopelessness of position that naturally cries for government aid. Yet in general, (despite the emphasis placed upon seasonality of prices, usurious interest rates, and prevalence and growth of tenancy, it is safe to say that no reform, control, or policy, that failed to probe beyond these into the matter of enlarging general economic productivity through capital accumulation and investment, could reasonably be expected to greatly ameliorate the unfavorable economic position of the rice growers of Monsoon Asia. The steps that actually have been taken by governments seem hardly to have touched the fundamental circumstances of rural poverty.) Perhaps the problem is beyond the reach of governmental agencies, or perhaps most of the countries of Monsoon

<sup>5</sup> Mukerjee, *The Rural Economy of India*, p. 64.

<sup>6</sup> Solomon, "Minute of Dissent," p. 49.

<sup>7</sup> Lee, *Land Utilization and Rural Economy in Korea*, p. 159. In marked contrast to the tenancy system so widespread in Chosen, India, and elsewhere in Monsoon Asia, is that in the Netherlands Indies where the government owns the land and leases it to the natives, who may not transfer their ownership rights except to other native farmers.

Asia can ill afford a drain on national treasuries or a burden on consumers of a magnitude sufficient to raise appreciably the incomes of domestic rice producers.

Although government intervention has taken many forms over a long period of years, only relatively recently has the influence of government been directed toward control over the behavior of prices. Various schemes for price control have been developed in the rice-importing countries, but price-influencing and price-subsidizing programs comparable with those tried in most of the principal wheat-exporting countries have not as yet appeared in the rice-exporting regions. In Monsoon Asia no government-sponsored rice program thus far has had as a principal objective an imposed limitation on the size of the rice supply.

#### RICE CONTROL IN JAPAN

The Japanese government has been attempting, indirectly or directly, to control the price of rice over a long period of time but especially since 1921, when the first basic rice law was promulgated. After two decades of experience, the problem of satisfactorily reconciling the conflicting interests of Japanese farmers, producers in the colonies, distributors and dealers, and rice consumers generally, does not appear to be solved. The number of times the objectives and methods of the control scheme have been changed suggests that successive plans have been greatly influenced by political expediency and that modifications in the control measures have been necessary because of failure to anticipate changes in conditions or effects of enforcement of existing legislation. Whenever modifications have been made, the scope of government control over the rice industry of the Empire has been broadened.

Originally the main concern of the government was to step up production to meet the demands of a rapidly growing population and to keep prices down in the interests of consumers. Disturbed conditions following the first World War,

crop shortages, high rice prices, and "rice riots" all played their part in the legislation of 1921. The Japanese farmer was having difficulty in making a living from rice cultivation, and was moving to the cities where there were greater opportunities as industrialization of Japan progressed. These circumstances presaged defeat of government efforts to achieve food self-sufficiency. There seemed reason for the government to assume a more active role in directing the agrarian activities of the Empire.

At the outset the Japanese program provided a quantitative type of influence over supplies. The main object was to encourage production in order to bring down prices to consumers. Nothing was said about prices as such until the basic law was first amended in 1925, and the phrase pertaining to adjustment of "supply and demand" was altered to cover "the quantity and market price of rice." The third important stage in development of Japanese rice-control legislation came in 1931, when a standard for price control was set which removed the ambiguity involved in earlier laws. Upper and lower limits for purchases and sales were to be established and the government could not buy and sell rice within the Empire unless the price of rice had gone below the minimum or above the maximum, except in cases of replacement purchases or sales of stored rice to be made at the current market price.<sup>8</sup>

A radical reform was introduced into the control scheme in 1933, when the basic law of 1921 was repealed and replaced by one known as the Rice Control Act. This legislation carried farm-relief features. Among other provisions it included the means for restricting, by extreme flexibility in import duties, the imports not only of foreign rice but of substitute foodstuffs such as millets, sorghums, and kaoliang, used extensively in some regions, especially Chosen. A change in the technique of price fixing was also involved in

<sup>8</sup> For a history of control legislation up to 1933, see Tobata, *op. cit.*, pp. 157-97. E. F. Penrose (at the Food Research Institute in 1933) made a translation of an elaborate statistical study in Japanese. But the quality of the statistical work was such that the heavy expense of publishing this translation seemed unwarranted.

the 1933 legislation. By the law of 1931 the government had set minimum prices (determined by the cost of production) and maximum prices (determined by the cost of living) for the entire year. Farmers in need of funds, knowing this, offered the government large amounts of rice at the opening of the season. These offerings acted to depress prices; hence modifications in the law were necessary.

The minimum price for January is now fixed and announced in December, and is increased each month up to March by an amount equal to the cost of storage and interest. For the period April–October the minimum price is that reached by March. In this way it was planned to discourage premature selling and to reduce the cost to the government of excessively large offerings coming right after the harvest. Chart 18 (p. 163), showing the seasonality in Japanese rice prices for two periods, brings out the influence of these changes.

By this time the earlier efforts to increase the rice output at home and in Chosen and Taiwan were bearing fruit, and the government authorities faced a problem of potential over-production. One method of controlling the situation was to force greater consumption of rice in the colonies, particularly Chosen, in order to cut down the exports to Japan Proper which were believed by Japanese farmers to be depressing the price of Japan-grown rice and thus adversely affecting the interests of home producers.

In 1936 three other measures were enacted which supplemented the 1933 act. The most important of these was the Autonomous Rice Control Law, which was designed to effect through rice producers and dealers themselves an autonomous control of the distribution of surplus rice in the whole Empire and thereby to aid the rice-purchasing program of the government. This legislation was enacted during a period of growing surpluses, the record carryover for 1935 of roughly 2.2 million metric tons being twice as great as the average carryover of the five preceding years and equal to approximately

one-quarter of annual consumption requirements.<sup>9</sup> The plan was to place upon producers and distributors part of the burden of holding stocks. The load was becoming too heavy for the government alone. Existing marketing agencies were to be supplemented by the formation of co-operative associations, especially in the colonies, for holding given quantities of rice, assigned on a quota basis, which could not be released for sale and distribution without government permission. The government was to finance the operations.

Apparently this plan did not work well, for in 1939 a Rice Distribution Control Law was passed, which established a semi-official company called the Japan Rice Company, Limited, for the purpose of monopolizing all of the rice markets of Japan. Speculation is now prohibited, brokers and dealers are placed under a licensing system, and other steps have been taken for the purpose of regulating the price of rice through the control of distribution.<sup>10</sup>

In the fall of 1939 the rice problem in Japan became one of the most important domestic issues confronting the cabinet. Japan's rice position had again undergone a change. A crop failure in Chosen and a small crop in Taiwan presaged smaller supplies for Japan Proper.<sup>11</sup> Within the rice year ending October 31, 1939, the carryover in Japan had fallen more than 50 per cent to the lowest level since 1918, and alarm was felt that a critical situation in food supplies might

<sup>9</sup> The 1933 legislation, to curtail additions to the home supply from the colonies, became effective in the fall of 1933 when Japan's bumper crop of 1933-34 (over 9 million metric tons) coincided with good crops in Chosen and Taiwan and helped to increase the carryover, which began to accumulate at the close of the 1930-31 season. See Statistical Notes, p. 343.

<sup>10</sup> The volume of rice handled by co-operatives has increased more than eightfold since 1925, but sales co-operatives have become more and more "mere Government agents instead of organizations to protect producers' interest from rice merchants, and rice merchants are almost entirely excluded from the collection phase of the mechanism of rice distribution." ("Changes in the Mechanism of Rice Distribution," *Monthly Circular*, Mitsubishi Economic Research Bureau, Tokyo, December 1940, No. 206, pp. 6, 9.)

<sup>11</sup> Although the Japanese crop for 1939 was good despite a severe drought which created a serious power shortage, the Chosen crop did not escape the effects of the summer drought and was well below normal. This situation followed three years of apparently large crops in Chosen. (See Statistical Notes, pp. 342-43, for comment on crop data for these years.) Taiwan's crop was the smallest since 1935-36.

easily arise. Agitation for government action to avert a shortage resulted in raising the rice price in November from 38 to 43 yen per koku, the highest price since 1925; in 1940 the price was set at 46 yen, the highest in 30 years. The first increase came shortly after all prices had been "frozen" by government decree. Measures to economize rice supplies were also taken. The extent to which rice could be polished was limited, restrictions were imposed on the making of *sake*, and officials urged the mixing of barley and rice, increased consumption of bread, and more complete use of leftovers.<sup>12</sup>

The Japanese rice-control scheme has been longer in operation and is more comprehensive than government programs instituted later in other Asiatic rice-growing countries, and it seems to have served as a guide for them. The conditions which have brought about government control activities are in general the same throughout the East, but seem to have appeared earlier, and in more acute form, within the Japanese Empire. Perhaps the reason for this was the earlier industrialization of Japan. Superficially, the problem of price stabilization appears to be relatively simple; but the history of the Japanese scheme confirms the experience of many Western nations that the difficulties are really very great.

Price-stabilization schemes are usually price-raising schemes, at least in the beginning, for they are planned in the interests of growers. At least part of the original purpose of the Japanese plan, however, was also to lower prices to consumers. If these ends are to be accomplished simultaneously, there must be considerable leeway for manipulation of prices through interference in the trading and marketing process. Actually, this is what the Japanese government has done. From the growers' standpoint, the results of all the legislation up to the middle 1930's were largely negative;

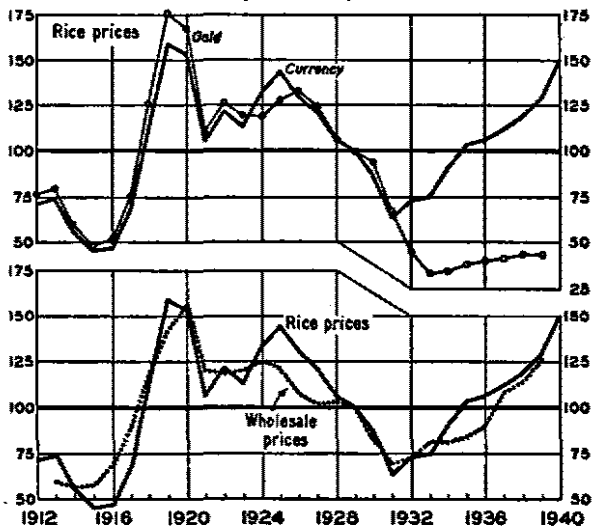
<sup>12</sup> Commenting editorially, the *Oriental Economist* (in "The Rice Supply Situation," December 1939, VI, 785) saw no need of foreign-rice imports if the Japanese people, "like the people in Korea," adopted measures of conservation such as being "content to live on 70% polished rice, or to mix rice with other grains, or to eat substitute food." However, large-scale foreign imports of rice were required (see pp. 90-91).



the control administration failed to prevent price declines that adversely affected agricultural interests.

The price of rice in Japan (calendar-year averages) has shown somewhat less variability since 1921,<sup>28</sup> especially when comparisons are made with the period 1912-21 (Chart 19),

CHART 19.—INDEX NUMBERS OF RICE AND WHOLESALE PRICES IN JAPAN, 1912-40\*  
(1929 = 100)



\* Rice prices at Tokyo (average quality brown) from Appendix Table IX; wholesale prices, Bank of Japan index.

but the evidence does not warrant attributing this behavior necessarily to governmental intervention. Comparisons with rice prices in other countries where no price-influencing measures have been employed are impracticable, since the qualifications necessary for the manifold factors that have affected

<sup>28</sup> According to data by the Japanese Ministry of Agriculture and Forestry (quoted in *Monthly Circular*, Mitsubishi Economic Research Bureau, Tokyo, December 1940, No. 206, p. 7), average percentage deviations in rice prices, for three-year periods, have been as follows:

1916-18 .....	49.3	1928-30 .....	27.8
1919-21 .....	48.5	1931-33 .....	24.8
1922-24 .....	28.9	1934-36 .....	20.8
1925-27 .....	15.9	1937-39 .....	11.1

prices in these countries would deprive such comparisons of real significance. Chart 19 shows the course of rice prices in Japan in the form of index numbers, both in terms of the national currency (yen) and in terms of gold, together with an index of wholesale prices. In general, since 1921, Tokyo rice prices have not risen as high nor fallen as low, though on a gold basis Japanese prices in the early 1930's fell lower than rice prices in such other importing countries as India and Java.

In December 1931 Japan departed from the gold standard for the second time, and the inflationary influences of the new monetary policy resulted in a rise of domestic prices after 1932. The relation between rice and wholesale prices in Japan in the middle 1920's was relatively favorable to the rice producer, but when rice prices started to decline, they fell more rapidly than the general price level, adversely affecting the farmer's position (see pp. 159-61). For a few years in the early 1930's until the influence of the war with China became felt, the grower's purchasing power was apparently somewhat improved, but it has not since returned to its earlier level.

Nor does it seem that prior to the 1933 legislation the government was outstandingly successful in reducing the amount of seasonal fluctuation in rice prices.<sup>14</sup> Since then rigid fixing of monthly minimum prices for an entire year and the outlawing of speculative trading have arbitrarily eliminated practically all semblance of normal seasonal price behavior (see Chart 18, p. 163). Growers have been given an incentive for holding their rice off the market and not attempting to dispose of it all at once right after the harvest.

<sup>14</sup> The evidence is not clear. In his study of Japanese rice control, Tobeta (*op. cit.*, p. 194) cites data which lead to opposite conclusions. "We may observe . . . that since . . . 1921, the monthly variations have increased, although we may at the same time observe that, but for the Act, the variations might have been much greater as a result of changed conditions of supply." From another analysis (the difference between the highest and lowest monthly average of the nominal price of rice in Tokyo during a year, divided by its yearly average), he concludes that "the Rice Control Act has served to reduce the monthly variations in the nominal price of rice. The problem is, which of the two observations shows the actual economic relation between the price of rice and the producer, as well as the consumer?"

In effect, minimum prices have been guaranteed which cover the cost of carrying through the first quarter of the year following the fall harvest.<sup>15</sup>

Harvest time in Japan is during the months of September and October, although in southern Japan harvesting may start early in August, when new rice begins to appear on the markets in small volume. The movement to market continues for several months but is heaviest during November and December. In so far as the statistical reports on rice stocks are able to reveal the monthly situation, stocks are generally smallest in November, when the Japanese rice year begins.

Each modification in the control legislation seems to have arisen from failure of existing measures to anticipate changes in conditions or effects of enforcement.<sup>16</sup> The 1939 legislation monopolizing all rice markets and licensing brokers and dealers,<sup>17</sup> for example, was an outgrowth of weaknesses which appeared in the operation of earlier laws. By decree the government announced price limits and the amount it desired to purchase. The very announcement seemed to be enough to encourage speculative activity and to maintain rice prices near the upper limit though never actually at it, for, under the law, the government was obliged to begin selling activities once the maximum price had been reached. Since the rice

<sup>15</sup> Probably three-fifths of the total Japanese rice crop is grown under the tenant system, the landlord receiving his rent in grain. In the past more than half of the tenants' crop was disposed of soon after the harvest in order to meet pressing obligations. Concentrated offerings were thought to depress prices, and created storage and other problems for the government. Frequently, after selling his share of the crop during the first quarter, the tenant later was obliged to repurchase rice for his own needs at much higher prices. To the extent that the seasonal advance in the price of rice excluded the cost of carriage, a situation was created wherein speculators might profit at the expense of producers. The control legislation was designed to improve the growers' position and reduce the opportunity for speculative gains by middlemen.

<sup>16</sup> Complicating the problem of price stabilization for the Japanese authorities has been the factor (referred to on pp. 139-42) of the particular preference of Japanese consumers for Japanese rice. From the beginning it has largely defined the character of the rice supply to be furnished the Japanese population. In no other country has this consideration assumed equal importance.

<sup>17</sup> The Rice Distribution Control Law of 1939 prohibited the settlement of futures transactions except in actual rice. The volume of such transactions in the Tokyo and Osaka markets amounted to 137 million koku in 1932, declined to 79 million koku in 1933, the year of the promulgation of the Rice Law, shrank further to 29 million koku in 1938, and in 1939 amounted to less than 4 million koku.

administration was morally bound to support its announced prices, purchasing all rice offered or selling its entire supply if necessary to stabilize prices within the set limits, the net effect was usually that the government made both its purchases and its sales at the current market. This meant that the operation almost always resulted in a loss.

[The Japanese rice-control program has been expensive. The funds allotted for carrying out the provisions of all legislation were successively increased from 200 million yen provided in 1921 to 850 million yen plus an emergency reserve of 300 million yen in 1934. Paying the producer the maximum price and selling to the consumer at the minimum, which amounts to direct subsidy to both, always results in a loss which the government must absorb. It was costly to carry the large stocks built up in years of surplus prior to 1939. After one year's storage, rice deteriorates so much that the government must sell old stocks at current market prices and lose about 4 yen per koku, or 12-18 per cent.]

[Although the Japanese system may be effective in extending some relief to farmers and consumers, it has been unsuccessful as a means of price control largely because of the absence of any regulation of production.] There is probably no phase of the Japanese rice-control program that has not been incorporated and tried in some of the numerous price-stabilization schemes for agricultural commodities in Western countries. Only production-control programs are absent thus far in Monsoon Asia, but even in face of a tendency toward shortage in aggregate supplies, production control has been and is seriously considered in certain countries, e.g., the Philippine Islands.

#### RICE CONTROL IN THE PHILIPPINES

Like Japan in 1921, the Philippine Islands were faced with a problem of shortage following two successive poor crops in 1934-35 and 1935-36. Low prices to producers, rising prices to consumers, much speculation, and the threat of hardship

created by a rice shortage led to government investigation and action. A commission was appointed to study the rice crisis and make recommendations. Nationalization of the rice industry was seriously considered. What emerged in 1936 was the establishment of the National Rice and Corn Corporation (NARIC) for the purpose of stabilizing prices. The corporation undertook to import and distribute rice at a price considered fair to both producers and consumers.

The Philippine plan had the same main objectives as the Japanese scheme. From the outset, however, it was recognized that the temporary crisis might soon pass and that within a few years supplies might be so abundant as to call for some form of production control. Moreover, the scheme was designed to relieve the plight of the Philippine rice grower. The investigating commission put it thus:

The industry is dominated by the speculative activity at the expense of the tenants and small farmers who, for need of cash or food, are compelled to sell their share of the crop long before or immediately after the harvest, thus glutting the market and bringing prices down to ruinous levels for a brief period. The margin of variation in the price of palay is very wide, extending sometimes to over 150 per cent. The whole industry is in an unhealthy condition. Producers and consumers are practically at the mercy of a few rice dealers, middlemen, and speculators who control the industry.<sup>14</sup>

When the newly formed corporation entered the market in December 1936, palay (paddy) prices in Cabanatuan, Nueva Ecija, the center of the rice trade, ranged between 1.50 and 1.80 pesos per cavan of 44 kilograms. Purchases were first made at 2.50 pesos, considered a "fair" price which would cover the cost of production and permit the grower a reasonable profit. Prices soon rose to 2.30 and 2.40 pesos in this important district. Another short crop in 1936-37 was favorable to the corporation's operations, and price stabilization was rather easily effected with the fund of 4 million pesos at its disposal.

By 1937, however, the problem was no longer one of

<sup>14</sup> Philippines, *Report of the Rice Commission to the President of the Philippines*, p. 6.

shortage. The 1937-38 crop was large, and so were the crops of the two years following.<sup>19</sup> The need for production control, if prices were to be successfully maintained, became apparent. Officials of the NARIC began to point out this need in 1938.

The good crops harvested between 1937 and 1940 were believed to have been due in part to the price-stabilization policy and practice of the corporation. Other contributing factors were: "the opening of vast tracts of public lands thru various public land grants; . . . the intensive government propaganda for the settlement of Mindanao, particularly Cotabato, by 'homeseekers' and by private immigrants; . . . the liberal practices followed by the Philippine National Bank in granting long-term agricultural loans," and "the conversion of sugar lands into rice lands" due to the quota limitations placed on the export of sugar to the United States after the passage of the Tydings-McDuffie Act.<sup>20</sup> In addition, the efforts of the agricultural department to introduce better methods of cultivation, seed selection, and fertilization presumably tended to increase yields.

Problems of overproduction are much more difficult to solve than those arising from temporary scarcity. The NARIC has funds sufficient to purchase only a fraction of the supplies that might readily become available on continuation of present tendencies toward large production. Without the power to control production, the problem of regulating prices will become increasingly difficult. The control scheme seems likely eventually to come to a disastrous end unless the government is prepared to subsidize the industry for an indefinite period. The funds available for such stabilization seem unlikely to be ample. The government of the Philippines would be in a much better position to support prices to producers if it could so control the domestic rice output as to require continued

<sup>19</sup> Between 1930-31 and 1934-35 production averaged 1.4 million metric tons. Both the 1934-35 and 1935-36 crops were under 1.3 million tons, whereas the crops between 1937-38 and 1939-40 all averaged around 1.5 million tons. See Appendix Table II.

<sup>20</sup> B. C. Lopez, "Need for Production Control," *NARIC Service Recorder* (Philippines, National Rice and Corn Corporation, mimeographed), June 1938, I, 9.

importations of a small proportion of the Islands' rice-consumption requirements, especially since one of the important privileges of the NARIC is the right to import rice against payments of customs duties lower than those paid by anyone else.

#### CONTRASTS BETWEEN JAPANESE AND PHILIPPINE PLANS

Although government intervention in the affairs of the rice industry has occurred in practically every rice-growing country of Monsoon Asia, the activities in Japan and the Philippines serve to illustrate the type of intervention designed primarily to stabilize rice prices. The mechanics of administration and operation differ in some important respects. For example, the Philippine corporation buys paddy and converts it into polished rice before placing it on the market whenever government intervention is thought necessary to regulate prices to consumers. Part of its capital is employed in the construction and operation of warehouses and mills. The Japanese scheme, on the other hand, involves dealing in brown rice almost exclusively. The government buys, stores, and sells rice in this form and has not attempted to become a factor in rice milling.

Part of the explanation for the milling and marketing activities of the NARIC in the Philippines lies in a situation found quite commonly in southeastern Asia but not in Japan. That is, the milling and marketing functions are largely performed by aliens, especially the Chinese, so that between the native farmer and the ultimate rice consumer is a group alleged to exercise a vital influence over rice prices. The Chinese rice millers and merchants have dominated this business for generations, but have recently become the focus for blame for all the ills of the rice industry.

In setting forth the main problems confronting the rice industry in the Philippines, the manager of the NARIC lists the following in order of importance:<sup>21</sup> (1) the problem of the

<sup>21</sup> Buencamino, *op. cit.*, p. 1.

tenant (*kasamá*) and small farmer; (2) the control of prices; (3) distribution and financing; and (4) nationalization. On the fourth problem, that of nationalization, it is frankly admitted that progress toward a solution has not been wholly satisfactory. The objective of gradually passing the milling and distribution of rice from Chinese to Philippine hands will require time for its attainment for a variety of reasons.<sup>22</sup> The Chinese engaged in this business even before the Spanish regime in the Philippines. They have the experience and trade ties with other Chinese in neighboring countries. The Filipino seems not to be so good a business man, though government officials from President Quezon down are optimistic about the Filipino's ability to learn the business within another ten years when complete nationalization is foreseen.<sup>23</sup>

While the NARIC appears to be well organized and operated as a business corporation, its dependence upon political support may prove a great handicap to efficiency. Officials of the corporation apparently feel the need for additional operating capital as the threat of surplus supplies looms larger. They seem favorably inclined toward the enactment of an autonomous rice-control law as in Japan, compelling producers to withhold part of their supply from the market until its release is authorized by the government.

<sup>22</sup> In this connection, H. H. Miller (*Principles of Economics Applied to the Philippines*, Boston, 1932, pp. 198-99) cites some evidence tending to refute the common assertion that the excessive profits of middlemen explain the low return to the grower and the high cost of rice to the consumer. To quote:

"In a recent study of marketing of rice in Nueva Ecija conducted by the college of agriculture at Los Baños it was found that, comparing prices paid to farmers by Cabanatuan rice mills and wholesale prices of rice in Manila, the difference, or margin, was relatively small. In terms of the wholesale price of rice in Manila, the farmer of Nueva Ecija received on the average 87 per cent, while the Chinese rice merchants obtained a margin of 13 per cent. Of this margin, 4 per cent represented milling cost; 3.9 per cent, railway freight; 2.1 per cent, other marketing costs; and 3 per cent, profit of miller and wholesaler.

"The results of the survey show that the Chinese merchants are performing essential marketing services at a fairly low cost. It is therefore evident that for the Filipinos to displace the Chinese in the rice trade they must be able to render marketing services at margins equal to or still lower than those now received by them. For cooperative marketing by farmers to be successful the same condition obtains."

<sup>23</sup> The President of the Philippines also holds the optimistic belief that the government will be in a position to withdraw from the rice industry and the operation of control measures within a decade. (Personal interview with V. D. W., Dec. 6, 1939.)



From minor rejoicing at the profits which accrued to the corporation at the outset, they are now more inclined to favor the Japanese policy of "service to the people." That is to say, faced with the problem of oversupply, the corporation must expect losses from its stabilizing operations. As in Japan, losses incurred in programs involving the subsidization of important sections of the population may be interpreted politically as the measure of the service rendered.<sup>24</sup>

The NARIC has been successful in reducing seasonal fluctuations in rice prices without resorting to the extreme measures employed in recent years by the Japanese control authorities. As a means of helping the native rice grower to break the vicious circle of increasing debt, the corporation's price-stabilizing activities may prove an important contribution. Data and charts in the offices of the corporation in Manila suggest a quite successful effort at smoothing the short-time variations in prices. The difference between the high and low prices of Macan No. 2 has narrowed from ₱3.20 in 1935 (pre-NARIC) to only ₱0.20 in 1940.<sup>24a</sup>

Whereas the Japanese scheme involves the setting of two prices, a minimum and a maximum, announced at the beginning of the rice year, and allows the market to pursue its own course between these limits, the Philippine plan involves setting only one price, announced just before buying operations begin. The NARIC then supports the market at the price set, in effect simply guaranteeing a minimum price designed to cover the producers' costs plus a reasonable margin of profit. The government does not set maximum sell-

<sup>24</sup> By 1937 the corporation realized the difficulties of operating wisely on the basis of out-of-date and unreliable statistical information on the rice industry. Efforts are being made to correct this weakness. As in Japan, the basis for setting "fair" rice prices involves an attempt to determine the growers' costs of production from season to season as well as some measure of living costs. Most countries have given little attention to this problem, and rice-production cost data are meager. In Japan, however, it is reported that the government appropriates 140,000 yen per year for the study of production costs in connection with the operation of its rice-control program.

<sup>24a</sup> See chart published in *The NARIC* (Philippines, National Rice and Corn Corporation), May-June 1941, I, 29.

ing prices,<sup>28</sup> but if prices to the consumer appear so high as to be endangering the public welfare, the corporation begins milling its own stocks of paddy to be sold at a certain price, and may also resort to importations. If the cost of imported rice is higher than the price set, the NARIC must incur loss in order to maintain the price.

Although any government-sponsored institution must serve the interests of the nation if it is to persist, the Philippine experiment in rice control has apparently not as yet been seriously confronted with the irreconcilable facts that higher prices for the rice grower mean more expensive rice for the consumer. Thus far the alleged excessive profits of the foreign middlemen have provided some leeway for operations, but in the end it will be surprising if a way can be found for subsidizing both the rice producer and the rice consumer without heavy drains upon the government treasury.

#### GOVERNMENT INTERVENTION IN OTHER COUNTRIES

In China, control over exports has long been exercised, and more recently imports have been discouraged in various ways in order to promote a national program of self-sufficiency in food. For the 10 years ending in 1935, rice imports into China averaged over a million metric tons; thereafter they fell to one-third of that level (Chart 17, p. 156). Before the war with Japan started in 1937, the Chinese government had begun a program designed generally to curtail agricultural imports by increasing import duties and at the same time to make better use of domestic supplies through improved transportation and rural credit. Progress was being made, but the program was interrupted by the outbreak of hostilities.

In Indo-China, rice prices have been affected most directly by export duties, currency manipulations, and treaty arrangements. Following the depression of the early 1930's, the most profound influence tending to sustain Indo-Chinese rice prices

<sup>28</sup> After the outbreak of the European war in 1939, the Commonwealth government created an Emergency Control Board which fixes a maximum price not only for rice but also for other essential commodities.

was the policy pursued by the mother country in permitting absorption in France of abnormal Indo-Chinese supplies arising when Asiatic demand was sharply reduced.

The government of Thailand has a 10-year plan which involves colonization of new areas in order to relieve population pressure and to build new districts of debt-free farmers. Once the colonists are settled, the government will purchase their crops at officially set prices which, however, will be below the market because the difference is intended to help repay the cost of settlement. One of the purposes of this program is to assist the Thai farmer to become independent of Chinese landowners and middlemen.<sup>26</sup>

The government of British Malaya has sporadically attempted to stimulate domestic rice production for many years. Rice growing is the chief occupation of the native Malays, but large importations are required each year from Thailand and Burma in order to feed the Chinese, Indians, and other races who outnumber the Malays. In addition to offers of cheap land, irrigation facilities, free water and seed, and so on, the governments of some states have now guaranteed a minimum price (\$2.50 [Straits] per picul) for paddy delivered to government mills for three years beginning in 1940. Some of the more recent of such activities reflect wartime conditions and the placing of Malaya on a war footing. Dealers in rice and rice prices are now strictly regulated. The rice trade had already fallen somewhat under government control through the food-control bill of 1939, but since the outbreak of war in Europe wholesale and retail maximums for all grades of rice have been fixed by the Food Controller and the importation of rice, with certain exceptions, has become a government monopoly.

Important modifications in government policy followed the impact of the world depression upon the economy of the Netherlands Indies. The drastic fall in prices of staple export

<sup>26</sup> Formation of the Thai Rice Company, which began operations in December 1938, was another government attempt to displace the Chinese as middlemen and exporters.

crops led to Dutch leadership or participation in control schemes for the chief export commodities, on the one hand; and the greatly restricted purchasing power accompanying the decline in value and volume of exports led to government efforts to reduce the necessity for foreign purchases, on the other. Home production of foodstuffs was encouraged. Import restrictions on rice were imposed in order to stabilize the domestic market, and have been applied for varying periods ever since. Rice imports into the Netherlands Indies averaged 596,000 tons annually during 1926-30, began dropping rapidly about 1932, and had reached a low of 147,000 tons by 1937. In Java and Madura alone, the decline was from a 225,000-ton level to only 9,000 tons in 1937.

Early in 1939, faced by the threat of war, a new rice policy was adopted by the Netherlands Indies government. It was designed to build up emergency stocks and to support the price of domestic rice so as to insure a steady supply for regions of deficit production within the islands. A Victuals Fund Commission was organized with broad powers to insure the food supply of the whole Netherlands Indies. The fund may buy or sell to support or stabilize prices when necessary. It immediately began to purchase large quantities of rice in eastern and central Java in order to hold prices within a range of 2.90 to 3.25 florins per quintal, which was determined by the Department of Economic Affairs as necessary to assure a fair return to growers and middlemen.

The Javanese plan involves the accumulation of reserve stocks in various centers, such as the east coast of Sumatra, southeastern Borneo, northern Celebes, as well as Java, for distribution to areas of short supplies.<sup>27</sup> Local dealers are compensated by the government for carrying these stocks. Within the past year or two, the Dutch policy for rice, although

<sup>27</sup> Rice sufficient for three months' consumption is stored in such areas, and the plan calls for the establishment of supplementary stocks of paddy equivalent to three months' consumption for the "storage of a quantity of rice sufficient for six or seven months' consumption in a certain area is not possible, as husked rice can be kept for only three or four months" ("The Netherlands Indies Food Supply Fund," *The Netherlands Indies: Bulletin of the Colonial Institute*, Amsterdam, April 1940, III, 125).

perhaps inspired by somewhat different motives, has evolved toward essentially the same type of price-stabilization activities as those carried on by the Japanese and Philippine governments.

National governments of the countries involved in the world wheat problem face the prospect of subsidizing a portion of their farmers in one way or another for some time to come. There is no such prospect of subsidizing rice producers in most rice-growing countries, though what might be termed an agricultural problem exists in an acute form in several Far Eastern countries, and agriculture in this part of the world very frequently means rice culture. If the East were developed commercially, the farm problem would take on the importance it now commands in Western countries; but so long as large areas support tremendous numbers of people in a subsistence environment and central governments are no stronger, there is small likelihood that the state will facilitate adjustments in the rice situation, as such, in an important degree in the near future.

However, in countries where conditions have existed that seem to call for some kind of government stabilization, the tendency appears to be that, once started, such state controls are extended and their scope broadened. Rice control in Japan will hardly be dropped in the foreseeable future; it may be extended or dropped in places such as the Netherlands Indies and the Philippine Islands; it is not likely that it will be introduced in India and China; and, though it might be attempted in the three export countries, the prospects seem poor for any degree of permanency in such plans. For the typical Asiatic rice grower, governmental intervention will probably have limited significance for some time to come. Despite fluctuating price levels, he will undoubtedly continue for a long time to live and work his land essentially as his forebears did, and to hope that his labor will be rewarded with good crops and enough food to continue his personal existence and that of his family.

## CHAPTER IX

### CONSUMPTION TRENDS SINCE 1920: THE EVIDENCE

Available statistical evidence strongly suggests that rice production in Monsoon Asia ex-China has failed to keep pace with population growth during the past two decades. Production and utilization per capita within the region have apparently declined. Index numbers of production, population, and per capita production and utilization by five-year periods, with 1921-25 taken as the base, are as follows (11 countries, not including China):

Period	Rice production	Population	Per capita production	Per capita utilization
1921-25 .....	100	100	100	100
1926-30 .....	102	107	95	94
1931-35 .....	106	113	94	92
1936-40 .....	107	120	89	87

Production per capita corresponds fairly closely with utilization or consumption per capita, since net exports from the 11 countries considered to other countries are only a small fraction (5-7 per cent) of production. But the index numbers of per capita utilization show a slightly larger decline than the index numbers of per capita production, because net exports to outside areas (Chart 7, p. 96) have tended to rise more rapidly than aggregate production.

This general suggestion of a declining trend in per capita utilization of rice warrants close attention. Rice is undoubtedly the major staple food of Monsoon Asia, and a preferred cereal. The fact that great numbers of people suffer hunger at times is beyond dispute. If the apparent downward trend in per capita rice utilization is real and is likely to continue, if it is general rather than localized, if the deficiency is not made good by substitute foods (home-grown or imported)—then the conclusion may seem inevitable that human misery

and privation must increasingly prevail in Monsoon Asia, and the fears of writers in the Malthusian vein may be realized through increasing "overpopulation" or "pressure of population upon food supply."

Many writers on world population problems have designated parts of Monsoon Asia as regions of population pressure, congestion of numbers, or "danger spots." According to Carr-Saunders,<sup>1</sup> both India and China have probably reached the Malthusian limit of maximum population, beyond which further increase is theoretically impossible because of insufficiency of food. Thompson<sup>2</sup> agrees that "there is little likelihood of any considerable change in China's population within the next few decades," and that "India's population will grow rather slowly during the next half century." Mukerjee<sup>3</sup> holds that the population capacity of India was overstepped in the early 1920's. East,<sup>4</sup> writing in 1925, regarded Japan as "terribly overpopulated"; a fairly recent international conference<sup>5</sup> reported that there "is little room for doubt as to the existence of overpopulation in Japan"; and Carr-Saunders,<sup>6</sup> while thinking that "it cannot be decisively proved by figures that Japan is over-populated," is unable "to resist the conclusion that there is congestion of numbers." Penrose,<sup>7</sup> on the other hand, sees that "the chief population problem of Japan is one of occupational overpopulation, mainly in agriculture," and Sarkar<sup>8</sup> disagrees with Carr-

<sup>1</sup> A. M. Carr-Saunders, *World Population, Past Growth and Present Trends* (Oxford, 1936), pp. 278, 290.

<sup>2</sup> W. S. Thompson, *Population Problems* (New York, 1935), p. 253.

<sup>3</sup> *Food Planning for Four Hundred Millions*, p. 27.

<sup>4</sup> E. M. East, *Mankind at the Crossroads* (New York, 1925), p. 92.

<sup>5</sup> L. J. Cromie, "Introductory Report on the Study of Demographic Questions," in *Peaceful Change. . . . Proceedings of the Tenth International Studies Conference, Paris, June 28th-July 3rd, 1937* (International Institute of Intellectual Co-operation, Paris, 1938), p. 133.

<sup>6</sup> *Op. cit.*, p. 266.

<sup>7</sup> E. F. Penrose, *Population Theories and Their Application, with Special Reference to Japan* (Food Research Institute, Misc. Pub. 7, Stanford University, Calif., 1934), p. 145.

<sup>8</sup> B. K. Sarkar, "The Population Trend in India with Reference to Food and Nutrition," *Indian Journal of Economics* (Departments of Economics and Commerce, Univ. Allahabad, Allahabad), January 1940, XX, 279.

Saunders' conclusions about India and points to a decline of the birthrate as "a solid fact of demographic India, however modest it be."

We cannot deal here directly or fully with the various and somewhat divergent concepts of overpopulation, population pressure on food supply, or population congestion, and their importance for Monsoon Asia. It suffices to focus attention first (in chapters ix and x) upon recent changes in per capita utilization of rice, the major foodstuff, and second upon potential expansion of rice supplies (in chapters xi and xii). These specific topics, however, are necessarily pertinent to broader questions concerning the relationship of population to food supply in the Orient.

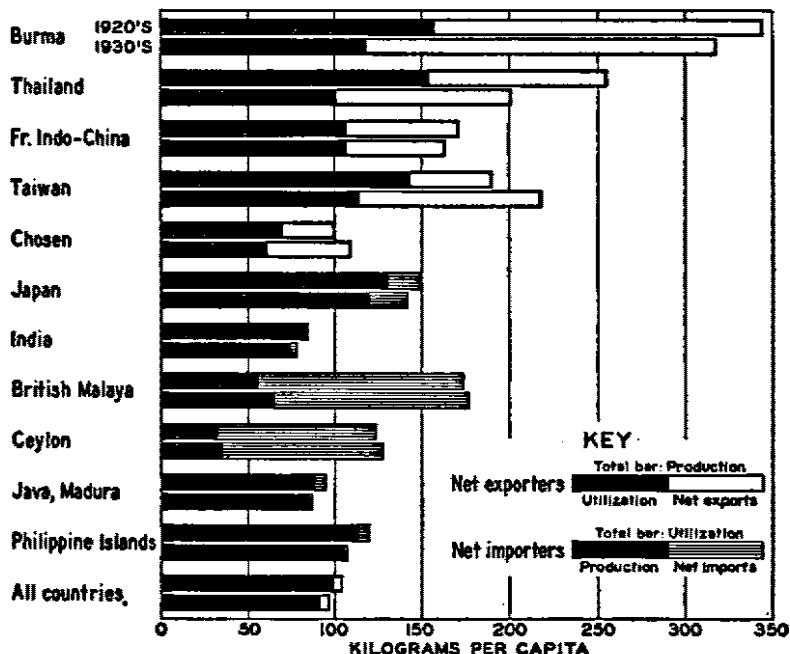
Statistics of per capita rice utilization are derived not from direct observation and recording of quantities of rice eaten in or purchased by households, but from calculations involving national statistics of areas under rice, yield per land unit, and production; international trade in rice; and population. The chances are substantial for errors to become incorporated in calculations of changes in per capita utilization of any agricultural product in almost any country over a 20-year period. It is inherently difficult anywhere to estimate closely the annual output of crops produced by vast numbers of farmers, and the difficulties must be particularly prominent in most countries of Monsoon Asia where farmers are so numerous, where so little of the output is marketed, and where competent statistical organizations employing advanced techniques are so new and so few. Before one attempts to explain the reduction in per capita rice utilization in Monsoon Asia since 1920, as suggested by the statistics, it is necessary to consider critically the basic data on acreage, yields, production, trade, and population of the several countries. This procedure may indicate where decline is probably real, or where it is only statistical; and where decline has been large enough to be significant, or where it has been so small as to be of negligible importance.



EVIDENCE OF CHANGE IN PER CAPITA RICE UTILIZATION

Summarized comparisons of changes in rice utilization per capita between the decade of the 1920's and that of the 1930's are given in Chart 20. The chart also shows changes in per

CHART 20.—CHANGES IN PER CAPITA PRODUCTION, TRADE, AND DOMESTIC UTILIZATION OF RICE IN 11 COUNTRIES OF MONSOON ASIA, BETWEEN THE 1920'S AND THE 1930'S\*



\* Based on data from Appendix Table VII. For discussion of the reliability of the data, see below, pp. 194-202.

capita rice production, per capita rice net exports of the net-exporting countries, and per capita rice net imports of the net-importing countries. Data are given for each of the 11 countries of Monsoon Asia ex-China and for the group. For the five net-exporting countries, production per capita is shown by the combined black and unhatched portions of the bars, net exports by the unhatched portions, and utilization by the black portions. For the six net-importing countries, production per

capita is shown by the black portions of the bars, net imports by the hatched portions, and utilization by the combined black and hatched portions. Since statistics of production and of population are not available for China, no concrete evidence of change in either production or utilization per capita can be presented for that country.

Production of rice per capita, if the statistics are reliable, appears to have declined in each of the three major exporters of the Indo-Chinese Peninsula, most markedly in Thailand and least in French Indo-China. Net exports per capita increased somewhat in Burma, but declined fractionally in Thailand and a little more in Indo-China. In Burma, the increase of exports in the face of reduction of per capita production spelled a larger reduction in per capita utilization than in per capita production. In Thailand, where per capita exports changed little, the decline in per capita utilization coincided closely with the decline in per capita production. In Indo-China, on the other hand, per capita utilization remained unchanged, and decline of per capita exports coincided with decline of per capita production. If for the moment we lean upon statistics that seem unreliable, Indo-China appears to have been one of the three exceptional countries of Monsoon Asia where per capita rice utilization remained as high in the 1930's as in the 1920's; the other two are British Malaya and Ceylon.

The Japanese colonies of Chosen and Taiwan, unlike the other three net exporters, seem to have increased rice production per capita; like Burma, to have increased exports per capita; and, like Burma and Thailand, to have suffered reductions in per capita domestic utilization. Increases in per capita exports thus appear to have exceeded increases in per capita production.

Not only the net exporters, but also the net importers, show diverse rather than similar developments. In Japan, India, Java, and the Philippines, rice utilization per capita has apparently fallen, though only moderately and much less than

in three of the net exporters, Burma, Thailand, and Taiwan. The decline of per capita utilization in Japan and India accompanied a larger decline of per capita production and an increase of per capita net imports, whereas in Java and the Philippines there was apparently decline both in production and in net imports per capita. The data for British Malaya and Ceylon point, exceptionally, toward increase of per capita utilization. Exceptionally also, together with Chosen and Taiwan, British Malaya and Ceylon appear to have enlarged their per capita rice production. In British Malaya, this increase (if credible, as seems unlikely) was apparently large enough to more than offset a decline in net imports per capita; in Ceylon, the net imports per capita rose fractionally, but most of the increase in per capita utilization reflected increase of per capita production.

The bottom bars on the chart, indicating changes in all countries combined, point toward the decline of per capita production, the somewhat larger decline of per capita utilization, and the slight increase of per capita net exports mentioned in the introductory part of this chapter. If the statistics are reasonably trustworthy for the countries covered, per capita utilization of rice was lower in the 1930's than in the 1920's in all countries of Monsoon Asia except British Malaya, Ceylon, and Indo-China; and in those the indicated increases were either negligible or small. The developments in China remain unknown. They cannot be judged from statistics of net imports, which tended to increase until 1936, but averaged only 1-4 per cent of domestic production in the brief period of years covered by official production estimates (1931-36). Nor is it possible to indicate the probable direction or amount of changes in per capita rice utilization that may have occurred within separate regions of the larger rice-consuming countries—such regions as were considered in an earlier discussion of levels of per capita rice consumption (chapter vi, pp. 113-21). For such analysis, the available data are no more abundant than for China as a whole.

The reliability of the trade statistics that enter into the calculations of changes in per capita rice utilization, as given in Chart 20, may be accepted as representing the facts within reasonable and narrow margins of error. Accordingly, the changes in per capita rice utilization suggested by the chart may be accepted so far as the trade statistics are concerned. But their validity then hinges upon statistics of domestic rice production and upon statistics of population, which are considered next.

#### QUALIFICATIONS OF "CONSUMPTION ESTIMATES"

The crude statistics of Chart 20 (p. 191) refer strictly to utilization of cleaned rice per capita per annum on the average in each of the past two decades.<sup>8</sup> They do not refer strictly to rice in the form in which it is eaten (in large part brown rice), or to amounts ingested (actually eaten), or to amounts consumed (brought into households for ingestion). They do not necessarily refer to utilization per capita in any particular year of either period. It would be desirable to have data for each country showing ingestion of rice calories per adult male annually; if accurate, this would provide a type of information much more suitable for appraising recent changes in rice-eating habits, though even such data would not yield the best results unless broken down to show changes within various parts of nations.

Such refinements are impossible, for reasons unnecessary to enumerate. So far as the estimates in Chart 20 are acceptable at all, one must assume that changes in utilization approximately represent changes in ingestion, that changes in utilization of cleaned rice approximately represent changes in consumption or in ingestion of rice calories, and that changes

<sup>8</sup> Averages of per capita utilization for the past two decades have been used rather than 5-year or 3-year averages, partly in order to condense the discussion, partly to focus attention upon probable long-term trend influences rather than short-term fluctuations of utilization attributable to accidental effects of fluctuating yields or economic conditions, and partly to avoid errors that might spring from fluctuations in levels of year-end stocks. The year-end stocks, however, seem not to vary much except in Japan (pp. 153-54).

per capita approximately represent changes per adult male. The principal weakness in these assumptions is probably that consumers tend increasingly to use less brown rice and more cleaned or polished rice in households (pp. 128-32); and if this is so, our method of estimating changes, even if otherwise accurate, must understate all indicated reductions of per capita rice ingestion. Moreover, it might be reasonable to infer that, in common with many Occidental countries, certain populations of Monsoon Asia have tended to consist more largely of adults and less largely of children. If this is so, accurate estimates of change in rice utilization per adult male would show somewhat more decline or slightly less increase than estimates of rice utilization per capita. Altogether, it seems probable that if the data used in Chart 20 were expressed in terms of rice-calorie ingestion per adult male they would show larger reductions or smaller increases between the 1920's and the 1930's. Rice, in short, may conceivably have lost more ground or gained less in the diets of Monsoon Asia than Chart 20 suggests, although this cannot be stated as a conclusion until the validity of production estimates and population statistics are further considered.

Estimates of population based on official data, and applicable to the middle point of the decades considered, are as follows, in millions:

Country	Jan. 1, 1926	Jan. 1, 1936	Percentage change
Burma .....	13.9	15.4	+10.8
Thailand .....	10.7	14.0	+30.8
French Indo-China ...	20.6	22.8	+10.7
Taiwan .....	4.1	5.2	+26.8
Chosen .....	19.5	23.0	+18.0
Japan .....	60.0	69.5	+15.8
India .....	320.0	355.0	+10.9
British Malaya .....	3.8	4.9	+29.0
Ceylon .....	4.9	5.6	+14.3
Java .....	38.2	45.3	+18.6
Philippines .....	11.5	13.2	+14.8
<b>Total .....</b>	<b>507.2</b>	<b>573.9</b>	<b>+13.2</b>

These estimates are undoubtedly of unequal reliability, but the basis for appraising their individual quality is not secure. The longest experience with estimation or enumeration of populations by modern techniques seems to be found in the Japanese Empire, the British colonies of India, Burma, and Ceylon, and the Dutch colony of Java. The rates of population increase in these countries between the 1920's and the 1930's range from 10.8 per cent (Burma) to 26.8 per cent (Taiwan). Of these, the rate of increase for Taiwan is the most exceptional, the other rates ranging only from 10.8 to 18.6 per cent. But, since the exceptional rate of increase in Taiwan is apparently accepted by students of population problems,<sup>10</sup> there seems to be little reason to question any of the indicated rates of population increase for the three countries of the Japanese Empire, or for India, Burma, Ceylon, the Philippines, or Java.

With Thailand, Indo-China, and British Malaya, there is reason to examine the population statistics more critically. In all three countries experience with population enumeration is relatively short. The data for Indo-China are quite generally regarded as insecurely founded;<sup>11</sup> and those for Thailand and British Malaya are based upon censuses that have become more inclusive only within relatively recent times. Since the indicated rate of population increase in Indo-China is smaller than in any other country, and the indicated rates in Thailand and British Malaya are larger, there seems some reason for believing that the rate for Indo-China may be too low, and the rates for Thailand and British Malaya too high.

If these inferences are warranted, it follows (on the assumption that statistics of rice production are reliable) that our calculations of change in per capita rice utilization between the 1920's and the 1930's, as in Chart 20, may mis-

<sup>10</sup> Carr-Saunders, *op. cit.*, pp. 280-81; H. G. Moulton, *Japan, An Economic and Financial Appraisal*, in collaboration with Junichi Ko (Brookings Institution, Washington, D.C., 1931), p. 388.

<sup>11</sup> Considered "very unreliable" by the League of Nations (Economic Intelligence Service, *Statistical Year-Book, 1939/40, 1940.II.A.3*, Geneva, 1940, p. 13).

represent the facts for Indo-China, Thailand, and Malaya. There may have been a decline in per capita rice utilization in Indo-China rather than the stability indicated in Chart 20, and there may have been less decline in Thailand and more increase in Malaya than is indicated by the statistics.

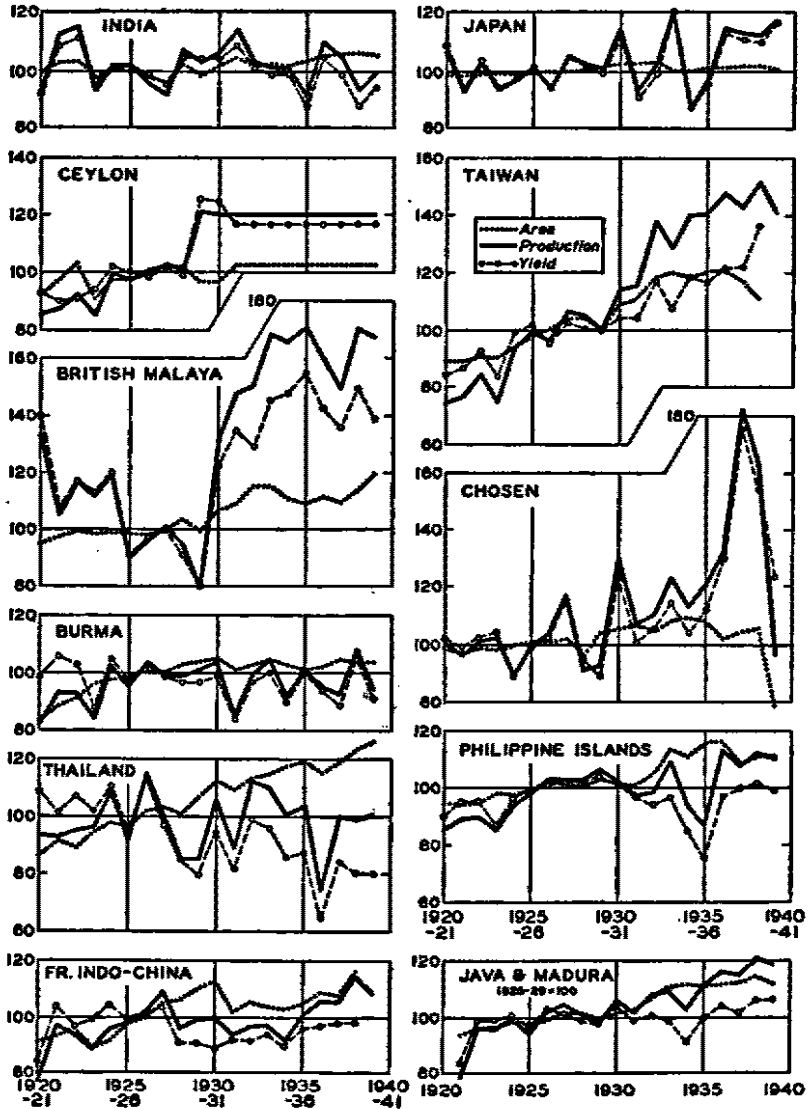
The assumption that statistics of rice production are reliable, however, needs to be tested. No fully adequate test is feasible; but a graphic comparison of annual official figures on rice areas, unit yields, and production provides a broad basis for critical appraisal. Such statistics, with each series for each country expressed as index numbers with 1925-29 as the base period, are given in Chart 21 (p. 198).

We see no reason to question the broad reliability of official statistics for Burma, Japan, India, Java, and the Philippines. In all five of these countries the area under rice shows only the moderate year-to-year changes that would be expected from the general immobility of lowland-rice culture, or trends that would be expected to result partly from governmental policies of protectionism for domestic rice producers. Rice yield per hectare in these countries also changes in level or varies from year to year only within limits that seem reasonable in view of what little one can learn of expansion in lands devoted to rice and of variations in weather conditions.

But the statistics for Indo-China, Thailand, Chosen, Taiwan, British Malaya, and Ceylon all present features which are difficult to accept as representing actual occurrences. The data for Indo-China (Chart 21) suggest an abrupt downward shift in the average level of yield between 1927 and 1928, and also a tendency for the area under rice to vary more widely than yield per hectare, thus apparently contributing more than yield to variations in production. In Thailand there is also evidence of an abrupt and not readily credible downward shift in the average level of yield between the periods 1920-27 and 1928-39. For these countries, the official statistics may lack comparability over the period from 1920 to 1940, and may be so biased that production in the 1930's

CHART 21.—INDEX NUMBERS OF RICE AREA, PRODUCTION, AND YIELD IN 11 COUNTRIES OF MONSOON ASIA, 1920-21 TO 1939-40\*

(Average 1924-25 to 1928-29 = 100)



\* Based on official data in Appendix Tables I, II, and III. See pp. 197-99 for comments on the reliability of the data.



is statistically understated in relation to production in the 1920's.

The bias of official data may be quite different in Chosen and Taiwan. There seems no reason to question the estimates of acreage in either country. But levels of unit yields appear to have been shifted upward, in an incredible degree, in Chosen<sup>12</sup> between 1935-36 and 1936-37 or a year later, and in Taiwan between 1931-32 and 1932-33. Of these countries it seems probable that official statistics make average rice production in the 1930's appear unduly high in relation to production in the 1920's.

The same sort of bias may be involved in the official statistics for British Malaya and Ceylon. In Malaya the estimates of acreage seem reasonable; the levels of yield may well have shifted twice—once downward, between 1924 and 1925; and once upward, by some 50 per cent, beginning in 1930.<sup>13</sup> In Ceylon, the statistics since 1930-31 are obviously untrustworthy, because they show no variation at all and are in fact mere repetitions. But for some reason official estimates of production were abruptly shifted upward between 1928 and 1929, making the average level of yield some 20 per cent higher. The probable bias of the official statistics of both of these countries is to show production in the 1930's unduly high in relation to average production in the 1920's.

The probable effects of errors in population and production statistics upon the estimates of changes in per capita rice utilization (between the 1920's and the 1930's, shown in Chart 20), may be summarized as follows:

1. No reason has been found to question the estimates of per capita utilization in Burma, Japan, India, Java and Madura, or the Philippine Islands. Further examination of consumption trends in these countries is therefore warranted.

2. For Indo-China, a correction of errors in population statistics would probably tend to make per capita utilization

<sup>12</sup> See Statistical Notes, pp. 342-43.

<sup>13</sup> *Ibid.*, p. 335.

in the 1930's appear *lower* than in the 1920's, while correction of the production statistics would tend to make utilization appear *higher* in the 1930's than in the 1920's. Since there is no way of appraising the magnitude of probable error in either the population or the production statistics, one is obliged to conclude that the facts regarding direction of change in per capita rice utilization in Indo-China are unknown, and therefore further discussion is not worth while. Utilization may have been the same in the 1930's as in the 1920's, or larger, or smaller.

3. For Thailand, the crude data on per capita utilization suggest a reduction of nearly 35 per cent between the 1920's and the 1930's. But the population and the production statistics both seem biased, the first pointing toward an incredibly large increase<sup>14</sup> and the second toward a surprising decline. If one should assume that the true population increase in Thailand was 20 rather than 31 per cent between the 1920's and the 1930's, and that average unit yield remained the same instead of declining 14 per cent between the two periods, the estimates of per capita utilization would then indicate a slight rise rather than the large decline shown in Chart 20. These are not altogether unreasonable assumptions. Consequently in Thailand as well as in Indo-China the direction of change in per capita rice utilization between the 1920's and the 1930's must be regarded as unknown. The large decline in per capita rice utilization shown by the data in Chart 20 is undoubtedly misleading and unrepresentative of the facts. Stability, a modest decline in consumption, or a small increase, is possible and seems more reasonable.

4. As to Chosen and Taiwan, the production statistics for

<sup>14</sup> A decade ago, at least, it was apparently accepted in Thailand that the censuses verified rapid growth in population, although it was recognized that earlier censuses were incomplete and therefore tended to exaggerate the rate of increase. The "Speech from the Throne with reference to the last census gave timely warning of the underlying danger of such a rapid growth without at least a parallel increase in the means of subsistence." See Executive Committee of the Eighth Congress of the Far Eastern Association of Tropical Medicine, *Siam, General and Medical Features* (Bangkok, 1930), pp. 214-15.

the 1930's clearly stand too high in relation to those for the 1920's; but no bias is apparent in the population statistics. Correction of the production statistics would therefore still further reduce the level of per capita rice utilization in these two countries in the 1930's, and would suggest that the real decline from the level of the 1920's was larger than the apparent decline shown in Chart 20. Here there appears to have been a true and significant reduction of per capita rice utilization, sufficiently well established statistically to warrant consideration.

5. Official statistics of British Malaya probably overstate the increase both of population and of production between the 1920's and the 1930's. The crude data of Chart 20 indicate a very small increase in per capita rice utilization. Because of the part played by immigration and emigration in gross population changes in this country, one has no satisfactory basis for making an assumption as to how much less than 29 per cent the increase of population may have been. And, although the level of domestic yield per acre in the 1930's may be some 35 per cent too high for proper comparison with the level of the 1920's,<sup>15</sup> domestic production is a minor factor in domestic utilization, net imports being more important. Here, as with Thailand and Indo-China, the facts as to increase, reduction, or stability of per capita use of rice are unknown. The same conclusion applies to Ceylon, for which population statistics seem reasonable enough but production statistics for the 1930's are clearly no more than guesses.

6. Changes in per capita rice utilization sufficiently well established to justify inquiry as to causes and consequences are accordingly those presented in Chart 20 for Burma, Taiwan, Chosen, Japan, India, Java, and the Philippine Islands. In all of these countries, exporters and importers alike, the evidence points toward a decline in rice consumption per

<sup>15</sup> This does not mean that official statistics of yield per acre in the 1930's are too high for accurately representing the facts; there are sound reasons for believing that they do, but they are certainly too high for proper comparison with standing official appraisals of yields in the 1920's.

capita between the 1920's and the 1930's; and in Chosen and Taiwan the true extent of decline has probably been larger than the data of Chart 20 suggest.

Moreover, since there has probably been a drift away from brown rice toward polished, decline of per capita rice-calorie ingestion has probably been larger than decline of per capita rice utilization as herein measured (p. 195). The statistical basis for appraising changes in Thailand, Indo-China, Malaya, and Ceylon seems too insecurely founded to warrant conclusions as to probable direction of change in per capita use of rice over the past two decades; but of Thailand it can be said that the official data of Chart 20 must at least exaggerate decline if decline actually occurred. Finally, the trend of per capita rice utilization in China remains unknown in the absence or near absence of population and production statistics.

#### PROBLEMS OF INTERPRETATION

Three questions immediately present themselves on establishment of a strong presumption that per capita utilization of rice, or per capita ingestion of rice calories, has declined in at least 7 of the 12 countries of Monsoon Asia. (1) How large a decline would presumably be significant to the populations affected? (2) Does a decline in per capita rice utilization imply improvement or deterioration of diet? (3) How are reductions in per capita use of rice to be explained in terms of causation?

The relative magnitudes of probable declines in per capita rice utilization are summarized in Table 5. Reductions are expressed in kilograms per year, pounds per year, calories per day, and finally in terms of percentages. The principal problem in appraising importance of decline is to decide whether absolute decline is more or less significant than percentage decline. If rice in the 1920's had been equally important in the diets of all nations, a decline of 10 kilograms would have substantially the same potential significance for any country. But rice consumption tends to be localized

rather than generalized in parts of several countries, notably Chosen, India, and Java among those considered in Table 5. Hence a decline of 10 kilograms in per capita rice utilization of a nation consuming say only 70 kilograms per capita on the average may mean more to the rice-eating population of that nation than an equal decline would mean to a nation

TABLE 5.—CHANGES IN PER CAPITA RICE UTILIZATION IN COUNTRIES OF MONSOON ASIA BETWEEN THE 1920'S AND THE 1930'S\*  
(Specified units of cleaned rice)

Country	Average annual utilization (kilograms per capita)		Change			
	1920's	1930's	Kilograms per year	Pounds per year	Calories per day*	Per- centage
Burma .....	157	118	-39	-86	-377	-24.8
Taiwan <sup>b</sup> .....	144	114	-30	-66	-289	-20.8
Chosen <sup>b</sup> .....	70	61	- 9	-20	- 88	-12.9
Japan .....	149	142	- 7	-15	- 66	- 4.7
India .....	84	78	- 6	-13	- 57	- 7.1
Java .....	95	87	- 8	-18	- 79	- 8.4
Philippines ..	119	107	-12	-26	-114	-10.1

\* Data as in Chart 20, p. 191.

<sup>b</sup> One pound of rice taken as 1,600 calories.

<sup>c</sup> Extent of decline probably understated; see pp. 199-201.

wherein the whole population were rice eaters consuming say 150 kilograms of rice per year. Accordingly, the percentage reductions of per capita use of rice shown in the final column of the table apparently afford the best index of potential significance of decline from the point of view of the rice-eating segments of the several populations.

On this basis of appraisal, the declines of 6-9 kilograms per capita in Chosen, India, and Java are to be regarded as pointing toward considerably more important changes in food-consumption habits among populations accustomed to use rice largely than is the decline of 7 kilograms in Japan. The change in Japan has presumably been of less potential significance than change in any other country. Burma, Tai-

wan, and Chosen stand out as the countries where decline of per capita utilization has probably involved the greatest changes in diets of rice eaters, especially if the reductions in Taiwan and Chosen are statistically understated.

Any decline of per capita rice utilization is difficult to interpret in terms of improvement or deterioration of diet, even if "rice utilization" be regarded as the equivalent of "rice-calorie ingestion."

1. A decline in per capita rice ingestion may conceivably mean a decline in total food-calorie ingestion if there has been no substitution of other foods for rice. In a prosperous Occidental country, such a decline might merely mean a lowering of national per capita food-calorie requirements due to reduction of output of human energy in physical work; its implications might be toward improvement of dietary status. This may conceivably be the meaning of the decline of per capita rice utilization in Japan. But in other Monsoon Asiatic countries, lower in economic status, a decline of per capita rice-calorie ingestion not offset by increase in per capita ingestion of other foods would be more likely to carry unfavorable implications—more people suffering hunger for longer periods.

2. If decline in per capita rice-calorie ingestion should be fully offset by increased ingestion of cheaper and less desired foods like maize, millets, cassava, or potatoes, the implication for the nature of the change in the diet might be qualitatively favorable but psychologically and economically unfavorable. The foods substituted for rice might contribute to the diet either more and better proteins than were contributed by the rice formerly ingested, or more vitamins and minerals. But if the foods substituted for rice are cheaper and not liked by the populations affected, the presumption is that there would be dissatisfaction with the change, and that it would be made under pressure of unfavorable economic circumstances.

3. If decline in per capita rice-calorie ingestion should be

fully offset by increased ingestion of more expensive and more highly preferred foods, the implication for the nature of the change in the diet would be psychologically and economically favorable, but it might be qualitatively either favorable or unfavorable. Such substitution would occur as reflection of improved economic status, and at the choice of individuals. If the foods substituted for rice were superior to rice in content of protein, vitamins, or minerals—as would be fish, meat, eggs, dairy products, wheat flour, and many vegetables and fruits—the change would mean qualitative improvement of dietary status. But if sugar (practically a pure carbohydrate without vitamin or mineral values) were the only substitute for rice, the change would involve qualitative deterioration of diet.

Accordingly, it would be important to ascertain, if possible, whether or not decline in per capita rice utilization has involved reduction of total food calories, or, if and to the extent that there has been substitution of other foods for rice, what particular foods have been substituted. The question of probable substitutions is given attention later, but basic data are so fragmentary that few definitive conclusions are possible.

The causes of decline in per capita use of rice, at least as between the two decades in question, may conceivably be of several types, differing from country to country. Demographic factors, especially internal migrations, would hypothetically need to be considered; for migration from a rice-eating region to a non-rice-eating region of a country might give rise to an apparent national reduction of per capita rice utilization that really meant no change or even increase in the level of use in the rice-consuming region. Such factors, however, seem not to be genuinely important.

More significant, probably, would be mere accident of weather conditions with attendant effects upon unit yields of rice. In any year in all seven of the countries where decline of per capita rice utilization has clearly occurred, either all

of the rice domestically consumed (as in the three net-exporting countries) or the great bulk of it (as in the four net-importing countries) is grown at home. In the net-importing countries, on advent of a short crop, the net imports never suffice fully to offset the shortage of crop; or, on advent of a large crop, the net imports are rarely curtailed sufficiently to keep total supplies at the same level as in the preceding year. Domestic utilization of rice, in total or per capita, is somewhat variable from year to year. If, then, in any importing country, the decade of the 1920's happened to contain a larger proportion of years with weather conditions favorable to good rice yields than did the decade of the 1930's, the distribution of favorable years would alone tend to elevate the level of per capita rice utilization in the 1920's as compared with the 1930's. It will be found that accident of weather is a significant factor in explaining reductions of per capita utilization in some countries.

The causes of decline in rice consumption need also to be sought in the effects of general economic cycles and economic trends upon incomes and actions of consumers and producers. The decade of the 1920's, in Monsoon Asia as elsewhere, was predominantly one of prosperity and economic expansion, whereas the decade of the 1930's was not. No doubt the duration and amplitude of trade-cycle advance, recession, and recovery were different from country to country of Monsoon Asia, and no doubt general long-term trends toward lower or high national per capita economic output and consumption were different also. But in general one has the impression that throughout Monsoon Asia pressure for the huge rural populations to economize was stronger in the 1930's than in the 1920's; and rice lost purchasing power as compared with nonagricultural products (p. 161). (Under these circumstances, one would expect to find that reductions in per capita use of rice, if offset at all by increase in consumption of other foods, tended to be offset by substitution of cheaper and less preferred foods and so to reflect decline in general levels of )



(living. Exceptions to this generalization might be found in portions of some nations with a relatively high degree of industrialization.) The populations of large urban centers might tend to maintain their rice consumption if domestic industry continued to provide employment and so to maintain the incomes of industrial workers. For them, the fall in the purchasing power of rice and other agricultural products might provide either stimulus to per capita rice utilization if rice were substituted for cheaper foods, or discouragement if more expensive foods were substituted for rice.

Finally, governmental policies themselves may have contributed toward decline in per capita use of rice. In a net-importing country, this might be the effect of adoption of a policy of restriction on rice imports as part of a drive toward self-sufficiency in rice, depending on the severity of restriction in relation to the impetus given to domestic expansion of rice output. Severe rice-import restrictions coupled with a policy of domestic expansion of substitute cereals might have still larger adverse effects upon domestic rice utilization per capita. In noncolonial exporting countries, governmental policies would be expected to exert less influence. In colonial exporting countries, however, the policies of the mother country could well be such as to stimulate rice exports from colonies to motherland, with adverse effects upon rice consumption in the colonies. As will appear in the following chapter where changes in rice utilization are considered country by country, policies in the Japanese Empire were influential in causing reductions in Chosen and Taiwan.

## CHAPTER X

### CONSUMPTION TRENDS SINCE 1920: INTERPRETATIONS

As preceding chapters have indicated, the facts regarding changes in levels of per capita rice utilization in the several countries of Monsoon Asia are difficult to establish, and explanations of changes that may be regarded as real rather than merely statistical are not likely to be found readily. Evidence on changes in per capita consumption of other foods than rice, and of food in general, is scanty. Problems of interpreting changes in per capita rice consumption would be complex even if the full picture of change in food-consumption patterns could be made clear.

In the following pages, however, some tentative explanations are advanced for the reductions in per capita rice consumption between the 1920's and the 1930's that have occurred in the Japanese Empire, India, Burma, Java and Madura, and the Philippine Islands. It would be futile to venture explanations with regard to British Malaya, Ceylon, Thailand, French Indo-China, and China, since not even the probable direction of change in rice utilization in these countries can be credibly established. The countries considered, however, provide illustrations of all of the existing types—net exporters and net importers, protectionist and free trade—except for a subclassification of the net importers represented by Malaya and Ceylon, wherein imports of rice regularly much exceed domestic output in their contribution to total supplies available for consumption.

Attention is focused in the following discussion especially upon the question of what foods if any have been substituted for rice as per capita rice consumption fell, and upon the influences that have presumably brought about the substitutions. It is important to know, first, whether there has been

greater use of superior and preferred foods, or increase in the consumption of cheaper substitutes regarded as inferior, and, second, to understand the causes underlying the substitutions.

#### THE JAPANESE EMPIRE

Developments in the Japanese Empire may reasonably be considered first. By the 1930's, the Empire had attained a position of substantial self-sufficiency in rice, at least in years of approximately normal yields. Prior to the first World War, imports of rice into Japan Proper came about half from Chosen and Taiwan, and half from non-Empire sources. Developments since 1911 are indicated by the following tabulation showing the percentage distribution of imports into Japan from the two colonies and from foreign sources respectively:

Period	Chosen	Taiwan	Foreign countries
1911-15 .....	24	20	56
1916-20 .....	37	18	45
1921-25 .....	47	17	36
1926-30 .....	57	21	22
1931-35 .....	65	30	5
1936-38 .....	63	35	2

By the 1930's, the colonies were supplying practically all of the imports, though this situation changed abruptly with an exceptionally short crop in 1939 (Chart 21, p. 198), followed by a poor crop in Japan Proper in 1940.

Over the whole period from 1911, while the rice-import deficit of the Empire as a whole tended to decline almost to the point of Empire self-sufficiency, the import deficit of Japan Proper tended to increase. Net imports rose from about 435 thousand tons in 1911-15 to 1,640 thousand in 1931-35 and 1,615 thousand in 1936-39 (Appendix Table V). The growing deficit occurred in spite of governmental encouragement of domestic rice production begun early in the 1920's; and it was filled increasingly by imports from the colonies in large part because of the governmental policy that encouraged colonial rice production. A protected market for colonial pro-

ducers was provided in Japan Proper, especially after 1927 when import restrictions on non-Empire rice became more severe. The government-encouraged expansion of rice output in Japan and in Chosen came chiefly through enhancement of unit yields, whereas in Taiwan increase in acreage was about as prominent as increase in yields (Chart 21, p. 198). Sharp rises in the controlled rice prices of Japan after 1931, involving enhancement of the purchasing power of rice (Chart 19, p. 175), presumably tended to stimulate Empire output.

Rice utilization in Japan Proper declined, as already noted, by approximately 15 pounds per capita, or 4.7 per cent, between the 1920's and the 1930's. This is only a small reduction, implying minor changes in food-consumption habits. A decline in rice ingestion of 15 pounds per year would mean a reduction of only 66 rice calories per day, or the equivalent of about 2.5 per cent of the total daily ingestion of food calories if the level of daily calorie ingestion is taken as 2,500 calories per capita.

If one turns first to the question of what foods may have been substituted for rice, only a partial answer is possible. Aside from rice, the chief sources of food calories, in order of magnitude, are apparently barley, beans, potatoes, wheat, sugar, other cereals, fish, various roots, seaweed, and fruit and green vegetables. Meat, poultry, eggs, and milk rank very low.<sup>1</sup> The trends of per capita consumption of these foodstuffs are not all determinable. Yet it seems clear that per capita consumption of barley and wheat declined between the 1920's and the 1930's; for between these two decades, when population rose nearly 16 per cent, aggregate barley production fell about 7 per cent and aggregate wheat utilization about 3 per cent. Thus it was not only rice, but barley and wheat also, that declined in consumption per capita.<sup>2</sup>

<sup>1</sup> According to contribution of the different foods to total food-calorie consumption as given by Grey, *The Food of Japan*, p. 29.

<sup>2</sup> For many years wheat utilization per capita tended to increase in Japan, but after 1927, when rice prices started to decline, per capita wheat utilization fell off. See Alsberg, "Japanese Self-Sufficiency in Wheat," p. 98. There is some evidence that there

Perhaps consumption of bean products has also fallen, since total utilization of soybeans increased no more than 4 per cent between 1922-30 and 1931-38. Sugar consumption, however, has remained stable at about 28 pounds per capita per year if one refers to changes between the periods 1923-24 to 1929-30 and 1930-31 to 1938-39. To the extent that one may judge by import statistics, per capita consumption of apples and bananas may have increased slightly, for net imports of these items were more than 20 per cent larger in 1934-38 than in 1924-28. There seems to have been increase also in per capita consumption of fruits generally, of vegetables, and of sea foods.<sup>3</sup>

The decline of per capita rice consumption in Japan may thus reasonably be regarded as one part of a process of improvement and diversification of diet: consumption of rice and other inferior cereals has declined, while noncereal foods have risen in importance. A small decline of total calorie ingestion, due to the fall of cereal calories exceeding the rise of noncereal calories in the diet, might be explained, adequately and without unfavorable implications for nutrition, in terms of shifts in occupation of the population. Farmers eat more per capita than factory workers in general. A decline in per capita food-calorie ingestion involving no hardship would therefore be expected with enlargement of the urban-industrial population in relation to the farm population of the country.

In some small degree, accident of yield may also help to explain, at least indirectly, the decline of per capita rice consumption in Japan Proper. The exceptionally poor crop of 1939 in Chosen, with resulting unavailability of the normal volume of exports from that colony, came at a time when

exists "a price for rice above which wheat consumption tends to rise and below which it drops sharply—presumably because more rice is consumed" (*ibid.*, p. 77).

<sup>3</sup> For a more detailed discussion of trends in the consumption of foodstuffs other than rice, see E. F. Penrose, "Japan, 1920-1936," in *The Industrialization of Japan and Manchukuo, 1930-1940: Population, Raw Materials and Industry*, ed. by Elizabeth B. Schumpeter (New York, 1940), pp. 154-87.

Japanese ability to pay for foreign imports was curtailed by her war efforts. Had there been no crop shortage in Chosen, rice imports into Japan in 1939-40 might well have been larger, slightly raising the average level of imports and of domestic utilization per capita in the decade of the 1930's.

Thus it seems probable that the world economic depression and the evolution of Japanese food policy—at least up to 1937 when undeclared war with China began—were not sufficiently important influences to cause deterioration in the national diet. It seems possible that dietary improvement might have been more marked under better economic conditions, and that developments since 1937 have meant deterioration in the national dietary position. Recent changes, however, cannot well be appraised in the absence of adequate statistics, and, in any event, might not become apparent until enough time had elapsed to permit developments to be viewed in perspective.

In Chosen, the decline in per capita rice utilization seems to carry quite different implications. Amounting to about 13 per cent between the 1920's and the 1930's, it was considerably larger than the decline in Japan. That the downward trend in Chosen has persisted for more than two decades is indicated by the following tabulation of annual averages in five-year periods from 1916 (mainly from Appendix Table VII):

Period	Production <sup>a</sup>	Net exports <sup>a</sup>	Utilization <sup>a</sup>	Population (millions)	Utilization per capita	
					(kilograms)	(pounds)
1916-20..	1.81	.27	1.55	17.1	90	198
1921-25..	1.92	.49	1.44	18.6	77	169
1926-30..	1.98	.69	1.29	20.4	63	139
1931-35..	2.29	1.10	1.18	22.1	54	119
1936-40..	2.73	1.09 <sup>b</sup>	1.64 <sup>b</sup>	23.8	69 <sup>b</sup>	152

<sup>a</sup> In million metric tons.

<sup>b</sup> Three-year average.

<sup>c</sup> Using three-year average of net exports. The average level of production in 1936-40, and hence the levels of utilization in total and per capita, presumably overstate the facts by a substantial margin; see above, p. 199.

From an approximate level of 198 pounds per capita in 1916-20, rice utilization fell progressively to about 119 pounds—a decline of nearly 40 per cent—in 1931-35. The presumption that statistics for 1936-40 are probably faulty and certainly not comparable with earlier periods (p. 199) precludes the assertion that decline continued after 1935, but recovery seems rather improbable for the five-year period as a whole, especially in view of the short crop of 1939 (Chart 21, p. 198). It may safely be assumed that decline in per capita rice utilization in Chosen between the 1920's and the 1930's appreciably exceeded the 13 per cent indicated by the statistics.

There was clearly no failure of domestic rice production to keep pace with population growth, for production in the 1930's was perhaps 25 per cent larger than in the 1920's (28.2 per cent according to official statistics), while the increase of population was some 18 per cent. Exports increased more rapidly than either production or population, stimulated by a familiar colonial policy that made it attractive for Korean producers to export rice to the mother country while employing cheaper substitutes at home.<sup>4</sup> It is possible that exports were stimulated also by the relatively low rice price (currency) of the period 1928-33 (Chart 19, p. 175); but on the whole Japanese policy seems likely to have been a more important factor in the increase of exports between the 1920's and the 1930's. In any event, Japan succeeded in converting Chosen into an ample rice granary, and rice became the chief cash crop of Korean peasants. The relative cheapness of other grains was the more marked because Japan artificially controlled the price of rice and did not impose duties on substitute grains.<sup>5</sup>

<sup>4</sup> France has followed the same policy with wheat. By supporting the domestic wheat price in relation to other grains, and thus artificially creating wide price differentials at point of export in northern Africa, the government provided a strong incentive for farmers there to ship wheat to France and to live more largely on barley, their second important grain crop.

<sup>5</sup> For a period following the middle 1930's, after what were considered ample rice supplies had been built up, it was no longer in the Japanese interests to continue this

Observers of Chosen's agricultural economy are in remarkable agreement upon the poverty and distress of the country and its people.<sup>6</sup> That Chosen is a "land of spring hunger" is noted even in official reports of the Governor General. Lee,<sup>7</sup> writing in 1935, observes: "It is a common saying among farmers that they cannot consume what they produce—the rice—but they sell it for cash and buy millet. . . . They may use other grains than millet to substitute for rice . . . . Barley, wheat, kaoliang or sorghum are commonly used in direct substitution for rice, but the increase in the per capita consumption of these cereals is not so marked as that of millet." Lee's own statistics of per capita consumption of foxtail millet, however, fail to show a persistent upward trend of per capita consumption, but only a shift in level between 1912-19 and 1920-30. His data do not extend beyond 1930, and we have been unable to find statistical evidence elsewhere of change in millet consumption between the 1920's and the 1930's. For wheat, however, statistics of Korean production point toward decline of per capita utilization, while statistics of production and net imports of barley point toward substantial increase in per capita utilization (some 35 per cent).

One gains the impression that between the 1920's and the 1930's, decline probably occurred in per capita consumption both of rice and wheat, the preferred cereals, and that increase occurred in consumption per capita of barley and perhaps of millet. This would mean deterioration of the Korean diet

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policy. It was accordingly reversed, and import duties were imposed on the cheaper grains in an effort to expand Korean rice consumption and curtail exports to Japan. Since production statistics for Chosen are not comparable for the periods 1931-35 and 1936-40, it is impossible to ascertain whether or not the reversal of policy had the effect of increasing Korean rice consumption.

<sup>6</sup> For example, see: Lee, *Land Utilization and Rural Economy in Korea*; W. Ladejinsky, "Chosen's Agriculture and Its Problems," *Foreign Agriculture* (U.S. Dept. Agr., Office of Foreign Agricultural Relations), February 1940, IV, 95-122; A. J. Crajdanov, "Korea under Changing Orders," *Far Eastern Survey* (American Council, Institute of Pacific Relations, New York), Dec. 20, 1939, pp. 291-97.

<sup>7</sup> *Op. cit.*, pp. 277-78.



from the psychological point of view, and reflects deterioration in general level of living; but it does not clearly imply nutritional deterioration. Whether or not increases in the consumption of barley and millet fully offset in calorie values the declines in rice and wheat consumption seems uncertain, but somewhat improbable. If so, Chosen must have become a "land of spring hunger" even more markedly in the 1930's than in the 1920's. The causes of this are apparently rooted in Japanese policy quite as much as in adverse economic conditions arising from the world depression.

The decline of per capita rice utilization in Taiwan appears—with allowance for probable statistical understatement—to have exceeded 21 per cent. This is a large reduction. It may reasonably suggest that Formosans have found it necessary to use substitutes for rice—if substitutes could be found—in one meal out of five. In this Japanese colony the population appears to have increased about 27 per cent between the 1920's and the 1930's, and rice production 46 per cent or somewhat less if allowance is made for overstatement of the production increase. As in Chosen, the decline in rice consumption per capita in Taiwan has come about not by failure of production to keep pace with population growth, but by extremely heavy increase of rice exports stimulated mainly by the rice policies of the mother country.

One has the impression that the population of Taiwan is less poverty-stricken and farther from chronic hunger than that of Chosen, and hence that the decline in rice consumption may not have involved as much sacrifice. Yet it seems impossible to ascertain whether or how the gap in the food supply made by the fall in rice consumption was filled. After rice, sweet potatoes and sugar cane occupy more crop land in Taiwan than any other crops (respectively about 13 and 11 per cent, as against 62 per cent in rice). To the extent that substitutes for rice have been found, it seems probable that the principal one may have been the sweet potato. Since the population has increased so greatly without appreciable immi-

gration, it seems unlikely that the gap in the food supply left by the decline of rice consumption has involved substantial reduction of food-calorie intake and increase in prevalence of hunger.

If sweet potatoes rather than other foods have fully replaced rice, psychological and economic deterioration in the dietary position of Taiwan are indicated, but not quantitative deterioration; and nutritional improvement might be assumed because of the superiority of sweet potatoes over rice as a source at least of vitamins A and C.

Reductions in per capita rice utilization thus carry different implications in the several parts of the Japanese Empire. The decline in Japan Proper does not suggest dietary deterioration, but only such changes in composition and quantity of food intake as would be welcomed by the population and likely to occur with general improvement of economic status. In Chosen, decline of rice consumption seems to imply economic pressure, only incomplete substitution of inferior cereals for rice, and intensification of food shortage. In Taiwan, the decline in rice consumption probably represents an unwelcome change forced by adverse economic circumstances, though perhaps not the emergence of quantitative food shortage and perhaps not a qualitative deterioration from the nutritional point of view.

#### BRITISH POSSESSIONS

Among the British possessions of Monsoon Asia, only India and Burma seem to provide a statistical background adequate for the measurement of changes in per capita rice utilization between the past two decades. In Burma, the world's leading rice exporter, rice utilization per capita appears to have fallen by nearly 25 per cent between the 1920's and the 1930's—the largest measurable decline in any country of Monsoon Asia. In India, the world's largest net importer of rice since the shrinkage of Chinese imports began in 1936, the decline of per capita rice utilization has approxi-

mated 7 per cent. Practically all Indian imports of rice come from Burma, and India is Burma's principal market (chapter v). No trade barriers have existed between the two countries.

The reduction of per capita rice utilization in Burma appears to be attributable to two principal developments: pressure on producers to maintain sales (and, indirectly, national exports) in the face of falling prices, coupled with a larger proportion of exceptionally low rice yields per acre in the 1930's than in the 1920's. Governmental policies, limited as they were to changes in the value of currency, could hardly have had the effects apparent in Chosen and Taiwan; and there is little to suggest increasing industrialization of Burma comparable to that in Japan, where it may have led to decline in total per capita food-calorie intake in which rice seems to have shared.

The very sharp decline of rice export prices in Burma between 1929 and 1933 (Chart 16, p. 151) and their persistently low though rising level thereafter presumably tended to stimulate exports. When prices fall and remain low, growers and dealers feel pressure to market larger lots, in the hope of maintaining incomes at levels sufficient to meet inescapable financial obligations and to purchase commodities regarded as indispensable. This is probably the normal behavior of farmers operating small holdings, who have few or no alternative uses for their labor. Rice, as mentioned earlier, occupies two-thirds of the cultivated land of Burma, is produced mainly on small holdings, and constitutes about 40 per cent of the total value of Burmese exports.

The effects of price developments upon exports are suggested by ratios of rice exports to production. At the relatively high rice prices of 1921-25, exports constituted 50 per cent of production; at the lower prices of 1926-30, 58 per cent; at the lowest prices of 1931-35, 65 per cent; and at the somewhat higher prices of 1936-40, 61 per cent. Production was smaller in 1931-35 than in 1926-30, yet a larger proportion of the crop was exported in the later period. Production was

larger in 1936-40 than in 1931-35, yet a smaller proportion of the crop was exported at the higher level of prices in 1936-40. Conversely, the lowest five-year average level of per capita domestic rice utilization corresponded with the highest ratio of exports to production, in 1931-35. There was some increase of per capita rice utilization between 1931-35 and 1936-40.<sup>9</sup> As between the decades of the 1920's and the 1930's, population, rice production, and exports all increased, but exports showed the greatest rise and domestic utilization fell in total and still more per capita.

Burman exports might perhaps have increased even more and utilization might have declined less in the 1930's, if the decade had not contained a large proportion of years presumably unfavorable for rice yields. Chart 21 (p. 198) suggests that the decade of the 1930's included four years (1931-32, 1934-35, 1937-38, and 1939-40) when yields per acre may reasonably be described as abnormally low, with probably only one offsetting year (1938-39) of exceptionally high yield. The 1920's, on the other hand, included only one year (1923-24) of exceptionally low yield and perhaps two (1921-22 and 1924-25) of exceptionally high yields. Years of low average yields for the whole country probably mean local crop failures, with some producers having no rice to sell and often not enough to feed their families. So far as one may base inferences upon the relative prevalence of low average yields in the two decades, it would seem likely that the 1930's witnessed a greater degree of local shortage than did the 1920's, with adverse effects upon the level both of exports and of per capita utilization.

The decline of per capita rice utilization from the 1920's to the 1930's was conspicuously large. If genuine, it must have involved either a severe and painful shortage of food calories, or a large degree of substitution of other foods for rice. Yet the available statistics for Burma provide no use-

<sup>9</sup> Data on production, exports, and per capita utilization by five-year periods are given in Appendix Table VII.

ful picture or explanation of what occurred. Production of two of the food crops listed in addition to rice<sup>a</sup> (maize and jowar) appears to have increased less rapidly than population, so that per capita utilization of these potential substitutes for rice has apparently fallen also. Production of gram (chickpeas), however, has risen sufficiently to permit increase in per capita consumption; but it remains a small item, domestic production of gram being equivalent to only 2-3 per cent of total rice utilization. Animal products, never important, seem unlikely to have risen substantially in per capita consumption. Unless the output of unlisted food crops such as cassava, sweet potatoes, or fruit has increased enormously, it is difficult to see what may have been substituted for rice, and the presumption arises that the gap in food intake left by the decline in rice consumption has not been filled. If so, this decline must be regarded as an indicator of unwelcome quantitative deterioration of diet and reduced level of living. With conjuncture of higher rice yields and prices in the future, however, presumably the situation would improve. If the assumption is correct that pressure upon farmers to market rice excessively has been a significant influence in national decline of per capita rice consumption, the inference may be warranted that deterioration of diet has occurred mainly among the rural population. Since the purchasing power of rice declined between the 1920's and the 1930's, the urban population may even have increased its per capita consumption. But of this there is no direct evidence.

It would seem reasonable to suppose that somewhat the same developments may have occurred in Thailand and Indo-China—pressure on producers to market and export increasingly large fractions of their rice output, with adverse effects upon the level of per capita rice utilization. Even more than Burma, these countries depend upon rice as their most valuable export crop. But in view of the probable inaccuracy of

<sup>a</sup> These statistically accounted for are limited to jowar, maize, and gram.

basic statistics, the diversity of export price movements (Chart 16, p. 151), and possible diversity of trends and annual fluctuations in rice production, the inference cannot be securely drawn.

In India, rice production has failed to keep pace with population growth, the respective increases being .7 and 10.9 per cent between the 1920's and the 1930's. Net imports rose by more than 90 per cent, but remained so small in proportion to production (only 5.4 per cent even in 1936-40) that per capita rice utilization declined about 7 per cent. The decline occurred, however, between the quinquennial periods 1921-25 and 1926-30 and again between 1931-35 and 1936-40, but not between 1926-30 and 1931-35 (Appendix Table VII, pp. 328-29).

This behavior in itself suggests that accident of yield may have been an important factor in the decline. Chart 21 (p. 198) indicates that there were two years of extraordinarily high yields per acre in the 1920's (1921-22 and 1922-23) and only one year of yields that might be called exceptionally low (1920-21). In the 1930's, however, there were three years of exceptionally low yields (1935-36, 1938-39, and 1939-40), and only one of yields that might be called exceptionally high (1931-32). If there had been yields about normal (say 98 per cent of the 1925-29 average) in the three poor years of the 1930's, average annual per capita utilization of rice might have been 80 rather than 78 kilograms, and the reduction from the 1920's about a third less than the calculations show.

Decline of per capita rice consumption in India might well have occurred, however, even in the presence of approximately normal yields per acre in the poorest years of the 1930's. In this decade, Indian rice producers, like the Burman, were presumably subject to pressures to tighten their belts and to market more heavily than they might have done in the absence of sharp decline in the rice-price level. As in Burma, it is possible that urban consumers found that decline in the pur-

chasing power of rice permitted them to enlarge per capita consumption; this is suggested also by the increase of per capita rice imports into India, which presumably go mainly to urban centers. Though not verifiable statistically, on general grounds the hypothesis seems tenable that urban consumers in India and some other countries may have increased their per capita rice consumption and possibly reduced their consumption of inferior cereals in the 1930's as compared with the 1920's. If it is a credible hypothesis, the conclusion follows that a national decline in per capita rice consumption may imply still larger decline among rice producers, but less decline, no decline, or even increase among urban consumers.

The possible substitutions for rice in the Indian diet seem sharply limited. Total utilization of wheat (deducting seed use) increased between the two decades at a slightly slower rate than population growth, implying little change in its per capita consumption. Increase in production of bajra and jowar, the other leading cereals in the national diet, was less rapid than the growth of population, and their consumption per capita accordingly may have declined unless, as is conceivable but not demonstrable, there was diversion of part of the output from feed use to food use.<sup>10</sup> Production of maize remained practically unchanged between the two decades, so that per capita utilization must have fallen; and production of barley declined, implying still more marked reduction of per capita utilization. Thus, as between the two decades, there is little reason to believe that inferior cereals were widely and generally substituted for rice. As for other foods, gram is also statistically indicated to have fallen in per capita consumption; and one would have little reason to assume increase in utilization of animal products. Sugar, alone of the principal foodstuffs for which statistical estimates of utilization

<sup>10</sup> Perhaps this possibility ought to be given more emphasis. If Chinese use of cereals (pp. 101-03) serves as a guide to Indian use, there is substantial customary use of inferior cereals for feed in India; and under pressure of shortage of preferred food cereals, diversion of inferior cereals from feed to food use might well occur.

can be prepared, seems to have risen in per capita consumption, but has remained only a minor component of the diet. Quantitative inadequacy of food supply, probably always chronic at least locally in India, may thus have been intensified over the past two decades, partly through accident of low yields and partly through impact of the depression upon farmers especially. The implications of the possible decline in per capita food-calorie intake appears less unfavorable if growing industrialization of the country has lowered the national food-calorie requirement—as seems possible. And it may be that diversion of inferior cereals from feed to food uses prevented much or all of the indicated decline in total food-calorie intake.

Over a longer period, the inferior cereals, notably the millets and barley, seemingly have tended to increase in per capita consumption while the preferred cereals, rice and wheat, have declined. Mukerjee<sup>21</sup> gives data showing that, as between quinquennial averages for 1910-15 and 1930-35, production of rice rose 10.2 per cent and that of wheat declined 2.2 per cent, while production of jowar, barley, bajra, and maize increased respectively 107.8, 73.4, 25.0 and 12.0 per cent. He concludes that "the food position of India is gradually becoming worse both with reference to the relative proportion of food production to mouths to feed and also with reference to the nutritive quality of the cereals." Our data for the past two decades tend to confirm the first part of this generalization, but not the second. Perhaps largely because of accident of yields, per capita consumption of wheat and rice appears to have been maintained better than per capita consumption of the inferior cereals. It remains possible that the fundamental long-term trend is toward greater increase of production and consumption of inferior cereals grown on upland or as second crop on paddy than of rice grown on paddy land.

<sup>21</sup> *Food Planning for Four Hundred Millions*, pp. 20-21.



## JAVA AND THE PHILIPPINES

Java (including Madura) and the Philippine Islands have been net importers of rice for many years. Unlike India, however, the trend of net rice imports during the past two decades has been downward, partly in reflection of governmental policies directed toward protection of domestic rice producers and self-sufficiency. Domestic rice production, though increasing, has not kept pace with population growth in either country. Hence, with the absolute decline in net imports, per capita utilization of rice has fallen. The reduction between the 1920's and the 1930's was about 8 per cent in Java, 10 per cent in the Philippines—somewhat more than in India, but considerably less than in Burma.

Accident of yield per hectare seems likely to have been a major factor in the decline of Philippine rice consumption. The yields in 1934-35 and 1935-36 were by far the smallest of any in the past two decades (Chart 21, p. 198). With normal yields in those years, per capita rice utilization might well have fallen not from 119 to 107 kilograms between the 1920's and the 1930's, but from 119 to 113. Nevertheless some reduction would probably have occurred for other reasons. Philippine producers, like the Burmese and Indians, presumably felt pressure to market excessively following the collapse of rice prices at the end of the 1920's.

As with most other countries, there is difficulty in ascertaining what foods, if any, may have replaced rice in per capita consumption. Import statistics show conclusively enough that per capita consumption of wheat flour (which is wholly imported) rose, while that of rice declined. Total net imports of wheat flour increased some 31 per cent between the 1920's and 1930's, while population increased only about 15 per cent. But wheat flour can hardly have provided more than 3-4 per cent of total food calories even in the later decade. Maize, the cereal of secondary dietary importance, seems likely to have declined in consumption per capita, since production fell about 9 per cent and net imports remained very

small, while population increased between the two decades. Despite the small increase in per capita consumption of wheat flour, the declines in rice and maize consumption imply reduction in the total per capita consumption of cereals, of a magnitude so large that it could hardly have been offset by increased consumption of foods like fish or sugar. Sugar consumption seems, in fact, to have fallen also. Reports suggest that there was an increase in the use of beans, sweet potatoes, other vegetables, and fruits, though no direct statistical evidence is available. On the whole, it seems probable that reduction of per capita rice consumption in the Philippines has involved some degree of quantitative deterioration of the diet, particularly among the rural population—an involuntary and unwelcome change partly in response to economic pressure. Yet rice consumption per capita might recover substantially from the level of the 1930's in the absence of weather conditions conspicuously unfavorable for the rice crop.

In Java, long-term influences tending to displace rice in the national diet have been in evidence for some time. Even before the world depression, Smits<sup>13</sup> pointed out the increasing importance of such foods as cassava, maize, and soybeans. Scheltema,<sup>14</sup> writing in 1935 and using quinquennial averages, showed that per capita rice utilization has swung up and down since 1850 without definite trend, with decline between 1920 and the early 1930's, and that per capita consumption of rice and maize together has probably remained fairly constant in level. Over half a century or more, maize and cassava acreage and production have increased much more rapidly than rice acreage and production. Java was a net exporter of rice until the late 1870's. Thereafter, the volume of imports tended to rise, particularly after the early 1890's, reaching a peak in the quinquennium following 1920. In the past two decades,

<sup>13</sup> M. B. Smits, *Rice Imports of the Netherlands Indies* (Fourth Pacific Science Congress, Batavia-Bandoeng, Java, May-June 1929), pp. 6-8.

<sup>14</sup> Scheltema, *The Food Consumption of the Native Inhabitants of Java and Madura*, pp. 13-14.

however, rice imports have fallen steadily, and were negligible in the late 1930's.

The decline of per capita rice consumption (about 8 per cent) between the 1920's and the 1930's may be regarded in some part as a long-term phenomenon associated with the tendency for food-crop acreage to expand more with respect to upland crops (maize and cassava especially) than to paddy land. But in substantial degree it probably also reflects the impact of economic depression and the effects of governmental policy. Javanese purchasing power for imports was reduced in the early 1930's by the declining quantity and value of her principal exports, such as rubber, copra, sugar, and tobacco. Many Javanese natives could not afford to buy imported rice, many lacked plantation employment and perhaps turned to production of upland crops. The government undertook to encourage home production of foodstuffs and to discourage rice imports. Even without governmental interventions, net imports of rice might well have declined, though probably less drastically than they did. Rice production, though encouraged, failed to keep pace with population growth; and with the decline in net imports, per capita consumption declined also.

When attention is restricted to the change in consumption between the 1920's and 1930's, the statistics for Java suggest that wheat flour, maize, and possibly sugar may have been substituted for rice. Wheat flour, though unimportant in the diet, rose more than 50 per cent in total utilization as against a population increase of 18.6 per cent; the utilization of maize, an important constituent of the diet, increased about 20 per cent. But utilization of cassava seems not to have risen quite so rapidly as population. Data appear insufficient to appraise probable changes in per capita consumption of other foods, but the consumption of some vegetables and fruits apparently has risen. Our impression is that total food-calorie consumption per capita cannot have changed much, though it may have fallen slightly. The nature of the probable substitu-

tions for rice suggests a moderate degree of deterioration in the quantitative adequacy of the national diet during the past two decades in a country where food supplies could hardly be regarded as ample at any time. Qualitatively, however, the composition of the diet may have improved a little.

#### SUMMARY AND IMPLICATIONS FOR THE FUTURE

It appears, if only dimly, that several influences of diverse types have contributed to the reduction in per capita rice consumption that has occurred in at least seven countries of Monsoon Asia over the past two decades. A review of these is pertinent as background for considering possible or probable future developments in the relationships of rice production to rice consumption in the region.

1. Accident of rice yield per hectare—an exceptional predominance of poor yields in the 1930's as compared with the 1920's—seems to have contributed substantially to decline of per capita rice consumption in at least three countries. These are Burma, India, and the Philippines. The same influence may have had a minor adverse effect on consumption in Japan Proper and Chosen.

2. Pressures brought upon producers by the sharp decline of rice prices between the two decades, and the loss of purchasing power of rice, probably contributed to decline of per capita rice consumption in practically all countries. The pressure may well have been heaviest in those countries where currency manipulations and other governmental policies were least in evidence, so that the fall in currency prices of rice was large and recovery slow and small. Such countries were Burma, India, and perhaps the Philippines. Rice prices (currency) and purchasing power recovered more rapidly in the 1930's especially in the Japanese Empire, where import controls also were strong. In Java, too, import controls were prominent during most of the 1930's, but these came late in the Philippines. It seems likely that one major effect of such pressures was to reduce levels of per capita rice consumption

considerably less among urban consumers than among the farmers who produce rice, and who constitute a very large proportion of the total population in all countries of Monsoon Asia.

3. Governmental policies as such presumably contributed to decline of per capita rice consumption especially in the Japanese colonies of Chosen and Taiwan, and in Java. In Japan Proper, the creation of a market, protected for rice but not for certain substitutable cereals, stimulated both production and exports of colonial rice, though exports were more affected than production. In Java, net imports of rice that might otherwise have occurred were restricted by import controls, without fully corresponding stimulus to domestic rice output. Policy, as such, could hardly have had appreciable effects on consumption in Burma and India. Little could have been done in any event, so long as trade between the two countries remained unhampered and the Burman surplus was much more than ample to fill import demand from India.

4. All three of the foregoing influences tended to make declines in per capita rice consumption involuntary and unwelcome, and to deteriorate national diets—probably in all cases from the psychological point of view and sometimes from the quantitative point of view, but not certainly from the qualitative point of view. But a fourth influence, probably operative only in Japan Proper but possibly in India as well, was the slow-moving long-term process of industrialization. This may involve lower per capita food-calorie intake in a nation, with reduction of rice-calorie intake partly but not fully offset by increased per capita consumption of foods more expensive and more highly preferred. In a country where industrialization may be regarded as a dominant influence on reduction of rice consumption, the reduction itself need not carry unfavorable implications with regard to the diet as a whole.

5. Another slow-moving and long-term influence may be the development of agricultural production, notably in rela-

tively larger expansion in the area of nonrice food grains than in the area under paddy. Within a country, when the regions suitable for paddy are close to exhaustion and construction of paddies becomes increasingly difficult, tendencies may emerge for expansion of areas where only upland crops can be grown, or for use of paddies for nonrice second crops, in the dry winter season. In either case, output of nonrice crops may tend to expand more rapidly than rice; and if subsistence economy without much international trade continues to prevail, per capita rice consumption is likely to fall while per capita consumption of upland crops increases. It seems probable that this underlying influence may have been operative at least in India and Java over the past two decades, though perhaps not strongly enough to have appreciably affected the decline in per capita rice consumption.

If influences as numerous and diverse and obscure as these have determined changing levels of per capita rice consumption in the past two decades, it seems likely that similarly numerous, diverse, and obscure influences may exert effects in the next decade or two. Prediction seems futile, since neither variation of yield, waves of prosperity and depression, nor changes in governmental policies can possibly be foreseen in advance other than by sheer accident. Yet for a long time the per capita consumption of rice in Monsoon Asia must depend very largely upon the rate of population growth in relation to the trend of rice production. In the following two chapters the potentialities for expansion of the rice output in Monsoon Asia are examined. The discussion is phrased, however, mainly in terms of the major factors that may influence production, rather than in terms of the probabilities that expansion of output will or will not parallel increase of population.

## CHAPTER XI

### POTENTIALITIES FOR RICE EXPANSION: YIELDS

Although the production of rice in parts of the East has tended for some time to lag behind the growth in population of rice-eating countries, nevertheless Monsoon Asia is not without potentialities for expanding its rice output. It may be true, as various geographers contend, that any "great expansion of Asiatic agriculture or intensive land use would seem impossible. The habitable lands of Asia have long been fully occupied."<sup>1</sup> However, a "great expansion" might not be required in order to provide sufficient food for a population increasing under conditions of the foreseeable future.

When one considers that many observers believe it feasible to double the paddy production of all southern Asiatic rice-producing countries, even including China, one can readily visualize what this means in terms of potential rice supplies. Mukerjee<sup>2</sup> has stated that "Indian crop yields can be at least doubled by the use of improved seeds and methods of tillage, fertilisers and by the utilisation of idle or semi-idle labour." Similarly, Thompson<sup>3</sup> believes that "the yield of agricultural products in China can be doubled. . . . the possibility of agricultural expansion . . . is . . . very large." When Zimmerman<sup>4</sup> studied Thai agriculture in 1930-31, he foresaw the possibilities of doubling yields generally and increasing the actual area of wet rice by a third or a half, over a 25-40-year period. The same general observations can be applied to

<sup>1</sup> Samuel Van Valkenburg, "Agricultural Regions of Asia. Instalment I," *Economic Geography*, July 1931, VII, 220.

<sup>2</sup> Mukerjee, *Food Planning for Four Hundred Millions*, p. 128.

<sup>3</sup> W. S. Thompson, "The Outlook for the Improvement of Standards of Living in China," in *An Experiment in the Registration of Vital Statistics in China*, by C. M. Chiao, W. S. Thompson, and D. T. Chen (Scripps Foundation for Research in Population Problems, Oxford, Ohio, 1938), p. 83.

<sup>4</sup> C. C. Zimmerman, *Siam: Rural Economic Survey, 1930-31* (Bangkok, October 1931), p. 821.

Burma, French Indo-China, the Philippine Islands, and other rice-growing countries to the south.

Even in Japan, already by far the most intensively farmed country of Monsoon Asia, the "generally quoted estimate, endorsed by Professor Nasu, gives 25 per cent. as the potential future increase in the per *tan* production of rice obtainable 'through the gradual improvement of social and economic conditions as well as by constant effort to improve technical skill in farming work.'"<sup>6</sup>

The apparent differences in points of view expressed by these quotations, and the seeming inconsistency between the limitations to Asiatic agricultural expansion in general and the potentialities for enlarging the rice output in particular are partly explained by differences in concepts. "Potentialities" may be viewed in terms of how nearly present output approaches the physical limits of production under optimum economic conditions and, clearly, "potentialities" may also refer to the probabilities for expansion under varying other sets of economic conditions. Here, and in the following chapter, we are not concerned with prospects for rice expansion under any assumed set of economic conditions, but solely with the question of physical possibilities—the various steps that might be taken to increase the rice output if economic circumstances permitted.

Rice production may be increased by improving the yields obtained, by enlarging the area sown, or by a combination of both methods. Yields may be enhanced by applying more labor to present lands, improving the soil through fertilization, crop rotation, better breeding and selection of varieties suited to the type of soil and climatic conditions encountered, and by better management of all these factors. Bringing more land into rice production depends upon its availability, adaptability, location, and numerous other factors—possibly the

<sup>6</sup>G. E. Hubbard, *Eastern Industrialization and Its Effect on the West, with Special Reference to Great Britain and Japan*, assisted by Densil Baring, with a conclusion by T. E. Gregory (issued under the auspices of the Royal Institute of International Affairs, London, 1935), p. 147.



substitution of mechanical for man power, and so on. The practicability of all of these general methods for expanding the rice output depends, in varying degrees, upon what is economically feasible. This chapter is concerned primarily with rice yields per unit of land area, some of the more important factors affecting yields, and the bearing of present and potentially procurable yields, considering only the physical limitations, upon aggregate rice supplies. Chapter xii will examine the potentialities for rice expansion through the opening up of new lands suitable for rice, or the conversion of older areas into paddy fields.

#### PRESENT YIELDS AND TRENDS

Diverse natural conditions and cultural practices within Monsoon Asia produce wide variations in the annual output of paddy obtained from given units of land. Yields range from the meager returns secured from upland (nonirrigated) fields in parts of Java, Indo-China (e.g., Laos), and many islands of the Philippine group, to the heavy production of the intensively farmed, irrigated paddies of Japan, the latter being many times as great as the former. Trends in yields over the past 20 years, in so far as they can be determined by the data at hand, have also been markedly different from one rice-growing region to another.

The data briefly introduced in chapter iii (Chart 3, p. 61) give, for all 12 of the important rice-producing countries of Monsoon Asia, a general indication of the different levels of yields obtained. Even on the basis of averages for whole countries, the wide range of productivity from one to another is clearly suggested. Average yields in Japan run about four times as large as those in Indo-China. In China (also a nation practicing intensive agriculture) yields are apparently quite high and are comparable with those obtained by the Japanese in Chosen and Taiwan. The drop to the average level of the countries farther south is rather great. British Malaya produces a little more than 10 quintals of cleaned

rice per hectare, whereas yields in Java,<sup>6</sup> India, Burma, and Thailand fall a little short of this figure. Yields in the Philippines are considerably lower but surpass those obtained in Indo-China. Production statistics for Ceylon are of doubtful accuracy, but there is little question that here the native rice grower gets a smaller output from his land than in any other country.<sup>7</sup>

In chapter ix attention was called to some of the qualifications that seem desirable in appraising the statistical record of various countries. These qualifications are more important in considering trends in yields than in indicating general levels. We accepted as credible in their general behavior the official statistics of Burma, Japan, India, Java, and the Philippine Islands (Chart 21, p. 198), but raised a number of questions regarding the interpretations that should be attached to the records for other countries.

Within the group of countries for which the statistics appear to be satisfactory, a definite and consistent upward trend in yields over the past 30 years is indicated for Japan; there appears to be a slow downward trend in the level of yields in Burma and probably also in India; but in Java and the Philippines the data are inconclusive. Accident of weather plays a part in average yields computed for all countries and may give misleading indications of trend for shorter periods, but the above generalizations are based upon a 30-year record, as presented in Appendix Table III, and may therefore be accepted with some confidence.

Of the countries for which the statistical record appears faulty in certain respects, Indo-China shows a downward trend

<sup>6</sup> Data on yields in the Outer Provinces of the Netherlands Indies are not at hand. In some districts they are reported to run higher than in Java, especially in Bali and on the west coast of Sumatra. See A. M. P. A. Scheltema, "Rijstproducties op Java en Madoera," *Landbouw* (Buitenzorg), 1928/29, IV, 780. This article also contains a useful map showing the yields of irrigated rice by "districts" (the smallest administrative unit) of Java and Madura, based on data for 1922-27 (opposite p. 780).

<sup>7</sup> Lack of an adequate water supply in many places, poor soils, and inability to employ a system of crop rotation are more responsible for the low yields of rice in Ceylon than any outstanding weakness in the cultural practices of the native grower. Transplanting is apparently not as universal as in most other Asiatic rice-growing countries.

in rice yields per hectare over the past 30 years, and the data for Thailand suggest a similar tendency over the past two decades; the Japanese colonies of Chosen and Taiwan show a consistent upward trend in the yields obtained, and although the amount of improvement may be exaggerated by lack of comparability in statistics over the period of three decades, the increase is probably real; in British Malaya the trend in yields has changed direction, but has been definitely upward since 1930-31;<sup>8</sup> and, finally, the statistics for Ceylon do not permit of any speculation as to trends.

In Asiatic countries as a group, little progress has been made during the past few decades in the improvement of rice yields. The exception is the Japanese Empire, where government-sponsored efforts at scientific agriculture have produced some notable results. More recently, during the past decade, yields appear to have risen in Burma, Indo-China, Malaya, and Java, but over a longer period there is strong suggestion of a downward trend in all three of the major exporting countries and probably also in India.

Outside of Monsoon Asia, in the newer rice-growing regions of Western countries, although production is small, rice yields tend to be higher and also tend to increase.<sup>9</sup> The gen-

<sup>8</sup> For many years the rice situation in British Malaya has been a reflection of the fortunes of the rubber and tin industries. Rice growing seems to be neglected, yields tend to fall, and annual imports are larger when conditions are good in other types of enterprise. Rice production is stimulated and imports are curtailed in periods of poor demand for the Peninsula's export commodities or, as in recent years, during periods of political uncertainty when ideas of self-sufficiency in foodstuffs have a strong appeal.

The neglect of rice cultivation was referred to in the annual reports of both the Straits Settlements and the Federated Malay States as early as 1915. The former report remarks: "From rice, a Malay might expect, if the season did not fail, to make, with the united labour of his wife and family, a bare livelihood: a small rubber plantation yields him enough to make him a comparatively rich man; and instead of the dried fish and the cloth garment that were all that he could afford as a rice-grower, he eats imported rice and dresses himself and his family in silks. Such of the rice-fields as are not cultivated are lying fallow, and cultivation can be resumed when desired" (Straits Settlements, *Annual Departmental Reports . . . for the Year 1915* [1916], p. 74).

<sup>9</sup> In quintals of cleaned rice per hectare, average rice yields for the five-year period 1930-31 to 1934-35, for selected countries outside Monsoon Asia, were as follows: Spain, 38.6; Italy, 29.6; Egypt, 18.4; United States, 14.6; Brasil, 8.8; and Madagascar, 7.7. Spain and Italy secure yields considerably higher than those in Japan, but production—even in Italy, by far the leading rice-growing country of Europe—is on a much smaller scale. Spain has long held the distinction of securing the highest yields of rice obtained anywhere in the world. This result has been attributed to heavier manuring, bet-

eral level of agricultural practice is lower in Asiatic countries than in most Western rice-growing areas, and it is probable that some exhaustion of the soil is occurring in the older cultivated lands. Soil fertility apparently may be maintained at a certain level by the practices commonly followed in many parts of the Orient, and by the natural recuperative powers of the land, especially during the dry season. To raise this level, however, requires artificial fertilization, and this practice is generally beyond the limited financial resources of the Asiatic grower.<sup>10</sup> Furthermore, only a small amount of livestock is available to the Asiatic. In some areas, the absence of adequate irrigation facilities or flood-control systems, and the extension of rice growing onto unproductive lands, have contributed toward holding yields down to a relatively low level. The practice of double cropping affects yields. When more than one rice crop is raised during a year, the yield of the second harvest is usually somewhat smaller than the first.

Suitable soil, drainage, an adequate amount and distribution of rainfall, freedom from diseases and pests, and so on, are all natural conditions contributing to good yields. Selection of seed adapted to soil and climate, amount of labor applied in the preparation of the land and care of the crops, and the manner in which such labor is applied (i.e., proce-

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ter cultivation, the use of improved varieties, and the prevalence of transplanting; but yields are doubtless higher also because the acreage is small and limited to very fertile land. Spain is one of the few Western countries in which rice is transplanted from the seedbed; the same practice is now general on more than one-third of the Italian rice acreage. Good and increasingly larger yields are being obtained in Egypt, which surpasses all Asiatic countries except Japan. The United States, as a rice producer, seems to rank with the Japanese colonies and with China in respect to yields, while Brazil and Madagascar secure unit yields more nearly comparable with those obtained in the poorer areas of southeastern Asia and adjoining islands.

<sup>10</sup> Sometimes, however, the use of fertilizer does not seem to pay. In Java, for example, it is understood that the natives can secure the necessary credit for making purchases if they wish, but except in the growing of truck crops, like onions and shallots, the application of fertilizer is not considered profitable. Likewise, soils on the western side of the Malay Peninsula are only slightly responsive to manuring, and the increases in yields that can be obtained are not economic (see p. 255). In many parts of Thailand and Burma, the cost of suitable fertilizers is too high to justify their use under present conditions.

dures in transplanting, crop rotation, fertilization) are all cultural practices having an important influence on rice yields. The number of crops grown each year, and the proportion of the crop that fails for one reason or another, similarly affect the levels of yield.

The departments of agriculture of most Oriental rice-growing countries have long given attention to the improvement of varieties and of methods of cultivation, but the task of educating the native rice growers away from the ancient practices is as difficult as an attempt to modify customs. The principal reason for the restricted use of fertilizers in Monsoon Asia is undoubtedly economic, but technical reasons are also involved and must be considered. Some further appraisal of the roles of seed selection, transplantation, and crop rotation in increasing yields is likewise desirable.

#### IMPROVED YIELDS THROUGH SEED SELECTION

It has been said that the number of varieties of rice exceeds the number of varieties of all the other cereals combined. The existence of so large a number of varieties provides "unlimited material for the breeder, and an opportunity for improvement in any desired direction by careful selection."<sup>11</sup> The development of high-yielding and otherwise desirable strains from the thousands of varieties of rice found in the Far East is usually the result of a method employed by botanists known as pure-line selection. This is merely the scientific outgrowth of the ancient practice of always saving the best part of the crop for seed. When little further progress can be made by selection alone, a process of hybridization, or cross-fertilization of two plants of different strains of the same or different varieties, is used to further improve the quality of paddy seed.

It might be relatively easy to develop varieties that are heavy-yielding, and thus to increase rice production in the field, but there are many other considerations. Any discus-

<sup>11</sup> Copeland, *Rice*, p. 132.

sion of varieties raises the question of what criterion should be adopted in determining desirability — what constitutes “quality,” what are the objectives of rice breeding, and what, if any, significant physical and chemical differences exist between different varieties.<sup>114</sup>

With most characteristics of a given variety of rice, desirability is relative both to the physical environment and to prevailing technology. High yield is a desirable characteristic, and different varieties differ greatly in this respect. But the same variety gives different yields under different physical conditions. A maturation period suited to local climatic conditions is desirable, but this obviously means that a variety with a given maturation period is desirable in some places but undesirable in others. Tightness of grain is of some significance in harvesting; some varieties shatter more easily than others. But the extent to which tightness of grain is desirable depends to a large extent on the methods of harvesting.

Climatic differences are of considerable importance. Some Japanese varieties will start growing at temperatures under which varieties commonly grown in the tropics cannot grow at all. Varieties grown in California must be resistant to low night temperatures. However, climatic conditions are by no means the only factor involved. Even in regions of very similar, in some cases almost identical, climate the same varieties will not necessarily grow equally well. Agricultural officers in Asiatic countries are now very cautious about recommending for a given district the adoption of a variety that has given exceptionally high yields in another district.

To the typical Asiatic rice consumer, flavor seems to be the strongest basis for preference. Flavor depends upon many factors, but it is probable that the taste preferences of particular groups are related to the varieties of rice that are adaptable to local conditions (p. 140). If this should be cor-

<sup>114</sup> For a discussion of the many complex and variable factors involved in a problem of this type, see C. L. Alaberg, “The Objectives of Wheat Breeding,” *WHEAT STUDIES*, June 1928, IV, 269-88.

rect, it is conceivable that preferences of consumers may change as the work of discovering and introducing improved varieties of rice progresses.

In agricultural departments and experimental stations throughout the Orient, the work of selection and breeding has been going on for many years.<sup>12</sup> But even after varieties have been perfected for different soils, climates, and uses in consumption, the further task of education remains before the average grower can be induced to change his customary methods. The distribution of free seed is often difficult owing to the farmer's ignorance of correct cultural practices or his reluctance to assume the risk of trying something "new" until results have been clearly demonstrated by field tests in his neighborhood. Selection and seed-testing farms are common in India, Ceylon, Java, Malaya, Indo-China, and Japan.

When governments launch agricultural programs that involve something more than mere recommendations to the grower, progress can be more rapid. The Japanese program of rice development in Chosen and Taiwan was far more than an educational campaign to acquaint the farmer with the merits of using certain varieties of paddy seed. In 1935 more than 65 per cent of the first rice crop produced in Taiwan was of Horai varieties, the trade name applied to varieties acclimatized to Taiwan; and in Chosen it is estimated that over 70 per cent of the area sown to rice consists of improved varieties.<sup>13</sup> In instances where the government's recommendations were not enough, this result was achieved by coercion.<sup>14</sup> In both Chosen and Taiwan discriminatory forms of taxation have been instrumental in forcing farmers to grow the varieties desired by the government authorities. In contrast with developments in the Japanese Empire, yields in India have

<sup>12</sup> According to a tabulation in Jones ("Improvement in Rice," pp. 453-54), some 52 institutions and stations were conducting rice-improvement work in nine countries of Monsoon Asia and 25 such places were doing similar work in fourteen countries located in other parts of the world.

<sup>13</sup> Jones, *op. cit.*, p. 437.

<sup>14</sup> Lee, *Land Utilization and Rural Economy in Korea*, p. 57.

been stationary or slowly declining for many years. There has been no lack of a government effort to raise the paddy output above the low level of the past few decades, but either the task has been too difficult or the effort has not been effectively organized. At a meeting of the Rice Committee of the Imperial Council of Agricultural Research late in 1939, it was stated: "Despite the fact that the Council has been financing rice research for the last ten years and new and better yielding varieties have been evolved, the total area [in India] under improved rice represents only six percent of the total area under this crop."<sup>15</sup>

Indo-China is another example of a country where efforts have been made since the first World War to improve the rice output per land unit without noticeable success. Every governor-general since that time has attempted to improve, as well as increase, the colony's rice crop. In the construction of flood-control and irrigation projects and in the extension of the area devoted to rice, considerable progress has been made, especially in Cochin China.<sup>16</sup> But developments in seed selection and fertilization seem to have lagged behind. The failure to achieve greater progress in yields has probably been due to administrative deficiencies. A central rice station, created at Cantho in 1927, distributes each year an average of eight tons of seed. An *Office du Riz* was opened in 1930, yet to date there is little statistical evidence of much improvement in paddy output in relation to the area under rice.

Every government is confronted with a difficult problem when it attempts to modify ancient practices of native rice growers. Non-Oriental administrations especially encounter obstacles. Perhaps the French are less effective colonial ad-

<sup>15</sup> U.S. Dept. Comm., Bur. Foreign and Domestic Commerce, *Foodstuffs Round the World*, Feb. 2, 1940, p. 3.

<sup>16</sup> Despite such progress, much remains to be done in educating the ignorant peasant in the maintenance of canals, ditches, and other works after they have been completed. The sides of the canals crack in the dry season and are softened by the rains so that much water is lost by seepage, or the walls are destroyed by slipping. After a series of years of normal rainfall, however, the peasant becomes careless in upkeep, as irrigation then seems to him to be unnecessary.



ministrators than the British or Dutch. One writer observes: "To Westerners, crop failures from flood are laid to a natural force. To the Indochinese, they are due to the failures of the emperor and his court to obey the dictates from heaven."<sup>17</sup> This suggests the difficulties of a colonial administration in which very little responsible government is exercised by the native peoples.

In British Malaya agricultural officials have encountered considerable difficulty in securing the co-operation of Malay paddy growers in experimental work. The Malay is alleged to be a lazy fellow who looks with suspicion upon any activities that might result in changing cultural practices in the direction of more manual work, longer hours, or an extended season of farm labor. Although the water buffalo is a useful work animal in connection with paddy culture, the introduction of more cattle is resisted. The possession of such an animal usually means that the Malay husband is required to work; without one, his wife and family are able to perform most of the necessary labor.<sup>18</sup>

It is not our purpose to review the work of variety and seed selection that has been going on for many years.<sup>19</sup> The important points to bear in mind are that, with few exceptions, yields have not been greatly improved during recent decades, and that the potentialities would seem to be much greater than

<sup>17</sup> T. E. Ennis, *French Policy and Developments in Indochina* (Chicago, 1936), p. 10.

<sup>18</sup> These observations are those of a British government official with long experience on the Peninsula. They are in harmony with other informal expressions of opinion received in Malaya in 1939-40. See also Federated Malay States, *Report of the Rice Cultivation Committee* (1931), I, 41. The committee, referring to the preparation of rice paddies by allowing the buffaloes to trample the fields, has this to say:

"How far this trampling process is in reality an economic necessity and how far it is born of the tendency which exists among cultivators to do the work of preparation of land with the expenditure of the least possible amount of effort is by no means clear. It is stated that it depends on the character of land, but it seems not improbable that it may depend to a considerable extent on the character of the inhabitants. It is noteworthy that, where conditions are least secure and assured, the habit of preparing the lands by allowing buffaloes to trample them is most prevalent."

<sup>19</sup> Those interested in this subject are referred to Copeland, *op. cit.*, pp. 101-64; and Jones, *op. cit.* Current reports of progress in rice research in specific countries are to be found in government publications, annual reports, or journals; e.g., for Malaya see R. B. Jagoe, "Padi Selection and Varietal Trials, 1938-1939," *Malayan Agricultural Journal*, December 1939, XXVII, 468-512.

the results thus far achieved. The knowledge exists, strains have been developed, and in many countries it is principally a matter of introducing varieties best suited to local conditions. Opportunities for improving yields through better seed selection appear very substantial throughout all of the rice-growing portions of southeastern Asia. In the Philippines, for example, it is estimated that rice production could be increased 10 per cent merely by replacing low-yielding varieties of rice in certain provinces with superior seeds.<sup>20</sup> One of the reasons for the large proportion of "brokens" in the finished product turned out by the major rice exporters is the lack of uniformity in the quality of paddy. Even if the seed used were not superior but selected only for uniformity, important advantages would accrue in milling.

When growers more generally follow the practices recommended by scientists, one may reasonably expect results to be shown in the yield statistics.<sup>21</sup> The potentialities are real, whatever the prospects for early improvement. Variety and seed selection, however, is only one phase of the problem—one factor among many affecting the quality and volume of paddy output from given plots of land.

#### TRANSPLANTING PRACTICES AND YIELDS

Over the greater part of Monsoon Asia where rice is grown, the seeds, after being soaked and sprouted, are sown in specially prepared seedbeds or nurseries, where the plants are allowed to grow for periods ranging from four to eight weeks, probably most often for six weeks. They are then transplanted by hand from the seedbed to the paddy field. Both technical and economic considerations explain the prevalence of this

<sup>20</sup> Philippines Dept. Agr. and Comm., *The Rice Industry in the Philippines* (1939), p. 18.

<sup>21</sup> An example of the type of advice quite generally at the disposal of rice growers sufficiently well educated to understand it may be found in B. R. Bautista, *The General Practice of Lowland Rice Farming in the Philippines* (Philippines Dept. Agr. and Comm., Bur. Plant Industry, Farmers' Cir. 39, 1937). Without a great amount of field work and education among farmers based upon the knowledge gained, such government publications become references for students rather than circulars of direct usefulness to farmers.

practice in Oriental countries, and the influence upon yields appears to be both direct and indirect. Generally, but not always, the physical yield per unit of area is greater when the practice of transplanting is followed, but transplanting also permits more flexibility in the timing of cultural operations and a better distribution of labor. Unquestionably, transplanting is a practice that has been found to be profitable over a very long period of time, under conditions prevailing in Monsoon Asia.

Thus, Grant<sup>22</sup> says of Burma:

The results of experiments carried out by the Agricultural Department show that on the most common types of soils where the water can be fairly well regulated at the beginning of the season the transplanted crop will give a yield of about 300 lbs. to the acre more than is obtained from broadcast sowing at the rate of 50 lbs. to the acre which is the optimum rate. In Arakan the results showed that there was little or no difference in yield between transplanting and broadcast sowing. However, the practice of transplanting has the advantage of enabling the cultivator to give good cultivation to the whole of his holding when the seedlings are growing in the nursery, which is not possible if the whole of his crop is to be sown broadcast and the seed is to be got into the ground in time. Transplanting appears to be the more reliable method over a number of years, particularly in low-lying areas where the crop in the early part of the season is liable to be damaged by floods, and on areas where the early rains are sometimes scanty or badly distributed.

In some parts of Japan rice has been sown directly on the paddy field as thickly as is customary with transplanted rice, and the yields have been approximately the same. Furthermore, although there is no transplanting in California, yields there compare favorably with those obtained in parts of the Orient (other than Japan) where yields are fairly high. Hence the practices correlated with transplanting must be important in explaining its prevalence in many regions.

One of the most definitely established advantages of transplanting is the control afforded over weeds, the extra labor cost involved being largely offset by savings in weeding.<sup>23</sup>

<sup>22</sup> *The Rice Crop in Burma*, p. 15.

<sup>23</sup> The cost of production per unit of paddy output is lower for lowland-rice culture than for upland. In the Philippines, according to estimates of the Bureau of Agricul-

Not only are weeds inherently better controlled in water than on dry land, but transplanting makes easier such weeding as is necessary. While the seedlings are growing in the nursery, the paddy field may be cultivated and cleared of weeds; and after transplanting the regular spacing of plants makes weeding during the growing period an easier task.

Transplanting also permits the plants to be more evenly spaced than they would be from broadcast sowing. There appears to be some experimental evidence of an optimum spacing, but the optimum varies with a number of environmental factors. Differences in spacing tend to be offset to some extent by differences in tillering, the amount of which is partially adjusted to the space available. Similar yields may be obtained from stands of different densities.

In regions where soil and market conditions are suitable and the supply of land is small in relation to the supplies of the other factors of production, transplantation has the advantage of leaving the fields free for other crops during the month or six weeks in which the seedlings grow in the nursery. This period may be essential to the maturing of a crop sown earlier.

Thus, on about 30 per cent of the rice land of Japan, barley, naked barley, and wheat are also grown. While the rice seedlings are growing in the nurseries from about the end of April until about the middle to the end of June, the other crops continue to grow on the land to which the rice is subsequently transplanted, until they are ready for harvesting about the end of May and the beginning of June. Without transplanting the rice seedlings, it would be impossible to bring the cereals grown on these lands to maturity, the month of May being essential to the ripening of the crops.

In China, similarly, the "planting of rice in seed beds while winter crops are still growing, and later transplanting the rice seedlings after the harvest of the winter crop, is the chief fac-

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ture, the cost for the lowland form of culture "would still be less if, all other costs remaining as they are, transplanting cost three times what it does" (Copeland, *op. cit.*, p. 284).

tor making double cropping possible in the northern part of the Rice Region."<sup>24</sup> Thus, transplanting is a practice sometimes explicable in terms of the whole agricultural system of a region.

Transplanting makes possible better labor distribution. Perhaps even more important, it gives the farmer in many regions greater leeway in planting; if for any reason the weather is unfavorable, he can postpone planting by waiting until the seedlings are larger. Probably one of the reasons for transplanting is to get a uniform stand. If the seed is planted directly in the paddy, some of it tends to be smothered in the mud, for the rice plant requires oxygen to germinate. One reason why farmers in California are sowing with airplanes is that they are able to drop the seed on the flooded field, and it is not so likely to be smothered in the mud.

Transplanting requires a large supply of labor. In places where the supply is scarce in relation to the supplies of the other factors, transplanting is not likely to be profitable even if it could be definitely shown that considerably increased yields would result. It is hardly conceivable that the practice will ever be adopted in the United States or Australia. But in places where agricultural incomes and wages are relatively low, the practice is likely to continue indefinitely, because of the advantages in land utilization, weed control, and soil cultivation.

Although transplanting is the typical practice in the rice-growing areas of Monsoon Asia, broadcast sowing is found in certain districts—sometimes owing to a local scarcity of labor, and sometimes partly because of the nature of the soil or the absence of sufficient water. However, since the proportion of the total Asiatic paddy crop that is sown broadcast is not known, there is practically no basis for estimating the rice-yield potentialities of an extension of the practice of transplanting. It is reasonable to assume that transplanting is now the custom in Monsoon Asia wherever circumstances permit

<sup>24</sup> Buck, *Land Utilisation in China*, p. 215.

it, and that in regions where the practice is not common, economic rather than physical limitations operate against it.

On lands where at present only one rice crop and no other crop is grown each year, some of the chief potential advantages of transplantation cannot be realized. Future changes that may involve an extension of the practice are unpredictable. Some potentialities for bettering rice yields by this method undoubtedly exist, but their magnitude remains unknown.

#### SYSTEMS OF CROPPING AND ROTATION •

In Monsoon Asia generally the land available for growing food crops is used as intensively as circumstances permit. Double cropping is common in many places (chapter iii, pp. 43-47), and multiple cropping is prevalent, especially in the Sino-Japanese portion of the rice belt. Unless some provision is made for maintaining fertility, such constant and intensive use of the land must inevitably exhaust the soil, and soil exhaustion must eventually be reflected in rice yields. Soil fertility may be maintained through fertilization (discussed below, pp. 251-62) and by a planned system of crop rotation in which the plant foods taken from the soil by one crop are restored later by an alternating crop.

Although growing more than one rice crop on the same land within a single year, or growing rice and some other cereal such as wheat or barley as a winter crop, or growing rice, some other cereal, a legume, or a truck crop is a rotation of crops, it is not a system of crop rotation in the Occidental sense. It would be less misleading to refer to such rotations within a single year as an alternation of crops, or double, or multiple cropping. Most frequently the chief purpose of these successive plantings is to make maximum use of the land, rather than to restore or increase soil fertility.

Crop-rotation systems in the Occident may be designed to balance the labor load and to maintain or improve soil fertility, but always aim to secure the maximum return consistent

with such objectives. The requirements of different crops and the amount of plant foods absorbed vary widely, but with some knowledge of these differences it is possible to grow a series of crops in different years on the same land without exhausting the soil. The root systems of plants require different depths of soil for establishing themselves; advantage may be taken of this in utilizing different layers of the soil in the planting succession. In some cases the usefulness of a rotation system in checking the ravages of plant diseases and insects, or the growth of noxious weeds, may be as important as the maintenance of soil fertility. With irrigated-rice culture, however, these latter considerations do not seem to be dominant.

Compared with temperate regions of the Western world, tropical and subtropical countries in general have been slow to work out genuine systems of crop rotation, although the advantages to be derived are many, and the beneficial effects on yields have been amply demonstrated. There are a number of reasons for the relative scarcity of well-established crop-rotation systems in Monsoon Asia. This is not to say that rotations are not common in numerous localities. The rotations that are found in Monsoon Asia are, in fact, many and varied, but the number and importance of those that are based upon considerations of scientific maintenance of soil fertility are impossible to estimate.

Data are notably lacking upon the variations in rotation practices from one part of a country to another. The most comprehensive information at hand upon cropping systems comes, surprisingly enough, from China. Buck's<sup>28</sup> investigation reveals information on the cropping practices found in all of the main agricultural regions of the country (Map 2, p. 32), but there are 547 "most common ones." Even when such data are available, it is obviously impossible to generalize in the absence of any measure of the frequency of the various systems or the area and production affected.

<sup>28</sup> *Land Utilization in China: Statistics*, pp. 253-69; and *Land Utilization in China*, p. 239.

Considering Monsoon Asia as a whole, it seems that in regions where any crop rotation at all is practiced, food crops are more commonly rotated with rice than are nonfood crops, and cereals are more commonly planted after rice than are legumes. Furthermore, fallowing as a means of restoring vitality to the land is far less common than in Western countries. Pressure to utilize the land to its fullest for food production is such that in the densely populated older parts of Monsoon Asia the amount of land that lies fallow from choice is practically nil. A certain proportion of the available acreage is unused during the winter, but usually because climatic conditions do not favor the growing of subsidiary crops. Finally, although such rotations as are reported may encompass a period of as much as half a dozen successive years, factors other than soil and climatic conditions are probably decisive in determining the crops that the farmer actually plants.

In Japan the chief cereal crops planted on paddies and subsidiary to rice are naked barley, common barley, and wheat. These are planted following rice, year after year without rest for the land. In some parts of the country one or more rapidly growing truck crops (e.g., radishes, eggplants, melons) may be produced in addition to a winter grain crop. No true system of crop rotation is generally employed, and soil fertility is maintained by the extensive use of fertilizers. In localities where climatic conditions are unsuited to winter grain, a green-manure crop may be planted on the paddies (see below, p. 255).

Parts of China present the same general situation as Japan.<sup>26</sup> In the Yangtze rice-wheat area, wheat or barley are commonly planted after rice, and also green beans and field peas. Rapeseed, tobacco, broad beans, soybeans, sesame, and sweet potatoes are other crops found in rotation with rice here and in areas to the south and west. In addition to

<sup>26</sup> There is some rotation of soils as well as crops in China, such as the exchange of soils between mulberry orchards and rice fields. Soil used for each crop is apparently beneficial to the other and is laboriously transferred.



tobacco, some nonfood crops such as opium, flax, and cotton, and various fodder crops are also rotated with rice in China. The variety of crops grown is large, the combinations are numerous, the cycle of years covered is most commonly from two to six, and rotations involving a fall crop planted after a summer crop in addition to a summer crop planted after a winter or spring crop appear most often in the southern part of China, in the double-cropping rice area (Map 2, p. 32).

In Chosen the winter cereal crop is ordinarily barley, wheat, or naked barley, as in Japan. Legumes are often planted for green manure on paddies located where climate and soil are unfavorable to other grains. Multiple cropping with vegetables is also common near the cities, but where the land is used so intensively certain vegetables are not allowed to mature but are used as green manure. Chosen may be included with Japan and China as countries with sufficiently similar natural conditions and intensity of land use that the problem of maintaining or improving rice yields becomes more a matter of fertilization than of scientific crop rotation.

The crops that are grown in any given locality are determined very largely by the suitability of the land, the character of the climate, the yields obtainable, the maturation period, and the availability of markets. Crops that might be grown may be more numerous or different, but the farmer's choice is influenced by the consumption requirements of his own household and by the necessity for some cash income. Because of this need for cash, prevailing market prices may well become the basis for selection of crops to be grown in addition to rice, especially in parts of the Sino-Japanese rice belt where natural conditions are favorable to the cultivation of a variety of crops.<sup>27</sup> Only if everything else is equal may consideration be given to long-term profitability of the cropping system accruing from the proper maintenance of soil fertility.

<sup>27</sup> The most important cash crops in China are opium, peanuts, rapeseed, cotton, soybeans, wheat, green beans, kaoliang, field peas, and sweet potatoes, all of which enter into crop rotations.

In other parts of Monsoon Asia where the use of fertilizers is far less common, where conditions are often less favorable for double or multiple cropping, and where rice yields average considerably lower, it would seem that planned systems of crop rotation would be of greatest importance. In India there appears to be far less diversity in cropping practices than in China. Various beans, pulses, and tubers are rotated with rice in both the rice and millet areas of India (Map 3, p. 34). In parts of the United Provinces, Bihar, and Bengal, rice matures in 60 days so that there is room for a multiplicity of crops. In these areas legumes, grown in both winter and summer, are common in crop rotations—apparently more so than in China or Japan, where the value of legumes for restoring the soil has also been recognized for centuries, but where cultivation of more important food crops, using fertilizer, is chosen instead. Wheat, gram, hemp, oilseeds, and jute are found in various rotations in India, but we are not in a position to judge the representativeness of particular combinations. One gains the impression that definitely established crop-rotation systems are rare, that examples cited as typical of a certain region in a certain province of India are by no means representative, and that scientific application of methods for maintaining the productive powers of the land has not proceeded far.

In other parts of Monsoon Asia, especially the southeastern portion where rice is grown continuously on the same land without any restoration of the plant food removed, the soil tends to become so depleted that yields reach a minimum. Much of the paddy land of Burma, Thailand, Indo-China, and British Malaya has lost its original fertility. Little or no manure or fertilizer is applied to the paddy crop in these countries, and no system of crop rotation is practiced on an important scale.<sup>28</sup> For many years, silt deposits from flooded

<sup>28</sup> There are some exceptions, e.g., in Malaya. The so-called *senggole* system of cultivation involves the growing of varieties which flourish equally well under flooded field conditions and when the land is dry. At the end of not more than four successive crops of

rivers and some fallowing have constituted the chief means of renewing the soil. The period of winter fallow following the rice harvest is regarded as essential to maintenance of land productivity when no fertilizer is used.

Rotations of the type found in parts of India and China are not feasible in all rice-growing countries of the Orient, especially in most parts of the Indo-Chinese Peninsula and the Philippine Islands. In the Philippines, the pronounced wet and dry seasons and the absence of adequate irrigation facilities preclude the growing of many nitrogenous crops that might be plowed under in order to replenish the soil.<sup>29</sup> In Burma also, although investigations have been made, it has not yet been found possible to raise a green-manure crop; the soil dries out too rapidly after the monsoon, and at the beginning of the monsoon is submerged so quickly that the only plants that can be raised at that time are semiaquatic grasses.<sup>30</sup> In these countries a relatively higher proportion of the rice fields are in fallow during part of the year so that some gains are forthcoming without special planning or care. But even whenever and wherever the rotation of crops on paddy lands is feasible, the practice is often not popular, as is the case in Ceylon.<sup>31</sup>

In Java, however, not only double and multiple cropping of the land are found, as in the Sino-Japanese portion of the rice belt and in parts of India, but systems of crop rotation seem to be more highly developed than in most tropical countries. Part of the explanation for the greater prevalence of

paddy, the land is allowed to revert to grassland, cattle-grazing land, or secondary jungle for about four years (Crist, *An Outline of Malayan Agriculture*, p. 126).

<sup>29</sup> P. A. Hill and K. O. Moe, *The Rice Industry: A Handbook for the Producer* (Muñoz, Nueva Ecija, P.I., 1920), p. 83. For the same reasons, multiple cropping and a second rice crop each year has not been a successful practice in most of the Philippines. ". . . the second or forced crop is planted during the season of high dry winds and oppressive heat which cause the plants to be stunted through excessive evaporation" (p. 61). In Japan, southern China, northern Indo-China, and Java, multiple cropping is feasible due to the more equable climate characteristic of these areas (see pp. 43-47).

<sup>30</sup> Grant, *op. cit.*, p. 22.

<sup>31</sup> H. A. Pieris, "The Cultivation of Vegetables as a Rotational Crop in Paddy Land in the Kandy and Matale Districts," *Tropical Agriculturist, The Agricultural Journal of Ceylon*, January 1940, XCIV, 27.

such systems is probably the advanced state of cultural practices developed in connection with plantation agriculture, and part of the explanation seems to lie in the system of land tenure found in Java (p. 169 n.). Natural conditions are favorable to the growing of many crops, irrigation systems are well developed, the soil is suitable for dry crops as well as irrigated rice, and on much land rice is rotated with crops like maize, soybeans, and groundnuts. In the sugar-producing areas, government provisions of tenure force a rotation in which sugar is grown on rice land for one year in three or four, rice three times in two years if ample irrigation is provided; other crops in the rotation scheme may be maize, cassava, soybeans, sweet potatoes, and groundnuts.<sup>43</sup>

Although average yields of rice per land unit for Java as a whole are not especially high (Chart 3, p. 61), it must be borne in mind that the upland or nonirrigated rice areas are a larger proportion of the total area under rice (a little over 10 per cent) than in most countries and that the low yields of the upland crop bring down the averages. Without the crop rotations found in Java, yields of the irrigated portion of the crop would probably be little higher than those prevailing in the export countries of the Indo-Chinese Peninsula, for the use of fertilizer in Java is not common and, despite noteworthy success in scientific improvement of varieties of plantation crops, very little has been done in this direction for rice.

For Monsoon Asia as a whole, it may be said that considerable potentialities are present for the improvement of rice yields through scientific rotation with other crops. Such physical potentialities cannot be appraised at all precisely, and there is little point in attempting to be specific, for their realization depends upon too many economic factors, the consideration of which at this time would lead to an evaluation of prospects rather than of potentialities. The extension

<sup>43</sup> Lord, "The Improvement of Rice Cultivation in Malaya, Indo-China and Java," p. 344. In Taiwan also, there is some compulsory rotation of sugar with rice and another cereal in areas adjacent to government dam projects.

of double cropping in many parts of Monsoon Asia with suitable climatic conditions depends upon proper drainage and irrigation, and in some places upon a more adequate supply of labor and work animals. Similarly, the establishment of systems of crop rotation over a period of years depends not only upon these same factors but upon the presence of markets whether local or foreign.

In other words, physical conditions alone do not prevent more rotations and ensuing higher yields in many parts of the Asiatic rice belt. Other factors of production are either absent or not found in proper distribution. Rice is a crop which seemingly does not exhaust the soil completely, although continuous cropping for many years reduces unit yields to a very low level. The protection against loss of soil fertility is to be found in suitable crop rotations or fertilization. In the Sino-Japanese portion of the rice belt, intensive use of the land for many crops without great soil depletion is due to a generous use of manures and fertilizers. Elsewhere in Monsoon Asia, but particularly in the newer rice regions of the Indo-Chinese Peninsula, the growing of many crops is less common, rice is generally the sole crop cultivated on rice fields, fertilizers are not generally employed, and yields have declined to a very low and apparently stable level. In such places the potentialities for improvement through crop-rotation systems are greatest. But in the same places fertilization would also accomplish the purpose of maintaining and increasing the productiveness of the land.

#### USE OF FERTILIZER IN MONSOON ASIA

The extent to which fertilizers are used on rice fields varies considerably in different parts of eastern and southeastern Asia. Over extensive regions scarcely any fertilizer is applied, and only the plowing in of the stubble and of the weeds that grow while the land is fallow contribute to the restoration of the soil. On the other hand, in Japan large quantities of commercial fertilizers and of "natural" manures are regularly

applied to the soil.<sup>23</sup> In other areas fertilizers are used here and there in varying degrees.

Japan has an important and increasing business in the production of commercial fertilizers. Until a few years ago substantial quantities were also imported; there has been a tendency for the use of soybean cake to decline, and the importance of Manchurian supplies of this fertilizer is on the wane.<sup>24</sup> Ammonium sulphate is proving more economical and more effective as a nitrogenous fertilizer than soybean cake. The extensive use of fertilizers is essential to the attainment of the high yields per hectare that are obtained throughout Japan, and until the outbreak of hostilities in China and the reorganization of the Japanese national economy on a war-time basis, the supply of chemical fertilizers was adequate. In Chosen, besides compost and green manure, ammonium sulphate, soybean cake, calcium cyanamide, and calcium phosphate are used, but not widely as yet, and the preparation of manure is one of the painstaking jobs of Korean farmers. In Taiwan, however, the use of fertilizers seems to be as general as in Japan.

In China "natural" manures have been used in rice culture for many generations. Night soil, animal excreta, garbage, and organic material are carefully conserved and applied at appropriate times. In addition, peanut cake, soybean cake, and chemical fertilizers have come into use in recent times in some districts. The 1929-33 survey in China under Buck's<sup>25</sup> direction brought to light no significant changes in fertilizing practice, except this use of commercial fertilizers. About

<sup>23</sup> The chief commercial fertilizers used in Japan are [pressed herrings, pressed sardines, dried sardines, other fish cakes, bone meal, soybean cake, rapeseed cake, cottonseed cake, other vegetable-oil cakes, ammonium sulphate, calcium cyanamide, calcium phosphate, and potassium phosphate. Calcium phosphate and ammonium sulphate are probably the most representative chemical fertilizers. Natural manures used extensively consist of compost, farmyard manure, green manure, night soil, and vegetables.]

<sup>24</sup> Fixation of atmospheric nitrogen has had a rapid and extensive development in Japan. As in many other countries, it has been fostered by the government for military purposes, and its rise probably explains the decline of fertilizer imports from Manchukuo in the form of soybean cake.

<sup>25</sup> *Land Utilisation in China*, p. 265.

half of the agricultural land in China is double-cropped; and in the south, where two or three rice crops are grown during a single year, farmers are reported to believe that they can obtain higher yields by applying their fertilizer resources to the rice crop during the summer than by using them on winter crops, e.g., winter vegetables, wheat, barley, beans, and peas.<sup>66</sup>

For the present discussion, the use of manures in Japan and her colonies, or in China—all regions where paddy yields are relatively high—is not of as much interest as are fertilizing practices in those areas where productivity is low and where larger harvests are necessary if the potentialities for increasing the aggregate rice supply of Monsoon Asia are to be realized.

In British Malaya<sup>67</sup> there is some use of burned rubbish, bat guano, cattle manure, and leaves. But cattle manure is scarce, the number of cattle in the country being relatively small. On the whole, very little fertilization is practiced in Malaya, and at first sight it might appear surprising that yields do not decline substantially. In this connection it is important to note that both in Malaya and also in some other regions of southeastern Asia the straw of the harvested crop is left on the ground, and at no time is it usual for the soil of a paddy field to be exposed dry to the sun. Some of the nitrogen and potash and a little of the phosphates are thus restored to the soil. More are restored by grasses and weeds accumulating in the fallow period. But the total amounts returned in these ways are apparently considerably less than the amounts taken out of the soil by the crops. It is stated that instances "are on record of sawahs in Negri Sembilan which have been under cultivation for 200 years without any manure. It is believed that the practise which prevails of allowing grass and weeds to spring up in the sawahs between

<sup>66</sup> F. J. Rosmiter, "Agriculture in China," *Foreign Agriculture*, October 1939, III, 448.

<sup>67</sup> For a concise and informative summary of the government's efforts to improve rice production and paddy varieties in Malaya, see the address by J. L. Greig, State Agricultural Officer, Selangor, before the Kuala Lumpur Rotary Club on Jan. 17, 1940 ("Malaya's Staple Food Crop and Measures Taken to Improve Production and Varieties," quoted in *Malay Mail*, Kuala Lumpur, Jan. 18, 1940, pp. 4, 16).

two crops and turning these under when the land is being prepared for planting may suffice to maintain fertility."<sup>38</sup>

If corrections could be made which would enable the effects of short-period variations in weather on annual yields to be separated from the effects of other factors, it would probably be found that yields per unit of area have remained constant over a long period in many regions of south-eastern Asia where little or no fertilizer is used. Constant yields have been observed in India and Burma also, but it is apparent from the comments of writers that a completely satisfactory explanation of the manner in which soil fertility is maintained, even at a low level, is yet to be found. Howard,<sup>39</sup> for example, raises the question when he says:

. . . this constant drain of nitrogen is not made up by the import of manure, we should expect to find a gradual loss of fertility. Nevertheless this does not take place either in Burma or in Bengal, where rice has been grown on the same land year after year for centuries. Clearly the soil must obtain fresh supplies of nitrogen from somewhere, otherwise the crop would cease to grow. The only likely source is fixation from the atmosphere . . . It seems probable . . . that actual fixation must take place in the rice fields . . . while the land is under water. The most probable seat of this fixation is in the submerged algal film on the surface of the mud.

The author does, however, bring out the importance of green manure, when he says that "the numerous experiments which have been carried out in India point to the great value of organic manure, including green-manure, in increasing production. These results are in accordance with experience, as the benefit of incorporating the weeds into the mud when the rice fields are puddled is well known to the cultivators."<sup>40</sup> Often even where green-manure crops can be grown it is more profitable to grow other crops. In regions of Java where the water supply is not adequate for double cropping with rice,

<sup>38</sup> Federated Malay States, *Report of the Rice Cultivation Committee*, I, 24. This seems probable, especially if the grasses and weeds are largely leguminous.

<sup>39</sup> Albert Howard, *Crop-Production in India: A Critical Survey of Its Problems* (London, 1924), p. 113.

<sup>40</sup> *Ibid.*, p. 117.



crops like maize, peanuts, and long beans are grown during the dry monsoon, although much of this land could produce a green-manure crop.

In Japan and China there is some green-manuring during the winter when rice cannot be grown. In certain areas of both countries, a legume (*Astragalus sinensis*) is grown which is related to the locoweed of the United States.<sup>42</sup> In parts of Japan in April and May when this legume is in bloom, the little bright blue patches are a conspicuous feature of the landscape. Though the practice of green-manuring exists, it is not very extensive in either country, probably because it is more profitable to grow some other winter crop, usually one of the barleys, wheat, or winter vegetables.

A more recent report on the results of research in British Malaya concludes: "After nine seasons' experimental work on the manuring of padi in Malaya, the amount of positive information gained is small, the amount of negative information great."<sup>43</sup> The report goes on to say:

From the mass of accumulated data one fact is certain and two general conclusions seem justified. The fact is that as yet we have no indication of the nature of the factor which apparently limits the yield of padi in this country; the first conclusion reached is that the padi soils of the western side of the Peninsula are only slightly responsive to manuring, such response as there is being mainly to phosphate manures, and the increases which can be obtained are not economic; the second conclusion is that excellent response to manuring can be obtained on Kelantan padi soil, nitrogen, as well as phosphate, having a marked effect.

Much, however, can be done on the eastern padi soils in determining the most suitable and economic fertilizer dressings for the different districts.<sup>44</sup>

In the absence of more exact knowledge on many matters

<sup>42</sup> It might pay the California rice grower to introduce this species of *Astragalus* as a green-manure crop rather than let his land lie fallow now and then. California rice land that has been fallowed one or two years, however, normally produces from 500 to 1,000 pounds more rice per acre, "when sown to the same variety, than similar land on which rice was grown the previous year" (Jones, *op. cit.*, p. 422).

<sup>43</sup> R. C. H. Wilshaw, "Padi Manurial and Minor Cultural Trials, Seasons 1937-1938 and 1938-1939," *Malayan Agricultural Journal*, December 1939, XXVII, 528.

<sup>44</sup> *Ibid.*, p. 529.

in connection with effect of fertilizers on paddy, any campaign to increase their use is premature. Soil and other conditions vary in different districts, and local research of an experimental character is an indispensable preliminary to the successful use of fertilizers. However, once the requisite local information is available there can be little doubt that potentialities for increase of yields will appear.

Whatever the secret of obtaining for generations a constant yield of paddy on the same land without manuring,<sup>44</sup> constant yields under these circumstances are always low yields. If the experience of more northerly countries is any guide, such yields could be doubled by changes in the methods of cultivation, especially the greater use of fertilizers. This view appears to be strengthened by consideration of the situation in the great exporting regions of Burma, Thailand, and Indo-China, where very little fertilizer is at present applied to the rice fields.

In Burma cattle dung is sometimes applied to the seedbeds. In Upper Burma it is occasionally applied to the paddy fields as well. But throughout Burma, and especially in Lower Burma, there is great waste of the available cattle dung. It is stored badly, and much of its nitrogen content is lost through leaching. Probably not more than one-eighth of the supply reaches the soil. As Grant<sup>45</sup> says, "manuring cannot yet be considered to be a feature of paddy cultivation in this country." Ammonium-phosphate fertilizers and bone meal have recently been used somewhat, but not as yet to a significant extent.

The Agricultural Department of Burma has carried out important experiments in fertilization, and the results have clearly demonstrated the practicability of increasing yields by the application of fertilizers in appropriate proportions. The clay and clay-loam soils of Burma are fairly well sup-

<sup>44</sup> In some sections irrigation water may carry with it material (alluvium) of fertilizing value. It is commonly believed that the Nile does this in Egypt. In regions of active volcanoes, Java for instance, volcanic dust is an important fertilizing factor.

<sup>45</sup> *Op. cit.*, p. 21.

plied with potash, so that yields are not improved by adding potash fertilizers. On the other hand, the soils are deficient in nitrogen and phosphate, and substantial increases in yields are obtainable by the application of ammoniacal nitrogen and phosphate fertilizers. These constituents can only be supplied in adequate quantities by cattle manure or by chemical fertilizers. It is said that yields "can be increased by over 50 per cent by applying well conserved dung at the rate of 3-4 tons to the acre."<sup>46</sup> In view of the present wastage of cattle manure, there is clearly considerable scope for its extended use at little or no increase in money cost.

Chemical fertilizers specially designed for rice soils are now on the market. There are two types: one contains 20 per cent of nitrogen and 20 per cent of phosphoric acid, and the other 13 per cent of nitrogen and 45 per cent of phosphoric acid. Yields per hectare can be increased between 30 and 100 per cent by their use. To be effective on rice soils, it has been fairly generally held that nitrogenous fertilizers must be applied in the form of ammonium salts rather than in the form of nitrates.<sup>47</sup>

The experience of Burma has considerable significance for Thailand.<sup>48</sup> In Thailand a little buffalo manure or bat guano

<sup>46</sup> *Ibid.*, p. 22.

<sup>47</sup> In this connection the following comment by Howard (*op. cit.*, p. 114) is of interest and is probably still applicable today: "The sources of all the nitrogen taken up by the rice crop in India, the forms in which it is absorbed by the plant at different stages of its growth, and the complete nitrogen cycle of the rice fields are matters in which we are almost completely in the dark. The only definite facts so far ascertained are: (1) the large amount of nitrogen taken up by the rice crop between transplanting and seed-formation, and (2) the preference of the rice plant for ammonia rather than nitrate as a source of its nitrogen."

<sup>48</sup> W. R. S. Ladell (*The Use of Fertilizers in the Cultivation of Padi, with Appendix Containing Some Soil Analyses and Experimental Results*, Siam Ministry of Commerce and Communications, Technical and Scientific Supplement to the Record 6, April 1930, p. 1) considers the statement of D. Hendry with reference to Lower Burma also applicable to Thailand. It also appears to be largely applicable to Indo-China. Ladell quotes Hendry: "There is an impression abroad that this land receives an annual coating of river silt which enriches the soil and maintains its fertility. But, so far as the main padi is concerned, this is not so . . . ."

"The system followed of continuous annual cropping with padi, is exhausting when practically nothing in the way of manure is returned to the soil; but most of the land has already lost its virgin fertility and has been reduced to a level of productiveness which now appears to be fairly constant, a level at which the plant food removed by

is sometimes applied to the riceland, and rice plants are sometimes dipped in a paste of bat guano before being planted on the paddy field. The experience of the Thai Bureau of Agricultural Science indicates at present that buffalo manure has no effect. This may be due to the amount of leaching in storage and to the poor diet of the buffaloes, but in any case the supplies of buffalo manure that could be made available would be inadequate for fertilizing more than a small part of the riceland. Bat guano, fish waste, bone meal, and oil cake increase yields, but prices are often too high to make their use profitable. As in Burma, the new fertilizers which combine ammoniacal nitrogen with phosphate have been the most successful.<sup>49</sup>

In Indo-China the peasant is usually content to bury the stubble after harvest and sometimes to keep his cattle on the paddy fields in the fallow period. In some cases manure accumulated in the villages is brought out on the rice fields. There are some low plains in Cochin China, where the soil is of a peaty nature and has a high nitrogen content, but in general the soils of Indo-China are poor in assimilable nitrogen and in phosphoric acid, and to some extent also in soluble potash. The use of commercial fertilizers has been limited almost exclusively to natural phosphates extracted locally. Failure to combine these with nitrogen and potash fertilizers has led to disappointing results.<sup>50</sup> In general, nitrogen and

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the annual rice crop is made good by the natural breakdown of the soil. And we are probably safe, therefore, in assuming that under the present system of cultivation a general average yield of about 1,500 lbs. per acre, apart from annual fluctuations, may be expected to continue in Lower Burma for some considerable time."

<sup>49</sup> The application of potash alone is of no value, and the soils of Thailand appear to be fairly well supplied with potash. The chief deficiency is in phosphate. Liming followed by the application of calcium and ammonium phosphate appear to have given the best results in the experiments conducted at the Government Seed Farm at Klong Rang Sit (Ladell, *op. cit.*, p. 2).

<sup>50</sup> In the south, experiments showed that nitrogenous fertilizers alone do not markedly augment yields per hectare, but that a significant increase in yields is obtained by use of a fertilizer made up of nitrogen and phosphoric acid. When potash is added to this fertilizer, the yield is increased only under certain conditions. Experiments in Tonkin and North Annam show that phosphoric acid alone increases yields to some extent but never profitably. Potash alone has rarely given favorable results. In parts of Tonkin nitrogenous fertilizers alone gave results apparently as favorable as those obtained from combined nitrogen and phosphorous fertilizers.

phosphoric acid combined nearly always give improved yields, and profitable results are often obtained from their use, but combined applications of nitrogen, phosphates, and potash appear to be even better.

In the Philippines there is some use of commercial fertilizers and some use of manure. Sufficient experimentation has been carried on to indicate the general profitability of applying fertilizers. Some of the Islands' soils apparently are not in urgent need of fertilizers, but the older lands require restoration.<sup>51</sup> Best results have been secured from fertilizers carrying both nitrogen and phosphoric acid. The Philippine Bureau of Plant Industry recommends green manures or the planting of secondary crops in rotation with rice when soil conditions permit, and the gradual taking up of mineral fertilizers. According to Bautista:

Lands with average production of 35 to 40 cavans per hectare need to be fertilized at the rate of 150 to 200 kilos of ammonium sulphate per hectare. Other chemical fertilizers supplying from 30 to 40 kilos of nitrogen per hectare may be used. Complete fertilizer supplying 30 kilos of nitrogen, 30 kilos of phosphoric acid, and 40 kilos of potash may be good also.<sup>52</sup>

The loss of nitrogen and phosphoric acid can be replaced by the use of green manure, which is done by broadcasting legumes such as mongo, tapilan, and others at the rate of 15 to 25 gantas per hectare; and plowing the crop under while in full bloom or just before the pods are formed.<sup>53</sup>

Officials of the Department of Agriculture and Commerce seem to hold the view that fertilization is not the primary condition to be fulfilled before the existing low yields in the Islands can be increased. Rather they stress seed selection, better

<sup>51</sup> According to J. S. Camus (*Rice in the Philippines*, Philippines Dept. Agr. and Natural Resources, Bur. Agr., Bull. 37, 1921, p. 40), an average production of 40 cavans (1,744 kilos) of paddy per hectare removes 20.64 kilos of nitrogen from the soil, 10.32 kilos of phosphoric acid, and 4.54 kilos of potash. If a similar amount of straw is harvested, 11.0 kilos of nitrogen, 2.44 kilos of phosphoric acid, and 23.03 kilos of potash are also lost.

<sup>52</sup> Bautista, *op. cit.*, p. 13.

<sup>53</sup> *Ibid.*, p. 12.

plowing and preparation of paddy fields, crop rotation, general education on good cultural practices, and similar factors.<sup>54</sup>

Even when cultivators are educated in the use of fertilizers from an agronomic standpoint, the extent to which fertilization will actually be practiced will be determined by the relative prices of fertilizers and of rice. At least in the case of commercial fertilizers which are likely to be of chief importance, the appropriate quantity of fertilizer to use is not a constant but varies with variations in the spread between the price of rice and the price of fertilizer. Obviously the mere fact that the use of fertilizer will increase yields is not in itself an indication that the cultivator will find it desirable to use it. Ladell,<sup>55</sup> writing in 1930 of Thailand, points out: "Before the war the relation between the price of padi and the price of the artificial fertilizers was such that manuring could not be undertaken at a profit, but since the war the position has changed; the price of padi has risen and the cost of the old manures has fallen."

In periods of depression there is sometimes a tendency for the price of rice to fall faster than the price of fertilizer. Thus Yagi,<sup>56</sup> writing of Japan, says:

The present impoverishment of the farming population is due to the fact that in times of general depression, the prices of agricultural products to be marketed and those of the various factors of production constituting the cost of production do not fall at the same rate. . . . By way of expediting the recovery of the natural equilibrium between the economic forces generally, the State must do away with all measures designed to help the artificial increase of the prices of fertiliser by big capitalistic interests . . . .

Japanese farmers succeeded in getting a law passed in 1936 forbidding fertilizer manufacturers to fix prices without government approval, but its regulations were widely evaded.

<sup>54</sup> Based upon general impressions secured from discussions with a number of such officials in November-December 1939.

<sup>55</sup> *Op. cit.*, p. 6.

<sup>56</sup> Yoshinosuke Yagi, "A Study of the Cost of Rice Production," *Kyoto University Economic Review* (Department of Economics, Imperial Univ. Kyoto, Kyoto), July 1932, VII, 112.

After the "China Incident" further legislation was passed in 1938 (Sulphate of Ammonia Output, Expansion, and Distribution Control Law), and, since Japan has been on a war footing, the prices of fertilizers used by farmers, like prices of most commodities, have been controlled by the government.

Such changes in relative prices of different commodities cause considerable disturbances in agricultural operations. In so far as they reduce the quantity of fertilizer which it is profitable to use during depressions, their effect tends to deplete the soil and leave it less fertile in succeeding years. Moreover, changes in the relations between the prices of cereals and the prices of fertilizers are not simply cyclical phenomena: they sometimes show evidence of the existence of long-period trends. In Burma, Thailand, and probably elsewhere in southeastern Asia, there has been a long-term downward trend in the price of fertilizer as compared with the price of rice. This is associated with the development of chemical fertilizers; the newer types, combining ammoniacal nitrogen and phosphate, save mixing, and their use reduces transport costs. It is a trend in itself favorable for maintenance or increase of rice yields.

It seems clear that the greatest potentialities for improving rice yields through the more general use of fertilizers are to be found in the rice-producing countries of Monsoon Asia lying to the south of the Sino-Japanese rice belt. Yields per hectare are notably low in all of these countries, and fertilizers are neither extensively nor intensively used in rice cultivation. Ample demonstrations have been given of the beneficial effects resulting from the correct application of appropriate fertilizing agents, although the particular practices to be followed under the wide variety of circumstances in which rice is cultivated have not by any means been completely worked out. There is no question about the great physical potentialities that exist. When experiments with fertilization of rice soils have been found to be uneconomic, they nevertheless have not denied existing potentialities under another set of economic

circumstances. Like practically all of the other factors bearing on rice yields, the use or nonuse of fertilizer is a practice heavily dependent upon a complex array of developments that fall under the heading of prospects.

#### CONCLUSIONS ON YIELD POTENTIALITIES

Of the general methods for expanding the rice output of Monsoon Asia, that of increasing rice yields per unit of land cultivated seems to hold great promise. Yields potentially attainable, assuming that circumstances permitted rice growers to follow all desirable cultural practices, would enormously increase the aggregate rice supply, perhaps far more than could be accomplished by an enlargement of the area under rice. Of the several methods by which unit yields may be improved that were singled out for specific discussion, better seed selection and more general use of fertilizers would seem to have the greatest potentialities. Introduction of systems of crop rotation and the extension and perfection of transplanting practices hold less promise, partly because they are closely linked with other features of the general agricultural pattern of a region that can only be altered appreciably by the development of engineering works, communications, and markets.

Except within the Japanese Empire, progress has been slow in the introduction of superior seed, a most important factor in yields. The breeding of improved, higher-yielding varieties for special conditions of soil and climate has been carried on to some extent in practically all of the rice-growing countries; yet the general adoption by growers of selected seed has, for understandable reasons, been very slow. Nevertheless, the potentialities would seem quite feasible of attainment under sufficient government sponsorship.

The greater use of fertilizers offers opportunities for materially improving yields, particularly in southeastern Asia, but, largely for economic reasons, the realization of the potentialities appears to be more difficult than in the case of



seed. The production of fertilizers in the future may be so developed as to make practicable their use in large areas not at present employing them. Also various factors in rice-production costs, or the level of rice prices in relation to total production costs, may be so altered as to make the wider use of fertilizers economic. And the establishment of suitable agricultural credit systems with provision for borrowing small sums might lead to a greater use of fertilizers with considerable increase in yields.

Cultural practices can undoubtedly be made more efficient in all countries, but especially in regions like the Philippine Islands,<sup>27</sup> Indo-China, and India. The practice of transplanting depends, among other things, upon an assured and regulated supply of water. Without a further development of irrigation schemes, transplanting will not be feasible over large areas in such countries as Ceylon. An adequate water supply is necessary also for the growing of a multiplicity of crops; if made available in places where there is now a water deficiency during the winter months, further justification would be provided for the extension of transplanting and crop-rotation practices. Certain parts of southeastern Asia, furthermore, are not sufficiently populated or near a convenient source of seasonal labor, or do not possess a sufficient supply of work animals, for cultivation to be as thorough and efficient as it might otherwise be.

The generations have witnessed few important changes in rice culture in Monsoon Asia. In fact, agriculture generally has remained essentially conservative, bound to tradition. Estate production of crops has been developed in a number of countries (Java, Malaya, Ceylon, the Philippines), but the

<sup>27</sup> Favorable natural conditions and political relations with the United States have not made it so necessary for the Philippine Islands to develop more efficient production and marketing techniques. This is being realized today: since agriculture has not been well developed along specialized lines, as in some other tropical areas of the world, the Islands cannot command an important position in world markets. If and when independence of the Islands materializes, protected markets will possibly be a thing of the past, and the Philippines will be required to undergo some important reorganizations in their agricultural economy.

methods of estate cultivation have been applied to rice only in a few cases. Even in the Japanese Empire, where the greatest progress seems to have been made in the development of the rice product and in rice-production techniques, "agriculture is described as 'not yet capitalized,'—a special feature worth recording."<sup>60</sup> "With the exception of the government-owned pasturages and upland farms in Hokkaido, motor-driven machines are scarcely used at all in the cultivation of a Japanese farm."<sup>61</sup>

Some years ago a firm of Chinese merchants started cultivation of rice on a large scale by mechanical means in southern Thailand, and the experiment was apparently successful. Thirty men were able to till an area of 600 acres of paddy, whereas by ordinary methods about 300 men are required.<sup>62</sup> But in considering the possibilities for British Malaya, a government investigation commission stated: "We consider that the government should give encouragement to projects of this description . . . . on the ground of expense, we are unable to support the proposal for a large scale demonstration . . . . persons who are interested . . . . would do well to pay a visit to Southern Siam . . . . and possibly to French Indo-China, where, we understand, an American firm of implement makers has also established a demonstration station . . . ."<sup>63</sup> When a government very much concerned with expanding rice production does not feel that it can afford to support a large-scale demonstration of mechanized rice grow-

<sup>60</sup> Shiroshi Nasu, *Land Utilization in Japan* (prepared for the Third Session of the Institute of Pacific Relations [Tokyo, 1929]), p. 81. However, in recent years there has been an extension of mechanization in harvesting and milling operations and an increased use of prime movers for pumping water for irrigated crops. "Between 1927 and 1937 the number of prime movers on farms—mostly electric motors and oil engines—increased from 51,628 to 187,813" (Miriam S. Farley, "Serious Shortage of Agricultural Labor in Japan," *Far Eastern Survey*, Oct. 11, 1939, p. 242, quoting the *Oriental Economist*). The war with China, beginning in 1937, put a stop to progress in mechanization which might under normal conditions, as pointed out by the *Oriental Economist*, "have a far-reaching effect on the destiny of the agricultural and all other industries of Japan" (*ibid.*).

<sup>61</sup> Nasu, *loc. cit.*

<sup>62</sup> See Federated Malay States, *Report of the Rice Cultivation Committee*, II, 178.

<sup>63</sup> *Ibid.*, I, 35.

ing, it is doubtful that under present conditions many individuals or firms will go far in venturing their capital.

Development in cultural practices generally would be reflected in enlarged paddy production. There seem to be considerable potentialities in this direction even in countries where rice yields are at present relatively high, and substantially more over extensive areas of southeastern Asia. The utilization of idle or semi-idle labor in some places, as in India, and the introduction of machinery in other places where there is a scarcity of seasonal labor, as in parts of the Indo-Chinese Peninsula, would permit more thorough cultivation with resulting beneficial effects on unit yields.

In most areas, however, labor is so abundant and capital so scarce that mechanization on any large scale is both improbable and undesirable. In densely populated regions, the social problems that would be created by depriving farm labor of the opportunity to subsist would tend to make conditions worse. Improved rice varieties, better seed, and the more general use of appropriate fertilizing agents offer greater promise than mechanization for enlarging the rice output under existing conditions of production in Monsoon Asia.

## CHAPTER XII

### POTENTIALITIES FOR RICE EXPANSION: ACREAGE

In addition to the methods discussed in the preceding chapter for increasing yields, the rice output of Monsoon Asia may be enlarged by an expansion in the area under paddy. Such expansion depends in large part upon the provision of adequate communication, drainage, and irrigation services in regions where they do not at present exist. With these services rice could be grown in places where other conditions are favorable and, in some areas where only one crop is now produced, double cropping to rice would be possible. Moreover, some expansion of rice output would result from new settlement in regions where the upland form of culture could be practiced.

Thus, the potentialities for adding to the area devoted to rice in Monsoon Asia may be realized by the settlement of new lands where both lowland-rice and upland-rice production would contribute to the output, and by the extension of double cropping in regions already settled and cultivating rice. An expansion in the total area under crops would involve some increase in other food crops; and to the extent that nonrice food crops are grown, either as upland or subsidiary paddy crops, the need for rice expansion will in some measure be reduced.

The area devoted to rice cultivation in Asiatic countries, exclusive of China, amounted to around 50 million hectares at the opening of the 1920 decade, and has expanded slowly since then, averaging approximately 55 million hectares at the close of the 1930 decade (Appendix Table I). For the period 1931-35 the area under rice in China was apparently 18 million hectares,<sup>1</sup> giving a figure for Monsoon Asia as a whole of about 73 million hectares. Although rice acreage has expanded somewhat more than production, it has prob-

<sup>1</sup> According to official Chinese figures, generally accepted as the best available.

ably increased less than half as rapidly as population. This is due largely to the fact that the rice areas of India, Japan, and probably China—the chief rice producers—have been enlarged very little during the past 20 years; the most noticeable expansion has occurred in the smaller producing countries (see Chart 21, p. 198).

Just how much of the 10 per cent expansion that occurred in rice acreage between the 1920's and the 1930's represents new paddies, how much new upland, and how much additions through double cropping cannot be determined. In the few countries for which some details are available the statistics provide no basis for making general observations. In Japan, for example, the area under upland rice has expanded in proportion to the slow growth in the total area under rice; in Java, the nonirrigated areas devoted to rice have become a constantly smaller proportion of the total over the past two decades; but in British Malaya the area under "dry padi" has fluctuated widely, apparently with economic conditions,<sup>2</sup> but seems to be declining in importance.

Although the most habitable lands of Asia have long been occupied, it does not necessarily follow that all of the productive land has been farmed. Much territory is either inaccessible or is, for one reason or another, less desirable for settlement under existing conditions of economic development. Given sufficient pressure on the land, eventual utilization can be expected. But it seems probable that, in the major rice-growing countries of Monsoon Asia, the principal limitation to further expansion of rice acreage has been the absence of suitable available lands.

#### POTENTIALITIES IN CHINA AND INDIA

Before dismissing consideration of the great rice-producing countries—China, India, and Japan—as offering little oppor-

<sup>2</sup> Between 1921-22 and 1922-23 the upland area planted to rice in Malaya increased from 54,700 to 101,700 acres, then fell to a low of 27,500 acres in 1929-30 but again increased to 104,700 acres in the following year; and by 1937-38 had once more gradually fallen to 44,600 acres.

tunity for additional expansion in the area devoted to rice, we must inquire somewhat more fully into the conditions suggesting this conclusion.

*China.*—It seems fairly generally agreed that all of the arable land of China is being used up to its economic limit.<sup>3</sup> Some writers, however, see the opportunity for modest additions to the amount of farm land: "Certain facts as regards land in China are now clear. In the first place, no great increase in the amount of farm land can be expected. The removal of graves from farm land, . . . the consolidation of the fragmented holdings, . . . cultivation of arable lands not now cultivated, and an economic size of farm . . . would probably make available an additional ten per cent of the present area in farms . . ." This judgment, of course, applies to lands suitable for all crops and not specifically for rice. Rossiter<sup>4</sup> of the United States Department of Agriculture holds that if "all land that was economic to farm were developed, it is doubtful if the total area would be increased more than 2 per cent."

A glance at Maps 1 (facing p. 24) and 2 (p. 32), showing the broad agricultural areas of China and something of the topography of the country, suggests the present limits of economic rice cultivation. In the Yangtze Valley one crop of rice is grown each year. In the extreme south, which is favored by abundant rainfall and high temperatures, two and even three crops may be grown successfully. But north of the Yangtze the rainfall is deficient and rice growing is confined largely to the lowlands where water is available for irrigation.

Buck<sup>5</sup> has estimated that about one-quarter of the land of the eight agricultural areas studied is under cultivation. In his broad division to the north, the "wheat region" (one-third of the total gross area), 39 per cent of the area is cultivated,

<sup>3</sup> G. B. Cressey, "Agricultural Regions of Asia. Part VI, China," *Economic Geography*, April 1934, X, 126.

<sup>4</sup> Buck, *Land Utilisation in China*, p. 202.

<sup>5</sup> "Agriculture in China," p. 442.

<sup>6</sup> *Land Utilisation in China*, pp. 166-67.

and in the south, the "rice region" (with two-thirds of the total land area), only 18 per cent of the land is cultivated. But one must remember that about 85 per cent of China consists of mountains and high plateaus. The amount of level land is relatively small, the hills are usually of poor soil unsuitable for crops, and the mountains are mostly granite with only enough soil for a crop like tea. This is especially true of outlying provinces which, for all practical purposes, may be disregarded in the present discussion.

There are some observers who foresee great opportunities for the extension of colonization and agriculture into the Manchurian region, Mongolia, the northwest, and even into Sinkiang.<sup>7</sup> These regions hold little promise as places where rice might be grown, but if they could relieve the pressure on land use for other crops some further expansion of ricelands within the present rice areas might be feasible. However, one cannot expect such a development very soon, if at all. Buck<sup>8</sup> has this to say:

[Dr. O. E.] Baker's large estimate of arable land in China has been unfortunate in that it has helped to sustain the erroneous idea prevalent in China that the country has vast areas of land potentially cultivable. These areas are supposedly to be found in the Northwest, principally, in the provinces of Suiyuan, Ningsia, Kansu and Tsinghaf. One has only to travel in these provinces to find that most of the good land is already under cultivation.

One is forced to concur in the view that has already been expressed that, in so far as China is concerned, there is little room for enlargement of the rice output by bringing more land under rice.

*India.*—More factual data are available on land use in India, particularly in the major provinces of British India, and the potentialities for expanding the area under crops are better understood. Reference to Map 3 (p. 34), showing the

<sup>7</sup> Thompson (*Population Problems*, p. 59) holds the belief that if all the unused lands of northern China, Manchuria, and Mongolia could be tilled, "there is not the least doubt that from one-fourth to one-half more people could be supported at the present standards."

<sup>8</sup> *Land Utilization in China*, p. 170.

distribution of rice and some other cereal crops in India and Ceylon, suggests the dominance of rice cultivation in those densely populated parts of the country having the proper soil and necessary water supplies. Less is known about agriculture and its potentialities in some of the native states, but these in general are not in the regions most suitable for rice growing.<sup>9</sup>

The land available for productive use to India's 360-370 million people is considerably smaller than the 1.57 million square miles included within the boundaries of the British Provinces (860 thousand square miles) and the Indian States (710 thousand square miles). Much of the land is desert, waste, or otherwise does not lend itself to agriculture upon which the great mass of the Indian population depends. Agricultural statistics for India deal with an area something over a million square miles. About 42 per cent of this land is sown to crops and another 10 per cent is currently fallow. Forests, which are badly needed to protect the water supply and to prevent soil erosion, account for approximately 13 per cent of the land area, while another 18 per cent is not available for cultivation by reason of its use for dwellings, utilities, and similar purposes. This leaves about 17 per cent of the total land surface of the British Provinces and the Indian States upon which statistics are collected, that is classed as "culturable waste other than fallow."

Apparently the question of how much of this area can ultimately be brought under cultivation by the application of scientific methods and machinery remains to be answered.<sup>10</sup> Some 113 million acres are involved (according to statistics

<sup>9</sup> About 96 per cent of the total area under rice is included in the official estimates of areas and yields: the eight major provinces of British India plus the larger Indian States like Hyderabad and Mysore (not, however, major rice producers) and those within rice regions in the United Provinces, Central Provinces, etc. From an area standpoint but not from the standpoint of rice production or potential rice production, the most important exclusions are such areas as the Punjab and the North-West Frontier Province. Many other minor areas are also not considered, since there are altogether some 675 native states in India. See Statistical Notes, p. 340.

<sup>10</sup> Sir M. Visvesvaraya (*Planned Economy for India*, Bangalore City, 1934, p. 29) has pointed to the need for an early investigation of this, among many other subjects.



for 1934-35): about 95 million acres in the British Provinces and 18 million in the Indian States. Mukerjee,<sup>11</sup> who has studied questions of Indian land use over a long period of years, has recently stated:

The chances of expansion of cultivation have now been exhausted, at least in the major provinces, hills, sand-dunes and uncultivable wastes now thwarting extension. . . . The area of forests cannot be given over to the plough in the major Provinces; it is already too small in relation to the cultivated area.

. . . . Diminishing Returns is now operating not only by the soil but also by water acting as a limiting agent in agricultural development.

It is particularly in Assam and Sind that unappropriated land remains to be developed.

Unequal and irregular seasonal distribution of rainfall creates a problem for India which is being solved through irrigation. About one-fifth of the crop land is irrigated—more than in any other country in the world. Half of the irrigation facilities of India are provided by government and private canals; wells rank second in importance, and tanks third. Over 300 irrigation schemes are in operation in British India alone. Of all factors limiting the extension of the land under cultivation, the supply of water is generally most important. But irrigation projects are of relatively minor importance in rice cultivation in India, since only a little more than one-fifth of the total rice area is artificially irrigated.

It would seem that any appreciable expansion in India's rice output, assuming that such an expansion is desirable, will come from an increase in yields rather than from an extension of the rice area. Improvement in cultural practices would appear far more feasible than the conversion of lands now being used for other crops, or so-called wastelands, to rice fields by means of a further extension of irrigation works.

*Ceylon.*—A word should be said about Ceylon, where conditions are somewhat similar to those found in southern India.

<sup>11</sup> *Food Planning for Four Hundred Millions*, pp. 10-11.

Except in two coastal strips, northwest and southeast, Ceylon receives a plentiful supply of rain. The south-central highlands region is the most favored from the standpoint of climate, relief, and drainage for tropical plantation agriculture, and here tea, rubber, cacao, and rice are widely cultivated. The north-central region of Ceylon was once quite productive but has long since been claimed by tropical jungle. Statistical information on the rice industry of Ceylon is meager, but there is little question that yields of paddy are very low. There are two rice-growing seasons, the *maha* paddy crop being sown in late August to mid-October and harvested in February or March, and the *yala* crop being sown in March-April and harvested in July to September.

Ceylon continues to import from India and Burma two-thirds to three-fourths of her consumption requirements. The Department of Agriculture has been making strenuous efforts to render Ceylon self-sufficient in foodstuffs; the Chamber of Commerce and various government agencies, on the other hand, are committed to a program of continuing development of Ceylon's export business. Since the two purposes cannot very well be accomplished at the same time, the British Colonial Office feels that the "best solution seems to lie in the adoption of a middle course."<sup>12</sup>

It is estimated that 400,000 to 2,000,000 acres would be required to produce sufficient rice to meet the island's needs, these differences of opinion being within the Central Board of Agriculture and the newly established Food Production Department of Ceylon.<sup>13</sup> Apparently grains other than rice can be cultivated with far less difficulty. In Ceylon's latest attempt to improve its home food-supply situation, an effort is being made to impress consumers with the desirability of eating less rice and more of other cereals.<sup>14</sup>

<sup>12</sup> Great Britain Colonial Office, *Annual Report on the Social and Economic Progress of the People of Ceylon, 1938* (Colonial Reports No. 1922, 1939), p. 1.

<sup>13</sup> J. S. Driberg, "Ceylon's Food Supply. II, Rice and Its Substitutes," *Tropical Agriculturist*, January 1940, XCIV, 3.

<sup>14</sup> *Ibid.*, p. 8.

But it is probably still true, as Turner<sup>15</sup> observed in 1927, that the returns from rice growing in Ceylon are small compared with other rice-producing countries, and profits have never been sufficient to attract capital and organization. Production of export crops, like tea, rubber, copra, and coconut oil continues to be a more profitable use of the land and a better source of employment.<sup>16</sup> The total crop area in 1936 was about 22 per cent of the total land area. A distant observer has no fair basis for judging the potentialities for expanding the area under rice, even under much greater pressure than has existed for the past decade or so.

Within the broad regions encompassed by China, India, and Ceylon, it is difficult to see how there can be more than a very slow expansion in rice acreage. It is therefore necessary to look elsewhere for any substantial enlargement of the rice supply that might accrue from planting additional areas.

#### LAND USE IN THE JAPANESE EMPIRE

The situation within the Japanese Empire is well known: less than one-fifth of the entire land area is arable. Mountains, forests, small alluvial plains, and dense populations are the main features of this island empire in which very little usable land is totally unproductive. Over a decade ago Nasu held that "the exploitation of arable land in Japan Proper, except for Hokkaido, has already reached a climax, leaving little room for further reclamation even with the very expensive and painstaking assistance of the Government."<sup>17</sup>

Certainly to the traveler over the well-beaten paths of Japan Proper there appears to be very little area not inten-

<sup>15</sup> Ceylon Director of Statistics and Office Systems, *Handbook of Commercial and General Information for Ceylon*, compiled by L. J. B. Turner (1927), p. 119.

<sup>16</sup> One of the most striking developments in Ceylon's economy over the past century has been the change from its one-time heavy dependence upon coffee to a diversification of interests represented by three staple export crops: tea, rubber, and coconuts. The process of developing foreign trade has necessarily been somewhat at the expense of the internal development of food resources.

<sup>17</sup> *Land Utilization in Japan*, p. 109. In 1927 about 1.1 million acres of land (450,000 cho) in Hokkaido were considered fit for conversion into paddy areas (p. 112).

sively used for some purpose. Outside observers analyzing Japan's industrial rise fail to see how the enormous increase in population could have been absorbed in agricultural pursuits. "Even before the beginning of industrialism, the agricultural population was extremely dense. There was comparatively little unoccupied land, and most of this was of distinctly inferior quality. . . . Japan had little possibility for agricultural expansion."<sup>18</sup> Alsberg, in examining the possibilities for expanding Japanese wheat production, concluded that the prospects were poor.<sup>19</sup> The Five-Year Wheat Plan for making Japan self-sufficient, announced in 1932, resulted in an expansion of area, but expansion "took place almost entirely through the displacement of naked and common barley . . . the consequence of a high price for wheat relative to barley."<sup>20</sup>

An examination of the statistics on food crops in Japan for the past 25 or 30 years shows that the expansion of production has not been accompanied by an increase in the aggregate area under cultivation, a rather strong indication that suitable lands were not available. Instead, there has been a general improvement in yields.

In Hokkaido, where Nasu once saw the greatest opportunities for expanding the paddy area, settlement has been slow. Rice is the dominant crop of the island but the climate permits only one crop to be grown annually, usually on the lowlands. Oats, potatoes, beans, wheat, barley, and many other minor crops are grown on the uplands. "The areas which are now being occupied are much less desirable and hold forth much less promise for the future than do those of earlier settlement."<sup>21</sup> Early production was confined to the southwest, but with the development of a rapidly maturing variety it has been possible to extend rice cultivation to the north and

<sup>18</sup> Moulton, *Japan, An Economic and Financial Appraisal*, p. 331.

<sup>19</sup> Alsberg, "Japanese Self-Sufficiency in Wheat," pp. 69-72.

<sup>20</sup> *Ibid.*, p. 96.

<sup>21</sup> D. H. Davis, "Agricultural Occupation of Hokkaido," *Economic Geography*, October 1934, X, 356.

northeast (see Map 4, p. 44). One geographer has expressed what seems to be the accepted judgment:

No great expansion of the agricultural area is to be expected; all of the really desirable land is already in use. . . . .  
. . . . the next few decades will witness only a systematic and orderly evolution along the lines of greater productivity per acre and the addition of a relatively small amount of distinctly sub-marginal land to production on a subsistence basis or to supplement income derived from other sources. This is recognized by the Hokkaido Government . . . .<sup>22</sup>

Turning now to other parts of the Empire where rice is or may be grown, one finds that Japanese experts are convinced that better utilization can be made of the land, but are not hopeful of substantial expansion of the cultivated areas. Nasu<sup>23</sup> is skeptical of the estimates issued by the Chosen government of the possible area of land considered fit for future use when he says: "we can hardly expect any great increase in the arable land area in the future, as the present area under cultivation has already reached about twenty per cent of the total area of the peninsula." The official figure for 1936 was 20.2 per cent.

One observer remarks: "When we consider that Korea is not more mountainous than, say, Italy or Bulgaria, where the relationship of cultivated land to total land is 41.4% and 36% respectively, it would seem that there is still considerable room . . . . for expansion."<sup>24</sup> Another concludes that "the land under cultivation in Chosen will show no perceptible increase in the near future."<sup>25</sup> This is a fair contrast between potentialities and prospects. Given the necessary capital and organization, over the longer term some progress in extending the land for crops may be made; but the near prospect is poor. However, our interest lies specifically in extending the area for rice.

<sup>22</sup> *Ibid.*, pp. 366-67.

<sup>23</sup> *Op. cit.*, p. 224.

<sup>24</sup> Grajdanzov, "Korea under Changing Orders," p. 292.

<sup>25</sup> Ladejinsky, "Chosen's Agriculture and Its Problems," p. 99.

Whereas in Japan Proper more than half the arable land is in paddy rice, in Chosen the paddy fields occupy only about one-third of the arable land. About 70 per cent of the rice area is now irrigated. Despite considerable progress in recent years, cultural methods are not as advanced as in Japan Proper, and much of the cultivated area consists of depleted soils. Yields were little more than half those secured in Japan until the past decade, when they were apparently considerably improved. Double-cropping and multiple-cropping systems are found in the south, but are less common than in Japan; in the north, where the cold winters prevent the growing of more than a single crop, fire farming is still fairly common. Until recently little control has been exercised over timber cutting so that vast forest areas have been destroyed, with resulting increase in soil erosion and flood hazards.

Most of the cultivated land is found on the southern and western side of the Peninsula, and the bulk of the rice grown for export to Japan comes from the southern part of Chosen. This is the region most favored by natural conditions for rice culture as well as the growing of other crops such as barley, naked barley, and soybeans. Very little unused land is still available. In the northern and middle areas of Chosen, soil and climatic conditions are less well suited to rice, but it is in these spaces that such future opportunities as may exist for extending the crop area are to be found.<sup>28</sup> One is quite secure, therefore, in not holding out much hope for expansion of Chosen's paddy output mainly by bringing additional lands under rice.

The mountainous but fertile tropical island of Taiwan has a more diversified agriculture than the larger Japanese colony of Chosen. Most of the native population is engaged in growing rice, sugar cane, sweet potatoes, tea, bananas, pine-apples, hemp and similar fibers—all products exported to the mother country or elsewhere. Two crops of rice are grown:

<sup>28</sup> At present, wheat, Indian beans, green beans, and other beans are the crops more largely grown in the north.

the first crop planted in February or March is harvested in June or July and supplies most of the surplus for export; the second crop planted in July or August and harvested in October or November usually occupies a larger land area than the first crop but the yield obtained is smaller. The growth of the sugar-cane industry and the extension of sweet-potato growing during recent years have brought about some contraction of the rice area.

As noted earlier, the Japanese authorities have pursued a fairly definite agricultural policy in Taiwan over a long period. Within recent years, however, plans have been changed several times. First, after it seemed that the rice supply of the Empire was ample, a new Ten-Year Plan was evolved which called for diversification of Taiwan's agriculture with emphasis on the tropical crops that cannot be grown in other parts of the Empire. The area under rice was to be kept fairly constant, increasing only about 10 per cent by 1948, while yields were scheduled to rise 15 per cent. By limiting the expansion of rice fields, more land was to be made available for other crops.

Then, after the short rice crop in Chosen in 1939, and greatly reduced stocks in Japan, the Japanese authorities became concerned about the rice supply. Sugar competes with rice for land use in Taiwan, and if sugar cannot be grown extensively in other parts of the Empire, a definite limit is placed upon the expansion of rice acreage. But the controversy over whether Taiwan should raise more rice or more sugar cane was temporarily settled in favor of rice when the shortage developed after the Chosen crop failure.<sup>37</sup>

In Manchukuo there is not a typical rice industry. Since the start of the European war, and partly because of the dis-

<sup>37</sup> Plans called for withdrawing 12,000 acres from sugar cane in 1940 and 24,000 acres in 1941. Approximately 27,500 acres of new land were to be opened up by means of land-improvement projects. "A 10-year land-improvement project has been prepared for increasing the arable land in Taiwan. It is expected that as much arable land will be added in the next 10 years as has been added in the past 30 years" ("Taiwan to Increase Rice Production," *Foreign Crops and Markets*, U.S. Dept. Agr., Office of Foreign Agricultural Relations, June 15, 1940, p. 769).

ruption of the soybean trade, greater emphasis has been placed by the Japanese authorities upon increasing the output of cereals. For 1940 it was hoped to obtain a 20–30 per cent increase in rice production, 30–40 per cent greater wheat output, and a 10 per cent expansion in kaoliang, millets, and maize.<sup>28</sup> Raising the soybean output was no longer to be encouraged; instead, through improved seeds, greater use of fertilizer, and similar measures, it was hoped to enlarge cereal production to the point where Manchukuo might be able to assist in relieving the food shortage that temporarily threatened the Japanese Empire. This program, however, was part of Japan's Ten-Year Plan for agriculture, which calls for more than tripling the present area under rice in Manchukuo. Earlier, in 1938, a comprehensive system of control over practically every phase of the rice industry was extended to this area with the formation of the government-sponsored Manchurian Rice Corporation.

If the statistics are to be trusted, rice production in Manchukuo has greatly increased since 1935–36, and appears to be more than twice as great as in the early 1930's when the average annual outturn was over 300,000 metric tons, presumably of brown rice. Whereas in Japan the northernmost limit of rice culture is in Hokkaido at about 43° north latitude, in Manchukuo rice has been grown in the valley of the Amur as far north as Blagoveshchensk (51° N.), though not on a very important scale. Elsewhere in Manchukuo rice growing does not extend as far to the north; since the establishment of the Manchukuo government, however, Japanese agronomists have found it possible to grow rice farther north than heretofore has been customary.

In Japan, where four-fifths of the land area is considered permanently untillable, rice production has been extended about as far as is possible by enlargement of the planted area. Long ago, improvement in yields was determined upon

<sup>28</sup> J. R. Stewart, "Manchoukuo Switches Emphasis to Cereals," *Far Eastern Survey*, Feb. 14, 1940, p. 46.



as the feasible method of increasing output. The same observation seems to apply with less force to the Japanese colonies of Chosen and Taiwan. Although the possibilities for acreage expansion are limited in both colonies, they seem to be larger in Taiwan, especially if land used for other crops but suitable for rice were to be made available. The most extensive area yet to be brought under cultivation in Manchukuo is in the north, but present agricultural potentialities seem to lie largely with crops other than rice.

#### OPPORTUNITIES IN THE MAJOR EXPORT AREAS

The most promising opportunities for the extension of rice-lands in the Far East seem to be in the southeastern part of Asia and on some of the outlying islands, but especially in the region which includes parts of Burma, Thailand, and French Indo-China. The characteristics of this region of surplus production have already received attention in chapter iii. At present there is apparently a considerable amount of land that is not being utilized for lack of irrigation or settlement. Because of the relative sparsity of population in such areas, the necessary reserves of labor are not available to meet the seasonal demands inherent in more intensive forms of cultivation, nor is the supply of work animals plentiful.<sup>29</sup>

Just how much of this land is suitable for rice cultivation is a matter of speculation. A permanent development of present waste lands awaits additional pressures from without. In the meantime, unproductive lands on the fringes of the present paddy area are utilized temporarily when the level of paddy prices provides the necessary incentive to growers. This type of extension of the planted area, however, is unimportant in

<sup>29</sup> "The number of oxen which a farmer has at his disposal has a very definite influence on his acreage. Since it has been shown that the size of the farm is one of the most important factors controlling the profits made, it is clear that the provision of working oxen is a major consideration in farm organization." Although this observation is made in connection with an area on the northeastern coast of South America where rice cultivation is almost entirely an East Indian pursuit, it seems to have equal application to the major export areas of Monsoon Asia. See H. D. Huggins, "An Economic Survey of Rice Farming in West Demerara," *Tropical Agriculture* (Imperial College of Tropical Agriculture, St. Augustine, Trinidad), February 1941, XVIII, 32.

comparison with the potentialities for improving, settling, and opening up territory now lacking in irrigation or flood-control systems, communications, and perhaps public-health control.

In Burma, little land suitable for growing rice remains unappropriated in present rice districts. As long ago as 1919, the Imperial Institute's Indian Trade Enquiry foresaw the need for Burma to move toward greater intensity of rice cultivation, stating that "the rice acreage of Burma, in the chief rice districts, has practically reached its natural limit, and increased production can only be achieved in those districts by more intensive cultivation."<sup>80</sup> But from 1920-21 to the close of the last decade, the area under rice in Burma increased from a little over 4 million hectares to a little over 5 million. This 25 per cent expansion probably represents some opening up of new lands and some extension of the crop into relatively unproductive areas.

The main physical factors that have determined the distribution of rice cultivation are rainfall and soil. Over four-fifths of the annual crop of Burma (and all of the export surplus) is produced in Lower Burma where rainfall is plentiful and soils are of a stiff alluvial-clay type. In Upper Burma paddy is grown chiefly on land that can be irrigated or on low-lying areas where the water can collect during the rainy season.

The largest proportion of the cultivated land in Burma is to be found in the lower Irrawaddy Valley and its delta region (Map 5, p. 56). At present there is apparently much land that is not being utilized for lack of irrigation, cultivators, or for various other reasons. Such potentially useful land exists even in central Burma, the region of densest population, yet this is essentially an arid area with an annual rainfall of less than 40 inches. The soils, though fertile, are of the sandy type and it is probable that, with additional

<sup>80</sup> Great Britain Imperial Institute, Committee for India, Indian Trade Enquiry, *Reports on Rice* (1920), p. 79.

irrigation, crops like barley and wheat could be cultivated more successfully than rice.

Stamp,<sup>81</sup> the British geographer, has been impressed by Burma's possibilities: "Upcountry one is struck by the immense areas of cultivable land which remain waste for want of cultivators." In describing the Arakan coastal strip he states that "there is a large amount of waste land which could be cultivated; but almost the only crop suitable for this very wet region is rice."<sup>82</sup> Again, referring to the Shan Plateau: "There are immense tracts of rolling country suitable for crops. Rice is grown together with potatoes, vegetables of all sorts, fruits . . . and in some places wheat."<sup>83</sup> And of the northern hills region, he says: "Rice is grown for the needs of the people, but there are enormous areas of waste land which might be cultivated."<sup>84</sup>

The best ricelands in Burma have no doubt already been planted. No quantitative measure of the area that might be adapted to paddy growing is available, but the observations quoted above suggest that rice production in Burma could be considerably increased through expansion upon present undeveloped lands.

In Thailand, likewise, there appears to be an opportunity for further expansion of ricelands, perhaps more so than in neighboring Burma. Although rice is grown in every administrative division (circle) the so-called seven inner circles constitute the chief producing area and provide the surplus for export. This great central alluvial plain receives about 48 inches of rain during the rainy season (June–November) and about 60 inches annually, while temperatures are high throughout the year. Croplands are frequently enriched by floods carrying silt, but these same floods in the Menam Valley can be quite destructive (see pp. 58–60).

It has been suggested that adequate flood-control and irri-

<sup>81</sup> L. D. Stamp, "Burma: An Undeveloped Monsoon Country," *Geographical Review*, January 1930, XX, 87.

<sup>82</sup> *Ibid.*, p. 92.

<sup>83</sup> *Ibid.*, p. 96.

<sup>84</sup> *Ibid.*, p. 102.

gation systems would substantially increase the area available for crops, but it is somewhat difficult to say just what this means in terms of rice production. If the cultivated land on the lower delta does not approach 40 per cent<sup>55</sup> of the total area, a quite sizable increase in the annual rice outturn of Thailand might be achieved by making a greater portion of such land available for paddy.

The information at hand, however, is not very satisfactory. In 1930-31 Zimmerman made a rural economic survey of Siam. His report suggests potentialities for expansion of agriculture in general—both through improved methods and by bringing unused lands under cultivation—but for rice he is far from specific.<sup>56</sup> Some years later he presented certain of his information in somewhat different form and made the point that in “one sense agricultural Siam under the old system is in a vicious circle. More money means more rice, and more rice means more irrigation, and more irrigation means more mosquitoes and more malaria. This circle can be broken by expanding a dry agriculture on the higher lands in the center and in the edge of this scoop which is central Siam.”<sup>57</sup> Lacking more specific information, it is probable that large areas of the Central Plain suitable for rice remain uncultivated, and that still more land in other parts of the country is undeveloped. But there are indications that it would be more

<sup>55</sup> Samuel Van Valkenburg, “Agricultural Regions of Asia. Part III, Farther India,” *Economic Geography*, January 1933, IX, 8.

<sup>56</sup> See Zimmerman, *Siam: Rural Economic Survey, 1930-31*. For example, in discussing the agricultural situation by regions within the country, the author states that in the northern section of Thailand “the land which is really fit for rice farming is relatively small in area compared with central Siam” (p. 141), but he also indicates that much “good land is uncultivated or poorly cultivated” (p. 287). In the northeastern section, where practically all agriculture is irrigated, crops other than rice are not developed (e.g., cotton, tobacco) “although much of this land is not suited for rice production” (p. 294). In the mountainous southern section only “a small area is fitted for rice farming and much of that is uncultivated. . . . Irrigation work . . . will help to increase the area available for rice farming . . .” (p. 158). But “this southern section [should] be utilized more for other crops than for rice . . . rubber, coconut, palm oil, cocoa, cassava . . . for the present population there is still a good deal of vacant rice land” (p. 159).

<sup>57</sup> C. C. Zimmerman, “Some Phases of Land Utilization in Siam,” *Geographical Review*, July 1937, XXVII, 392.

desirable to use such land for purposes other than rice growing.

Turning now to the other surplus producer, perhaps even greater potentialities exist for expansion of the rice acreage in Indo-China than in either Burma or Thailand. In some of the western provinces of Cochin China, and in Cambodia, large tracts remain uncultivated, probably because of inadequate irrigation and sparsity of population.<sup>38</sup> When rice prices have been high, there has apparently been a spread of cultivation to poorer lands in some parts of the country, as in Burma.<sup>39</sup> The area in Indo-China that could be developed for rice through improved drainage, irrigation, communications, and additional settlement is probably large enough to expand the colony's rice output materially should necessity arise or conditions justify this development.<sup>40</sup>

Indo-China is a country of sharp contrasts. The higher, hilly regions are comparatively unused and sparsely settled, while the low, flat delta lands are fairly intensively cultivated and support sizable concentrations of population. Forests have been cut over and the land cleared by burning, as in some parts of northern Thailand. When the soil is exhausted or the fuel supply runs out, the fire farmers move on, leaving a denuded countryside.

Rice is grown in both the north and the south of Indo-

<sup>38</sup> When the French arrived in Cochin China, the greater part of the soil was uncultivated and was mere swamp land. They undertook to create a network of canals which would serve both navigation and irrigation or drainage. According to government brochures, over 650 kilometers of main canals and 2,500 kilometers of minor canals have been dug, removing far more earth than the quantity dredged for the construction of the Suez Canal. The worst and most frequent droughts take place in Tonkin and in Annam, where vast irrigation works have been built and are still building.

<sup>39</sup> C. J. Robertson, "The Rice Export from Burma, Siam and French Indo-China," *Pacific Affairs* (Institute of Pacific Relations, New York), June 1936, IX, 250.

<sup>40</sup> The *Office du Riz*, created in Indo-China in 1930, and the work of the *Institut des Recherches Agronomiques* have been reported as bringing to light the amount of potential rice-land still unused, but we have been unable to secure specific information. Gourou (*L'utilisation du sol en Indochine française*, p. 149) estimates that the thinly populated portions of western Cochin China amount to about 15,600 square kilometers. It is here and in Cambodia that the possibilities for increasing rice production are best, but it will probably take 20 years to settle and develop the country. If this land were producing rice at the level of yields prevailing in the late 1930's, the exportable surplus of these areas would be over a million tons greater.

China, but in Tonkin and Annam (along the coast) not enough is produced for the needs of a rapidly growing and already dense population. Furthermore, in these areas climatic factors are less favorable and there has been no important expansion of the rice area. In the delta region of Tonkin and in parts of Annam two rice crops are grown annually, but droughts and floods are a more serious threat than in the southern part of the country.

The older provinces of Cochin China consume all the rice they grow, but in the newer western provinces, opened up by the French government, there is a surplus for export. Similarly in Cambodia, surpluses are grown and large areas remain to be developed. Much of this country now covered by forest was once extensively cultivated, as when Angkor flourished. Nothing is being done now to reclaim this region, and apparently no immediate plans have been made. One may travel many miles through the rice fields without seeing signs of human life—an experience quite unusual in most rice regions of Monsoon Asia. This is particularly true of the lower part of the Mekong delta, where the largest surplus is produced. The great disadvantage of the area—and this in part accounts for the low density of population—is the uncertainty of production from time to time caused chiefly by floods, as in the Menam delta region of Thailand.

In normal years, the upper part of the delta and the region around the great lake, Tonle Sap, produce a smaller surplus. The lake becomes a leading source of prosperity, supporting fishermen at one time of the year, and rice growers at another when the waters have subsided. Fish is an important element in the diet in this part of Indo-China and is consumed along with rice, which monopolizes the use of the land.<sup>41</sup>

Elsewhere the relatively low yields obtained in Indo-China have been commented upon. In less than 50 years, the French

<sup>41</sup> In recent years the plantation system of rubber growing has been introduced, especially in the area to the north and west of Saigon, but on the whole, crops like corn, tobacco, or cotton are poorly represented.

authorities have brought some 2 million hectares under farmland by means of canals and other types of irrigation projects. But progress has been slow in settlement and in obtaining a satisfactory supply of labor and of work animals, especially in southern Indo-China.<sup>43</sup> It is not surprising, therefore, that agriculture in these areas is not more intensive.

From time to time attempts have been made to make use of imported labor. Long ago Javanese workers were brought into the country, apparently with considerable success, but this movement came to a halt during the first World War and has not since been resumed.<sup>44</sup> On the whole, Chinese labor has been quite satisfactory but is expensive and transient. The Chinese prefer to migrate to Malaya where they can buy land or go into commerce. Rice growing in Indo-China has never offered the same opportunities for the immigrant laborer, especially the Chinese.

It seems clear that in portions of Burma, Thailand, and Indo-China a considerable but unmeasured amount of land suitable for lowland-rice culture is available for exploitation. Furthermore, there must be a vast amount of land suitable for upland food crops such as maize and cassava. But the improvement of this upland may be slower than the opening of new paddy lands, for malaria prevents the occupation of foothill country in many parts of the Indo-Chinese Peninsula, the Philippines, and the Netherlands Indies. The strip farming of paddy land seems to be a barrier, and unless development

<sup>43</sup> Without sufficient labor to practice more intensive farming the use of work animals is also restricted. According to a 1937 estimate there were about 2.3 million cattle and slightly fewer buffaloes in Indo-China for use by a population of over 23 million (U.S. Dept. Comm., Bur. Foreign and Domestic Commerce, *Foreign Commerce Yearbook*, 1938, 1939, p. 322).

<sup>44</sup> According to Virginia Thompson (*French Indo-China*, New York, 1937, p. 151), an "article comparing Javanese labour favorably to the Chinese, . . . had early awakened the Cochinese planters' interest. The Javanese were good and steady workers, though less robust than the Chinese. Their labour output was smaller, but they attached themselves more to the soil, were more easily disciplined, and totally without that commercial aptitude that made the Chinese a problem. The Dutch government naturally opposed their wholesale migration. In 1906 Indo-China contrived to get official consent to importing Javanese labour under certain conditions. The experiment proved highly successful . . . The War, however, changed the willingness of the Dutch to permit labourers to leave Java."

is started by a whole community at once, the farms of the few pioneers attract all the pests in the locality, conditions of living become bad, people die of malaria or become discouraged and finally withdraw to the settled lowlands.

Government activities will be important, as they have been in the past, in opening up the remaining lands for settlement and rice culture. Conditions are apparently such that the potentialities for expansion of rice acreage cannot be realized on a significant scale by the individual efforts of pioneers, but must be fostered and supported by government planning, organization, and financing of the necessary community improvements.

#### AVAILABLE LANDS IN ADJOINING AREAS

Remaining for consideration are rice areas, or potential rice areas, in Malaya, the Netherlands Indies, and the Philippine Islands. Some geographers have grouped all of these regions together under the name Malaysia, and with some justification.<sup>44</sup> All stages of development are illustrated here and despite the relatively limited areas of favorable relief, drainage, soil, and climate, there is undoubtedly much room for expansion of the cultivated land area, particularly in the islands. The serious handicaps to agriculture, however, are the coverage of dense tropical forests and the sparseness of settlement which means an insufficiency of labor.

The Malay Peninsula itself need not detain us long. Although only a small proportion of the total land area is under cultivation, judged by temperate-region standards, Malayan soils are poor. "Their fertility in Malaya depends on optimum conditions of temperature and rain, and on the intensive weathering always rendering small amounts of plant food available."<sup>45</sup> A large part of the Peninsula is covered with dense forests, but few of its trees are commercially

<sup>44</sup> See especially, Samuel Van Valkenburg, "Agricultural Regions of Asia. Part VIII, Malaya," *Economic Geography*, July 1935, XI, 227-46; and October 1935, XI, 325-37.

<sup>45</sup> Grist, *An Outline of Malayan Agriculture*, p. 6.



important. Climate and soils are well suited to estate-rubber cultivation, however, and the development of the rubber and tin industries has greatly overshadowed rice growing, purely a native Malay pursuit.

In 1939-40 a little over 790,000 acres were under rice in British Malaya, an all-time high. Production has increased greatly in the past two decades, but roughly two-thirds of the country's rice requirements must still be imported. A decade ago it was estimated officially that potential paddy lands not already alienated in British Malaya amounted to 600,000-1,000,000 acres.<sup>44</sup> Since then over 100,000 additional acres have been brought under rice, but a considerable potential remains.

Despite strenuous efforts now being made to enlarge local rice production in Malaya, no responsible government official considers the prospect for complete self-sufficiency very good. The immediate objective, and one practicable of attainment, seems to be to supply 60 per cent or more of consumption requirements from domestic production. The limitations to rice expansion are well recognized, and, in normal times, the exploitation of the country's principal export industries is preferable economically. Unlike Java, Malaya is not situated both to promote export crops and to produce sufficient food for native inhabitants and foreign labor.

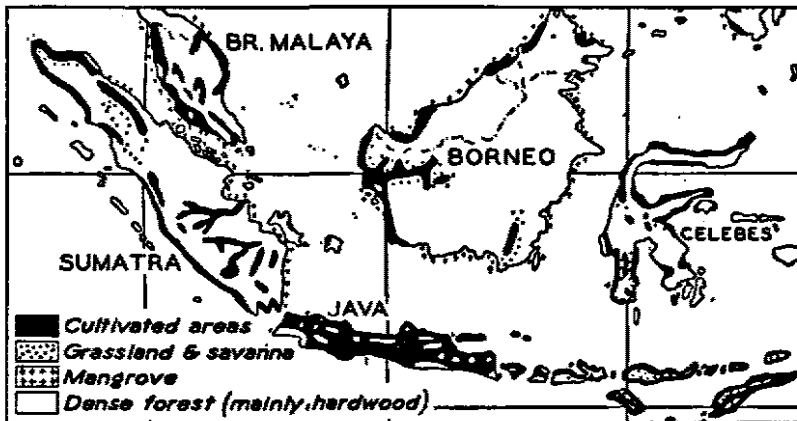
The population of the Netherlands Indies has been increasing rapidly for many years, particularly in Java. Since the turn of the century, the Dutch authorities have followed a policy of encouraging native production of foods along with the development of export crops. As pointed out earlier, the result has been a constantly decreasing dependency upon outside sources of supply. Still the islands are not completely self-sufficient in rice, and in Java, one of the most densely cultivated regions in the world, very nearly all of the available ricelands are being utilized. Other food crops have

<sup>44</sup> Federated Malay States, *Report of the Rice Cultivation Committee*, I, 20.

expanded in area more than rice. In order to add much to the paddy area it would be necessary to displace other crops.

The Outer Provinces of the Netherlands Indies, like some of the islands of the Philippine group, would seem to hold considerable promise for bringing in new ricelands. Map 8

MAP 8.—LAND UNDER CULTIVATION IN THE NETHERLANDS INDIES AND MALAYA\*



\* Modified from *Economic Geography*, July 1935, XI, 243.

shows how relatively small a proportion of the total land area is cultivated, especially when comparison is made with Java. At present most parts of these islands are so thinly populated that full use cannot be made of the undeveloped portions. During recent years, the Dutch government has been encouraging and subsidizing migration from Java to tracts selected for colonization in the Outer Provinces, but to date this movement has not assumed large enough proportions to relieve the population pressure in Java or to provide a labor supply for a very wide extension of agriculture in the Outer Provinces.

Development of crops in Sumatra has, however, been very rapid and one may confidently expect a continuation of present trends. Only since the first World War has Sumatra's develop-

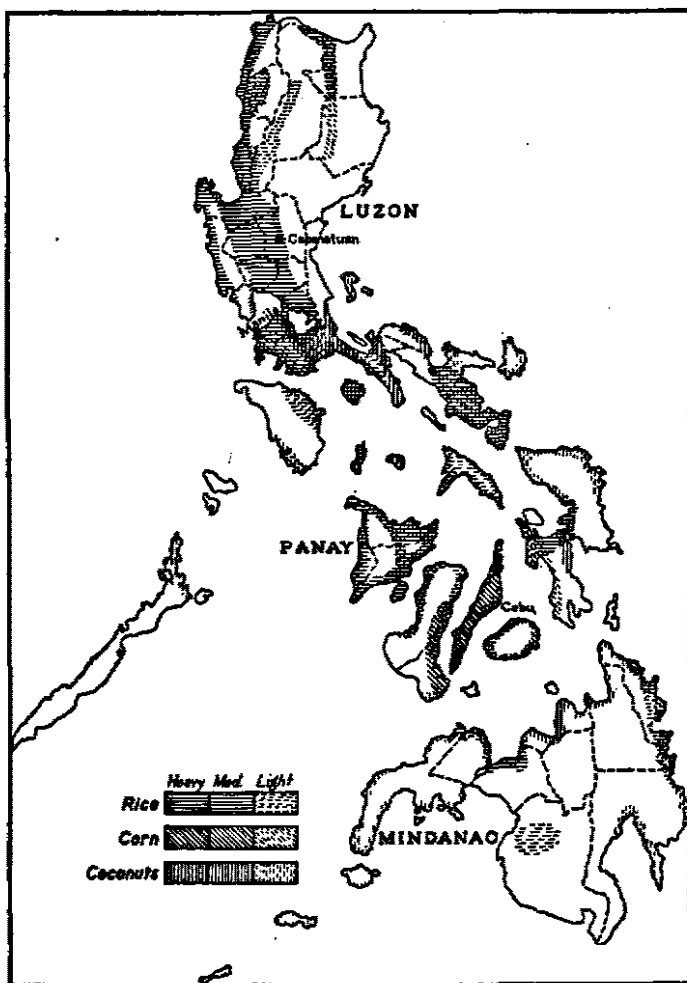
ment been pushed vigorously, principally through the establishment of plantation agriculture—rubber, tobacco, coffee, tea, and palm oil. On the west coast of Sumatra productive paddy lands are now being cultivated, but establishment of ricelands has generally been more difficult than in Java.

In Borneo agricultural development has been much slower. Except for the coastal regions, the island is covered with a dense tropical forest. Agriculture is well developed in parts of Celebes and there is abundant room for further expansion. Many other islands of the group offer opportunities for expansion of paddy lands. But so little information of a statistical character is available that one can only guess as to the potentialities. Bali, Lombok, and Celebes produce more rice than they need and have a surplus for export to other islands of the Outer Provinces, and since about 1936 Java has also produced a modest surplus for export to these areas. But even so, in 1938 the Outer Provinces imported over 300,000 tons of cleaned rice.

Numerous conditions must be fulfilled for utilizing any of the tracts of land that may be found in the outlying islands of the Netherlands Indies. Private capital alone probably is not enough for opening up such regions. Government-sponsored efforts are needed, communications must be developed along with plans for making waste or forest useful for cultivation, and above all some cash export crops or extractive industries must be started to support the new colonization, for rice growing itself does not now offer sufficient incentive for state development. So long as food needs can be met in other ways, there will be no urgency about extending the area under paddy in outlying possessions beyond the point necessary to support the local population.

Directing attention now a little farther to the north, one notices from Map 9 that rice in the Philippine Islands is quite heavily concentrated in the provinces having pronounced wet and dry seasons—central and northwestern Luzon, and the western parts of the islands of Mindoro, Panay, Negros, and

MAP 9.—CONCENTRATION OF CHIEF FOOD CROPS IN THE PHILIPPINE ISLANDS



Palawan. Here a single crop of rice is grown except in a few places provided with artificial irrigation. Other regions of the Islands, with a climate characterized by no dry season but a pronounced maximum rainfall (about 71 inches) also produce rice—sometimes two crops—and are located chiefly

near the Pacific Coast toward the southwest in Tayabas and the provinces in the Bicol Peninsula in Luzon, and in eastern portions of Mindanao, Leyte, and Samar Island.

Two decades ago it was estimated that the rice-producing area of the Philippine Islands could be increased by at least 55 per cent.<sup>47</sup> Since then the area harvested has increased by over one-third. A recent publication<sup>48</sup> states: "Considering that there are large tracts of land still available for rice cultivation, notably in Cotabato, the Bicol Provinces, Nueva Vizcaya, Samar, etc., it will be only a matter of time when the entire need of the population will be adequately met with."

Some of this territory appears to be well adapted to rice culture, but is not as yet settled with enough people to provide a labor pool, and efforts to encourage migration have not met with universal success. The government has sponsored settlement schemes, some of which are now beginning to show results. For example, in Cotabato, paddy production increased from 850,000 to 1,800,000 cavans between 1934 and 1936, largely the result of crops produced by new settlers.<sup>49</sup> "While there is no reliable figure . . . it may be held certain that not more than 40,000 hectares are dedicated to it [rice] at present. This area is still very insignificant, taking into consideration the whole area of not less than 300,000 hectares which can be devoted to rice. . . ."<sup>50</sup>

Out of a total land area of some 29.6 million hectares in the Philippines, government estimates are that 14 million hectares can be converted into productive agricultural farms. "There are still thousands of hectares of idle land which are awaiting occupation and exploitation. Mindanao . . . has truly been called the 'Land of Promise.' . . . if the total area available for agricultural purpose can be fully developed, the same can easily support a population of 50,000,000

<sup>47</sup> Hill and Moe, *The Rice Industry*, p. 163.

<sup>48</sup> Philippines Dept. Agr. and Comm., *The Rice Industry in the Philippines*, pp. 17-18.

<sup>49</sup> According to the 1936 Annual Report of the Provincial Governor, and reported in B. C. Lopez, "Need for Production Control," *NARIC Service Recorder*, July 1938, I, 7.

<sup>50</sup> *Ibid.*, I, 7.

people, on the basis of the present standard of living."<sup>21</sup> Even discounting such statements somewhat, it seems that the Philippine Islands, when compared with a region like Java, are undeveloped and possess good possibilities for extending the area under rice.

Rugged topography and lack of rainfall are about the only limiting factors. The second does not seriously interfere with cultivation and the first can be overcome. One of the most spectacular examples of surmounting the obstacle of rough terrain is to be found in the mountains of northern Luzon where the famous Igorot rice terraces are located. The exceedingly elaborate terracing of steep mountain slopes in this region is explained, of course, not by any present need but by the history of tribal warfare of generations past. No such natural obstacles prevent the general growth of ricelands in many of the islands whenever conditions justify the spread of cultivation. Although rice is the leading crop of the Philippines, the coconut, corn, tobacco, sugar, and abaca crops are also important and provide a diversification in agriculture not found in the districts of the neighboring mainland countries to the west.

The thousands of islands lying off the southeastern portion of the Asiatic continent, principally the Netherlands Indies and the Philippines, are old in history, but with a few notable exceptions are not densely populated or developed to their full potentialities. Obstacles to settlement are many and obvious, but it has been demonstrated that they can be overcome. Much of the land is fertile and can be converted to lowland-rice culture or opened to upland farming under appropriate conditions. Like the undeveloped portions of the Indo-Chinese Peninsula, these islands represent physical potentialities for expansion of rice acreage and additions to the rice supply of Monsoon Asia. The limitations to the realization of the potentialities are largely economic, as is the case

<sup>21</sup> Philippines Dept. Agr. and Comm., *Land Resources of the Philippines* (1939), p. 4.

almost everywhere, but perhaps they are greater here than elsewhere, and progress toward overcoming them may well be slower.

#### CONCLUSIONS ON POTENTIALITIES FOR RICE EXPANSION

Enough has been said in foregoing pages to indicate that in generally densely populated Monsoon Asia it is physically possible for a considerable expansion to occur in the aggregate rice output. Our discussion has of necessity been highly speculative; nevertheless one gains a concrete, though very inexact, impression of potentialities that seem to lie principally in an improvement of existing rice yields and, secondarily, in an extension of rice areas. Of the numerous methods for increasing productivity, scientific seed selection and the use of appropriate fertilizers stand out as offering the greatest promise for enlarging unit yields. And the most notable potentialities for expanding rice acreage—by the use of suitable land not now productively employed and by the more intensive use of present rice fields—appear to be in southeastern Asia and the adjoining islands.

Assuming for the moment that it would be a desirable thing to do, some additional land in Monsoon Asia could be made available for rice cultivation by a re-allocation of land use. It is probable, however, that the expansion in rice acreage that might conceivably result from a displacement of other crops would not be large. In only a few countries are there lands almost equally well suited to rice and other crops. Excepting sugar, the typical plantation crops of southeastern Asia and adjoining islands compete very little with rice for land use; they are commonly grown on upland not suitable for irrigated rice. Other cereals, tubers, and vegetables, when grown on irrigable land, are grown mostly during the dry season, cassava possibly excepted.

In Java a sizable part of the riceland is leased each year to European concerns for sugar production. Rice production might be increased considerably if Java ceased to export

sugar. If world sugar prices dropped so low that less cane was grown or exported, a corresponding area would be released for rice. Something of this sort happened during the depression of the 1930's in Java and in the Philippines, and probably such shifts have occurred elsewhere. Similarly in Taiwan, land now producing sugar cane could be diverted to augment the area under rice. In fact, the most recent Japanese plans for Taiwan call for just such a shift in land use.<sup>82</sup>

Rice production might also be increased by growing an additional rice crop on land now used for some other crop. The opportunities in this direction do not seem especially promising, as second and sometimes third crops are already being grown where climatic conditions are favorable. Attempts to grow paddy out of season have generally not been successful. Along the Perak River in the Federated Malay States experiments were conducted with a view toward growing paddy between January and July (normal season July-January) but the crops harvested were not considered satisfactory.<sup>83</sup> Similar efforts to grow a second rice crop in the Philippines have also been unsuccessful.<sup>84</sup>

In some parts of China and India additional crops could be grown, but it is doubtful whether over a period of years much increase in total rice output could be effected, for the land needs even more fortification than it now receives from short periods of rest. A more promising development in such

<sup>82</sup> See p. 277. Before the short rice supplies of 1939-40 had developed, the Japanese government had planned for Taiwan over the next ten years the following increases in yields: rice, 19 per cent; sugar cane, 21 per cent; cotton, 38 per cent; sweet potatoes, 48 per cent; jute, 60 per cent; ramie, 77 per cent; and castor beans, 300 per cent. O. L. Dawson and W. Ladojinaky, "Recent Japanese Agricultural Policies," *Foreign Agriculture*, June 1939, III, 272. Despite temporary abandonment of the program of agricultural diversification in Taiwan, this may well remain the objective over the longer term.

<sup>83</sup> See "An Out-of-Season Trial with Padi in Connexion with the Perak River Pumping Scheme at Bota and Lambor Kanan," compiled by J. L. Greig, *Malayan Agricultural Journal*, July 1939, XXVII, 271-79. Experiments were conducted over two seasons, deficiency in rainfall being made up by providing irrigation through a pumping scheme. No basis was provided for such a conclusion, but it is suggested at least that the influence of season may be more closely related to the incidence of pest than to a direct effect on the rice plant itself.

<sup>84</sup> See p. 249 n.



regions would seem to be an improved system of rotation or some crop rotation where none is now practiced.

But these additional possibilities would seem to be of minor importance in comparison with all of the other means physically available, but not necessarily feasible, for adding to the rice supply. The potentialities for rice production in parts of the world outside of Monsoon Asia should not be completely overlooked, although at the moment it is rather difficult to visualize their significance to the food-supply problems of the Orient.

Some 60 countries or colonies in other parts of Asia, Europe, Africa, North and South America, and Oceania are currently producing small quantities of rice wherever favorable conditions prevail. The aggregate production of all of these areas is small in comparison with the total of world rice production (about 5 per cent), but it is a reasonable assumption that in the numerous places where rice is already being grown there are opportunities for further expansion.<sup>55</sup>

There are wide areas in the Americas and in Africa where conditions of temperature and seasonal rainfall seem suited to the requirements of the rice plant. The absence of rice from such regions seems explicable partly in terms of topography and soil, partly in terms of historical origins, cultures, and densities of populations, and partly in terms of agricultural alternatives and stages of economic development.<sup>56</sup> But there is probably no important place where production costs are, or could be, low enough to warrant an expansion in output for

<sup>55</sup> Cuba, for example, grows little rice but imports more than 95 per cent of her requirements, partly from the southeastern Asiatic export areas. The U.S. Department of Agriculture ("Cuba Strives Increased Rice Production," *Foreign Crops and Markets*, May 25, 1940, p. 670) estimates that if "capital were available for preparing the land, the area suitable for rice cultivation could be increased by more than 100,000 acres." Another 30,000 to 50,000 acres of suitable land is now held unexploited by the sugar companies.

<sup>56</sup> In the southern hemisphere, rice is not grown as far from the Equator as in the northern hemisphere. In Africa the present limit is at 26° S. on the east coast and 18° S. on the west. In South America rice growing reaches 34° S. in the east. In Australia rice cultivation has been extended as far as 35° S. It is entirely possible that in the future rice culture may be pushed beyond these boundaries, and further toward the earth's poles.

a mass market much beyond the needs of easily served neighboring areas of consumption. In the absence of any great threat of a world food shortage, the sweeping generalities sometimes made by writers about the potentialities for increasing the supply of important food crops become quite meaningless.<sup>57</sup>

It is clear that there is available for rice growing only a portion of the world's land surface that may still be unappropriated for agriculture. Earlier chapters have set forth the requirements for successful cultivation and the reasons why rice production and consumption are concentrated as they are in Monsoon Asia. It seems highly probable that only the potentialities for rice expansion that exist in Monsoon Asia have significance for the food position of Oriental countries, and that even these physical possibilities may have limited bearing upon the near-term prospects in the rice economy of Monsoon Asia, discussed in the following, concluding chapter.

<sup>57</sup> For example, there "is every reason to believe that the world can double, triple, quadruple, and still further multiply its rice crop . . ." J. R. Smith, *The World's Food Resources* (London, 1919), p. 105. The author, however, does not repeat this statement in his 1925 edition of *Industrial and Commercial Geography* (New York).

## CHAPTER XIII

### TRENDS IN THE ASIATIC RICE ECONOMY

Many and varied forces are at work tending to alter the rice economy of Monsoon Asia. All of them are characteristically slow moving; some are measurable despite inadequacies of the statistical record, while others are obscure or difficult to evaluate. Observations covering the past two decades suggest tentative answers to a number of questions raised in the foregoing chapters. More securely founded conclusions as to prospects must await better indications of the type of world order that will emerge from present wars in the East and the West.

It is difficult to overrate the importance of rice in Monsoon Asia. This single crop continues to dominate agriculture almost everywhere except in regions with an unsuitable climate; rice is therefore preponderant in the economic life of most countries which are largely agricultural. And this is a situation not readily changed. Even though industrialization may proceed apace in parts of Monsoon Asia, and even though plantation agriculture may be further extended upon the restoration of more favorable economic circumstances, the pressure on the food supply is such that for a long time to come vast areas must be reserved for rice growing. Though conceivably more productive combinations of rice and other food crops may yet be found, no other crop can at present take the place of rice in land utilization and contribute so much to the total food supply.

Nor, within the foreseeable future, is any other food likely to displace rice from the dominant position that it has held for centuries in the diet of Asiatic peoples. Millions of the inhabitants of the rice world still live largely in a subsistence economy where family groups cultivate the land by methods little changed over the generations, and consume the greater

part of the crops they grow. For both economic and social reasons, per capita consumption of rice will undoubtedly continue at a high level for a long time to come.

Over the past few decades, however, population growth has been more rapid than the expansion of the area devoted to rice and the increase in yearly production, with the result that per capita consumption has fallen rather generally throughout Monsoon Asia. Though the evidence is not conclusive, there appears also to have been both a quantitative and qualitative deterioration in the diets of huge numbers of people. Cheaper substitute cereals have been and are consumed where they are available, as have various other foods, but there still seems to be need for larger total food consumption by millions whose present calorie intake appears subnormal to a degree that is no longer common in the Western world, at least in times of peace.

Unlike the situation in important parts of the wheat world where levels of consumption have generally risen, many groups are prevented from eating more rice not because of diversification of diet, but because of inadequate producing and purchasing power. Japan Proper (until recently) has been about the only important exception. If population pressure on the land, already strong, continues to grow, and if expansion of the aggregate rice output can be effected only with difficulty, the question of the future adequacy of food supply may be raised for rice in Monsoon Asia more appropriately than it was for wheat by Sir William Crookes in 1898.

This is not to say that famine will face millions of people. The pressure created by numbers alone exerts itself gradually. But increasing pressure upon food resources taxes man's ingenuity in making adjustments, and under certain conditions the result is a gradual lowering of consumption levels. This, apparently, is what has been happening on a large scale in Monsoon Asia during the past decade or so.

The relationship between food supply and population is of special importance because of its bearing, real or imag-

inary, upon the causes of war. "Overpopulation" and "population pressure" are often advanced as forces that largely explain international conflict. Probably their actual importance is commonly exaggerated, but it seems reasonable to assume that gradually rising planes of living are conducive to peace as well as fostered by it. That other factors are also involved in the aggressiveness of nations is nowhere better illustrated than in Monsoon Asia with its several important areas of so-called "population pressure."

Our survey of the physical potentialities within Monsoon Asia suggests that Asiatic rice-growing countries have the inherent capacity for meeting the needs of future populations. In order to realize these potentialities, however, economic conditions must favor action on many fronts; and, in the absence of such conditions, one may expect a continuation of tendencies toward restricted levels of consumption and subnormal planes of living for a large if not increasing proportion of the population.

Economic circumstances, in turn, are substantially influenced, if not determined, by public policies of many nations. The political environment of coming decades, therefore, will be of first importance in the solution of the major problem of food supply. Hence it would be futile to discuss prospects for the continuation or modification of present trends in the rice economy without giving some consideration to the future political complexion of Monsoon Asia.

One can be reasonably certain that the period of readjustment following present wars will bring important changes, will be confusing and painful, but will permit some operation of normal economic forces, whatever the political regime provided that it is sufficiently stable. The natural resources of Monsoon Asia that have been most fully exploited would be of limited value to any controlling power that did not have access to the principal world markets. Products of mines and tropical plantation industries find their chief outlets in highly industrialized countries, such as the United States, where

substitutes would be found if political obstacles hindered the free flow of exports. Such commodities as rubber, tin, and silk cannot continue to be important sources of wealth to the producing countries unless buyers continue to be found outside the Far East. Furthermore, conditions must also favor a free flow of capital into the undeveloped portions of Monsoon Asia if their potentialities are to be realized in the not too distant future.

#### PROSPECTS UNDER FAVORABLE ASSUMPTIONS

Under the most favorable set of economic circumstances over the next 10 or 20 years—with real peace as distinguished from an armed truce, and political stability secured without ruthless coercion—one could reasonably expect certain things to happen. A reversal of the recent trend toward economic nationalism and a rise of a semifree trade regime would be a most important development. The investment of Western capital would probably be resumed and tend to increase; plantation agriculture would go forward where it is already established, as in the Netherlands Indies, Malaya, Ceylon, the Philippine Islands, and to a lesser degree in the Indo-Chinese Peninsula; and the tendencies toward industrialization (including the development of communications and transport) would proceed in Japan, China, India, and to a lesser extent elsewhere.

Such developments would mean certain shifts in population, with a larger proportion outside of subsistence agriculture—on plantations, and in mines, factories, and commerce. Many farm laborers having no alternative today would find employment outside of agriculture with resulting enhancement in their capacity to buy. So long as there are world markets to absorb the output of the enterprises that may be developed in Asia, the industrialization should tend to raise general planes of living in the countries concerned.

With continuing expansion of plantation economies and further industrialization, the present rice-import deficits of

India, Japan Proper, British Malaya, Ceylon, and the Netherlands Indies would tend to increase. China's imports of rice would probably return at least to the level of the 1920's until her internal development had proceeded further. The Philippine Islands would undoubtedly supply their own needs. Growing deficits among the net importers could probably be met by present producers of surpluses—Burma, Thailand, French Indo-China, Chosen, and Taiwan. However, in time, Japan Proper might be required to draw regularly upon sources other than Chosen and Taiwan. ①

The major exporting countries of the Indo-Chinese Peninsula should be the better able to meet growing deficits in other parts of Monsoon Asia by reason of a drying up in demand from non-Asiatic sources. Before the depression of the 1930's, the trend in demand from Europe and elsewhere was downward, as expansion in output of varieties more acceptable to these markets took place in other parts of the world. Abnormal conditions during the depression years temporarily interrupted the trend, but it is reasonable to expect its resumption as non-Asiatic sources of supply increasingly serve the Western markets. Further expansion of rice output may be anticipated in the surplus-producing regions of the Americas and Africa.

Under the assumed conditions of peace and political "reasonableness" that would contribute to the economic development of important sections of Monsoon Asia, one could expect an increased demand for rice from various sources. Rice prices, though not so clearly the purchasing power of rice, would tend to rise. The consequences in many places would be a stimulation of acreage expansion. But acreage and production of other food crops would also be stimulated, especially crops like maize, cassava, and sweet potatoes. As upland crops, these are even now probably in the process of expanding in some places, although the trend in this direction is not of long standing except perhaps in Java.

If there should be a continued development of plantation

agriculture, as assumed, the hill country would import more rice from the plains than in the past, and per capita consumption would presumably increase. The growth of industrial areas would likewise act as a stimulus to per capita rice consumption, at least in the beginning. In time, rising levels of real income would act in the opposite direction, as circumstances permitted greater diversification in the diets of industrial workers. With an increasing general level of prosperity, the consumption of all foods, other goods, and services would doubtless increase, in time elevating the growers' planes of living also. Their per capita rice consumption might then rise, even in the surplus-producing regions.

From a dietary standpoint such changes might not all be beneficial. The urban dweller in an industrialized area would probably have little difficulty in securing a variety of foods that would provide necessary balance and protection, and his willingness to modify habits would doubtless be greater than if he had remained on the farm. But the rural worker transplanted from a village to a plantation environment might suffer a qualitative deterioration in his diet despite his greater prosperity. This has happened before, in southeastern Asia as well as elsewhere. When forced to do so by lack of employment, the peasant grows fresh produce on his own small holding and thereby unconsciously provides a factor of safety; when employed, he not only neglects the vegetable plot, but indulges his preference for highly polished rice, thereby lowering his general resistance, if he does not actually fall prey to a recognized deficiency disease.

Offsetting such adverse developments, which are perhaps inevitable with change, are the advantages frequently gained by farmers finding alternative employment in the cities, the relief from overcrowding in agriculture in localities where farming is a matter of getting employment rather than of making profit, and, for the plantation laborer, the opportunity to learn effective cultural methods even though they apply to crops other than rice. But it is not likely that rice



cultivation would or could be abandoned on an extensive scale. Rather, the situation in general would be that more mouths needed to be fed, but that fewer farmers were available to produce the necessary food. This, in time, would be reflected in prices and would encourage the improvements needed to enlarge the rice output. The introduction of many such improvements would depend upon an adequate supply of capital and credit. ✓

The average rice grower of Monsoon Asia probably does not possess more than one draft animal and a few crude pieces of cultivating or harvesting equipment, commonly of his own workmanship. Some farmers produce chiefly for the needs of their own families with just enough surplus to pay taxes; some have no surplus and must borrow, going more and more into debt; others have a marketable surplus. Some can use their land in growing various crops in succession or simultaneously; others cannot. Although there are an infinite number of variables in production—in soil, weather conditions, amount and type of labor needed, yields obtained, irrigation water available and its cost, taxes and rent, and so on—capital, or credit in some form, would undoubtedly make improvements feasible in most cases. ✓

Tools require fluid capital for their purchase and, since many natives have almost no capital, the introduction of better cultivating tools and machinery is of necessity slow. Largely for this reason, native growers are commonly able to cultivate only the best land and to grow only heavy-yielding crops that will furnish enough food to support a family. If land must be spaded or prepared with a hoe, no more than a small area can be farmed. Rice, grown on irrigated paddy fields, is almost the only crop that will furnish enough food to support the cultivator's family with the primitive means of cultivation at his disposal. Until more capital is available for better tools and more draft animals or machines, rice will remain the dominant food for many regions and also the dominant crop, and much land will remain uncultivated. ✓

Any important increase in capital investment in Asiatic enterprises would bring greater emphasis upon management, and stimulation to technological progress. At first such developments would have little effect upon rice growing; later they would mean increased demand from centers of nonagricultural activity. This demand would tend to increase prices to rice growers who, upon possibly finding rice culture more profitable, would have an incentive for improving cultural methods through the use of better seed and equipment, more fertilizer, and so on. There would also be a profit inducement to extend the area under rice and other crops, and to increase the productivity of present fields by growing additional crops.

All such developments would permit what may be considered a "substantial" expansion of the rice output, land could be put into the cultivation of commercial crops, and greater industrial development would tend to relieve overcrowding in agriculture. These events might lessen if not resolve the present apparent difficulty of population growth outstripping expansion in food resources unless, indeed, they served to overstimulate population growth itself. But even under the most favorable conditions, this more hopeful outcome can hardly occur without serious maladjustments. And the necessary adjustments will fail to occur, or will be slower, as the economic and political environment is less favorable than here assumed for the sake of exposition.

#### PROSPECTS UNDER UNFAVORABLE ASSUMPTIONS

If peace should come with important territorial changes in Monsoon Asia, or if the peace should be, in effect, an armed truce, one could not expect the capital necessary for development to flow, except slowly, or the many existing restrictions to trade to disappear. Certain parts of the rice economy might be exploited more vigorously than heretofore, under government pressure and new management, but it seems unlikely that much could be achieved for Monsoon Asia as a whole. Even if territorial changes could be considered as approach-

ing an "ideal" distribution, there would be an interruption or slowing down of development processes, at least temporarily, until the stability of the new political regime could be more or less definitely established.

Nor is it likely that artificial barriers to commerce could long entirely prevent the movement of food supplies within the Asiatic region. Only a relatively small restriction of trade, however, may be sufficient to bring severe hardship and even starvation in parts of those countries unable to produce their home food requirements. A nation's ability to feed itself depends upon both the raw foodstuffs grown at home or imported from abroad, and upon the various services through which these are made available for consumption.

For the rice-importing countries, it is not only the availability of foreign surpluses and the prices that must be paid, but also the uncertainties of government export policies and the services of transport during periods of disturbed political conditions, that render such nations vulnerable and anxious to escape possible embarrassment by decreasing their dependence upon outside supplies. As efforts to increase the degree of regional self-sufficiency are successful, the areas producing rice surpluses suffer through a contraction of markets and a fall in rice prices.

Continuation of the strong tendencies toward economic nationalism that became especially marked after the depression of the early 1930's would accentuate the weakness of Burma, Thailand, and Indo-China, all heavily dependent upon rice exports. Depression adjustments of neighboring rice-importing areas have already emphasized the vulnerability of countries with monocultural agriculture. For example, when Java entered into an international control agreement in order to assist her sugar industry, rice production was expanded on former sugarlands and the need for rice imports was reduced. India embarked upon a policy of tariff protection for her own sugar industry, and the exchange between Burma and Java of rice and sugar was greatly discouraged. Similar adjustments

on the part of other rice-importing countries have adversely affected all of the rice-exporting nations. A continuation of the trends of the past decade would mean that outside markets for rice would tend to disappear, and, unless alternative means could be found for maintaining present levels of living, the peoples of the Indo-Chinese Peninsula would be forced back into an even more primitive type of existence.

Attempts to diversify agricultural output in the rice-surplus producing countries would have beneficial effects in so far as this resulted in changes in consumption for the local population, but the most likely export crops that could be grown would be competitive with the already well-developed plantation industries of neighboring regions. And before the abnormal requirements for war, supplies of tropical products were generally ample for meeting the demands of world markets, already shrinking under a wave of protectionism.

There has been some tendency to promote crops other than rice and to establish light industries in the rice-exporting countries, and conceivably their position might be improved over the longer period by a continuation of these tendencies. But such development is not likely to occur except under more favorable economic conditions. Even if progress were made under our unfavorable assumptions, it would mean reduced import requirements or additional competition in other spheres of export. Such adjustments tend to increase the cost of moving such goods as continue to be traded, and so maintain the incentive for the one-time rice-importing regions to adhere to policies of economic nationalism. Whether or not Burma, Thailand, and Indo-China are content to continue to be primarily exporters of rice and importers of finished goods, they can do little to change the basic conditions.

If, however, some of these countries should come under the political influence or control of more powerful nations, it is quite probable that they would continue to sell their rice within the economic bloc of which they were then a part, and absorb, in return, goods and services provided by other units

more advanced industrially. This would amount to the old system of free trade, but within the bounds of a circumscribed world within a world.

That policies of economic nationalism tend to bring greater and greater demoralization of international trade and a reduced plane of living for all peoples involved seems reasonably clear. In a peaceful and orderly world, it is politically feasible to acknowledge the evils of such policies, and not impossible to moderate them. Continued uncertainty, however, seems to make adherence to such policies obligatory. Presumably the time will come when drastic changes in attitude will be forced upon those responsible for the formulation of national policies. We cannot say when this will occur. Changes in the political composition of Monsoon Asia following the termination of present wars might readily result in a rather sudden shift and re-orientation, completely reversing the tendencies of the past decade or more. On the other hand, many years may elapse before a gradual readjustment takes place.

#### OUTLOOK FOR THE RICE SUPPLY

Actual developments in the rice economy of Monsoon Asia over the next few decades must therefore remain a matter of much conjecture. The temptation is always strong to suggest that events will take a course somewhere between the most favorable and the least favorable assumptions. But it is quite conceivable that either extreme will come closer to the facts when they are known. A decade passes rapidly and may leave only a slight imprint upon the Orient. On the other hand, many things suggest that a setting is being provided for much more rapid change in the future.

Whatever else happens, the factors affecting crop yields and birth and death rates will be modified but slowly; the serious problem of food supply and population will remain something basic and inescapable. Although opportunities exist for increasing rice yields and bringing additional lands

under crops, even in a part of the world where intensive forms of agriculture are common, an expansion large enough to reverse the tendency of the past few decades for population growth to outstrip rice production is not a near-term prospect under any circumstances, aside from accidental elevation of levels of yield over periods of a few years.

There is no particular reason for anticipating a marked early improvement in yields or an extension of the area devoted to rice in countries not under pressure to become self-sufficient, or in areas of surplus production unless there is a considerable increase in effective demand from foreign countries. In the principal net-importing countries, however, population pressure will make necessary considerably larger rice supplies than have ever been produced thus far.

One can expect little of the increase in output needed to arrest present tendencies to come from China, Japan, India, or Java. These are all areas of dense population, where nothing in the record of the past few decades suggests that a further expansion in rice production can be easily effected. Merely to maintain the lower levels of per capita rice consumption of recent years would require enormous additions to the aggregate supply over a period as short as one decade. Only a few small surplus-producing countries seem to be in a position to expand their annual rice output fairly readily.

If, through specialization, the rice-surplus-producing countries of the Indo-Chinese Peninsula, which possess perhaps optimum conditions for concentration on rice production, could grow appropriate qualities of rice at substantially lower costs than now prevail in other Asiatic countries, the advantages of buying from these sources might eventually become apparent to present-day importing countries. It would seem to be more profitable for a number of such countries (e.g., the Philippines, Netherlands Indies, Malaya, and Ceylon) to import their rice requirements than to neglect alternative crops or industries for which they enjoy economic advantages not possessed by Burma, Thailand, or Indo-China.

Only programs of self-sufficiency in food supplies would defeat this development, and even these programs can be successfully pursued only if the cost is not too great. Despite the physical potentialities for rice expansion that may exist in some present rice-importing areas, it is not likely that within the foreseeable future they will be exploited beyond immediate needs.

It may be contended that the application of science to rice growing, as in Japan, would result in appreciably increasing production in the most populous countries where little opportunity remains for enlarging the planted area. With peace and a reasonably stable government, Chinese production of rice might expand with the development of higher-yielding varieties and improvement in cultural methods. Even if such progress were made—and no marked improvement can be anticipated in the near future—it would be under conditions of internal development that would affect the rate of population growth at the same time. Similarly, some opportunity for improving rice yields exists in India, but progress will be slow as long as Burma can make up India's deficiency at low cost—a situation which will doubtless continue until demand is less restricted from other parts of the Orient.

Under conditions of peace, Japan herself should be able to remain more or less independent of foreign-rice supplies, through a further extension of rice-growing techniques in Chosen, Taiwan, Manchukuo, and possibly elsewhere within the Empire. If dictated by economic and political exigencies, the Netherlands Indies could undoubtedly continue to decrease dependence upon outside rice supplies, but if postwar economic conditions are more favorable, there would seem to be a much greater incentive to continue development of already established export crops and industries.

Near-term gains and losses in rice production within Monsoon Asia, except under far-reaching changes that may possibly follow the war but cannot now be foreseen, would probably cancel each other, and not greatly affect the aggre-

gate rice situation. In other words, if the over-all economic and political pattern of Monsoon Asia were not radically different from that of the past quarter century, one might expect a continuation of present basic trends, at least for another decade.

However, in all of our speculation, we have been obliged to deal with a statistically unknown quantity of first importance in the rice situation of Monsoon Asia, i.e., China. What happens in China over the next few decades could have a most important bearing upon the Asiatic rice position, the rice trade, and the fortunes of the rice-exporting countries, or it could have hardly any significance at all. In the past, political unrest in much of China made it difficult for inhabitants of port cities to secure food supplies from the interior farming regions. They were therefore obliged to import from foreign sources. Before the war with Japan interrupted the development, improvements in transportation and rural-credit facilities began to make it possible, at least on a small scale, for surplus-rice producing areas within China to supply such deficit areas.

At any particular time millions of Chinese may be in want of sufficient food, and for many more the margin of safety may be small. Crop failures, floods, and other catastrophes may create hardships and starvation, but food shortages do not recur repeatedly in the same places, to the same people. Large portions of the Chinese population could not have continued to exist for centuries in a state of serious "under-nourishment." Poor domestic crops, floods, or low foreign-rice prices have stimulated imports in the past, but it does not necessarily follow that within China there was not somewhere enough food to feed all of the people. In other words, the internal development of the country, or the lack of it, has a most important bearing upon China's future dependence on the surplus-producing countries; but there seems to be no real reason why, with favorable conditions, China cannot eventually put herself on a self-sustaining basis in respect to rice.



If China were to cease altogether drawing upon the rice supplies of neighboring areas to the south, and if Japan were to do likewise—as well she might under conditions of peace—the pressure upon the available surpluses would be appreciably relieved. This would not greatly change the larger problem over the long term, but it would permit more time for adjustment. As already indicated, there seems to be no reason why the necessary adjustments cannot be made under a favorable political and economic environment.

Over a long period, a series of decades, one may expect that new lands will be opened to rice cultivation, old lands reclaimed, and yields further improved in response to or in relief of the pressure on food supplies. But perhaps the most important, and certainly the most unpredictable, element in the longer-term outlook is the technological development that may lie ahead.

Notable, but not spectacular, progress has been made over recent decades in the breeding of improved, higher-yielding varieties and varieties adaptable to conditions once considered quite unfavorable to rice culture. The production of fertilizers may be so developed as to make practicable their use in large areas not at present employing them. Discoveries may be made in processing or treating rice prior to consumption that conceivably may alter concepts of quality, growing requirements, and techniques.

But in addition to the technological developments that may appear in the growing, processing, and consumption of rice, progress in medicine, science, manufactures of all sorts, and in a host of other fields may have an important bearing upon the rice situation. For example, at one time the cultivation of rice was believed to encourage the spread of tropical diseases like malaria. It is now conceded that rice growing, properly conducted, tends to improve swampy and unhealthful lands and thus permit habitation and utilization of areas formerly avoided. Laws still exist in parts of southeastern Asia restricting the use of certain regions for reasons of health. Such

restrictions, based upon antiquated beliefs, undoubtedly hinder the cultivation of rice in places where a different policy might contribute to the effective use of waste or partially cultivated land and to the promotion of better living conditions.

But the problem of malaria apparently is not completely solved for unoccupied hill country where upland-rice crops may be grown. When it is, agriculture should tend to spread to such regions, become more diversified, and relieve congestion on the plains. The food crops that might be grown on extensive upland areas, once opened to settlement with the assistance of science and government, should help meet the food deficiency that threatens large sections of Monsoon Asia.

Many developments are possible within the rice economy of Monsoon Asia. Whatever the future may hold, it is difficult to visualize any type of world order in which the problems of the Far East will cease to be of growing significance to the Western world. A genuine understanding of these problems involves recognizing rice as something more than just food for millions of people. Rice not only reflects the social and economic pattern of life for the agricultural masses of Monsoon Asia, but it is also a symbol of their hopes. Rice is the peasant farmer's means of subsistence, his first need and principal possession, his medium of exchange and standard of value. It is natural that this powerful identification of rice with his economic well-being should carry over into his family, social, and religious life. Eventually, if imperfectly, the expression of man's hopes is translated into the political sphere. When rice is scarce or dear and families must go hungry, man will work harder and longer, but when his position seems to be without hope, he will also fight and kill to survive. Political maneuvering often obscures the underlying stresses and strains upon static, or even advancing, economies. So long as it remains the lifeblood of Monsoon Asia, there will be a crying need for more rice, both to satisfy the primitive wants of millions and to enhance the importance and dignity of human life for other millions.

**APPENDIX TABLES AND  
STATISTICAL NOTES**

TABLE I.—AREA UNDER RICE IN MONSOON ASIA (EX-CHINA), 1910-11 TO 1939-40\*  
(Million hectares)

Crop year	Total 11 countries	Total 10 countries (ex-India)	Burma	French Indo-China	Thailand (Siam)	Chosen (Korea)	Taiwan (Formosa)	Japan	India	British Malaya	Ceylon	Java and Madura*	Philippine Islands
1910-11..	.....	.....	3.02	....	1.46	1.12	.456	2.92	21.70	....	....	2.24	1.04
1911-12..	.....	.....	2.98	....	1.57	1.32	.479	2.95	23.41	....	....	2.28	1.08
1912-13..	.....	.....	4.03	3.05	1.97	1.32	.481	2.98	25.04	....	....	2.37	1.14
1913-14..	.....	.....	4.07	3.87	2.16	1.41	.494	3.00	26.69	....	....	2.60	1.24
1914-15..	.....	.....	4.04	4.23	2.04	1.46	.500	3.01	27.17	....	....	2.80	1.13
Av....	.....	.....	3.63	3.72	1.84	1.33	.482	2.97	24.80	....	....	2.46	1.13
1915-16..	.....	.....	4.21	3.97	2.07	1.49	.491	3.03	27.49	....	....	2.81	1.14
1916-17..	.....	.....	4.28	4.11	2.17	1.51	.472	3.05	28.19	....	....	3.25	1.23
1917-18..	.....	.....	4.33	4.12	2.22	1.52	.466	3.06	28.18	....	....	3.30	1.37
1918-19..	.....	.....	4.20	4.12	2.16	1.54	.483	3.07	26.97	....	....	3.49	1.38
1919-20..	.....	.....	4.24	4.81	2.48	1.52	.497	3.08	27.90	....	....	3.58	1.48
Av....	.....	.....	4.25	4.23	2.22	1.52	.482	3.06	27.74	....	....	3.29	1.32
1920-21..	50.03	22.26	4.18	4.76	2.45	1.54	.500	3.10	27.77	.255	.306	3.50	1.67
1921-22..	51.25	22.65	4.45	4.85	2.60	1.52	.500	3.11	28.60	.261	.323	3.38	1.66
1922-23..	51.81	23.03	4.57	5.00	2.53	1.54	.510	3.12	28.78	.266	.344	3.47	1.68
1923-24..	50.26	23.07	4.82	4.62	2.69	1.54	.507	3.12	27.19	.264	.301	3.47	1.74
1924-25..	51.57	23.51	4.90	4.76	2.78	1.56	.530	3.12	28.06	.265	.324	3.54	1.73
Av....	50.98	22.90	4.59	4.80	2.61	1.54	.509	3.11	28.08	.262	.320	3.47	1.69

1925-26..	52.27	23.87	4.94	5.07	2.74	1.57	.548	3.13	28.40	.264	.324	3.52	1.76
1926-27..	51.56	24.34	5.04	5.18	2.89	1.58	.566	3.13	27.22	.263	.336	3.55	1.81
1927-28..	51.52	24.76	5.00	5.45	2.93	1.59	.585	3.16	26.76	.268	.338	3.66	1.79
1928-29..	53.23	24.77	5.14	5.49	2.85	1.50	.585	3.16	28.46	.278	.338	3.65	1.78
1929-30..	52.63	25.27	5.20	5.68	3.04	1.62	.568	3.18	27.36	.266	.320	3.59	1.81
Av....	52.24	24.60	5.06	5.37	2.89	1.57	.569	3.15	27.64	.268	.331	3.59	1.79
1930-31..	54.01	25.82	5.27	5.83	3.18	1.65	.614	3.21	28.19	.236	.320	3.67	1.79
1931-32..	54.12	25.09	5.07	5.30	3.09	1.66	.624	3.22	29.03	.293	.340	3.71	1.78
1932-33..	53.99	25.68	5.14	5.47	3.21	1.63	.664	3.23	28.31	.310	.340	3.84	1.85
1933-34..	54.44	25.97	5.23	5.38	3.24	1.68	.675	3.15	28.47	.310	.340	3.97	2.00
1934-35..	54.15	25.93	5.14	5.34	3.34	1.70	.667	3.15	28.22	.297	.340	4.00	1.96
Av....	54.14	25.70	5.17	5.46	3.21	1.66	.649	3.19	28.44	.293	.336	3.84	1.88
1935-36..	54.84	26.11	5.06	5.46	3.38	1.68	.679	3.18	28.73	.293	.340	3.99	2.05
1936-37..	55.42	26.16	5.11	5.64	3.26	1.59	.682	3.18	29.26	.299	.340	4.00	2.06
1937-38..	55.61	26.24	5.24	5.58	3.37	1.63	.658	3.19	29.37	.294	.340	4.03	1.91
1938-39..	56.40	26.88	5.20	6.01	3.51	1.65	.625	3.19	29.52	.305	.340	4.09	1.96
1939-40..	.....	.....	5.20	....	3.58	1.22	....	3.17	29.28	.321	.340	4.01 <sup>b</sup>	1.97
Av....	.....	.....	5.16	....	3.42	1.55	....	3.18	29.23	.302	.340	4.02	1.99

\* For sources of data and methods of computation see Statistical Notes for individual countries. Dots (...) indicate that data are not available.

<sup>a</sup> Calendar years beginning with 1910. Data prior to 1916 for irrigated fields only.

<sup>b</sup> Harvested area.

TABLE II.—RICE PRODUCTION IN MONSOON ASIA (EX-CHINA), 1910-11 TO 1939-40\*

(Million metric tons of cleaned rice)

Crop year	Total 11 countries <sup>a</sup>	Total 10 countries (ex-India) <sup>a</sup>	Burma	French Indo-China	Thailand (Siam)	Chosen (Korea)	Taiwan (Formosa)	Japan	India	British Malaya	Ceylon	Java and Madura <sup>b</sup>	Philippine Islands
1910-11..	45.82	19.46	2.92	....	1.84	1.38	.555	6.18	26.36	....	....	2.60	.58
1911-12..	46.30	20.66	3.38	....	1.79	1.53	.595	6.85	25.63	....	....	2.80	.32
1912-13..	46.59	22.22	4.57	3.00	2.28	1.44	.536	6.65	24.37	....	....	2.65	.69
1913-14..	47.61	22.43	4.10	3.65	1.78	1.60	.679	6.66	25.18	....	....	2.92	.64
1914-15..	47.77	23.79	3.73	4.32	1.93	1.87	.610	7.55	23.98	....	....	2.88	.50
Av. ...	46.82	21.71	3.74	3.66	1.92	1.56	.595	6.78	25.10	....	....	2.77	.54
1915-16..	52.38	23.39	4.27	3.59	1.88	1.70	.634	7.41	28.99	....	....	2.93	.58
1916-17..	55.34	24.60	4.65	3.05	2.36	1.85	.615	7.74	30.74	....	....	3.14	.79
1917-18..	55.41	23.92	4.83	2.86	1.86	1.81	.640	7.23	31.49	....	....	3.29	1.00
1918-19..	44.13	23.60	4.06	2.86	2.11	2.03	.614	7.25	20.53	....	....	3.33	.95
1919-20..	52.35	23.56	3.74	2.96	1.41	1.68	.652	8.06	28.79	....	....	3.64	1.02
Av. ...	51.92	23.81	4.31	3.07	1.92	1.81	.631	7.54	28.11	....	....	3.27	.87
1920-21..	49.27	25.31	4.14	2.85	2.66	1.97	.641	8.37	23.96	.267	.143	3.11	1.16
1921-22..	54.06	25.08	4.70	3.60	2.63	1.90	.659	7.31	28.98	.210	.146	2.71	1.22
1922-23..	56.07	26.51	4.68	3.46	2.70	1.99	.721	8.04	29.56	.234	.154	3.30	1.23
1923-24..	49.48	25.06	4.23	3.27	2.74	2.01	.645	7.34	24.42	.224	.142	3.30	1.16
1924-25..	53.43	27.01	5.15	3.54	3.08	1.75	.805	7.57	26.42	.238	.166	3.43	1.28
Av. ...	52.46	25.79	4.58	3.34	2.76	1.92	.694	7.73	26.67	.235	.150	3.17	1.21

1925-26..	53.12	26.71	4.82	3.61	2.61	1.96	.854	7.91	26.41	.180	.163	3.28	1.34
1926-27..	52.62	27.66	5.19	3.74	3.25	2.03	.823	7.36	24.96	.192	.166	3.51	1.40
1927-28..	52.34	28.62	4.96	4.01	2.84	2.29	.914	8.23	23.72	.202	.172	3.60	1.40
1928-29..	54.54	26.85	4.97	3.55	2.42	1.79	.900	7.99	27.69	.189	.168	3.48	1.39
1929-30..	53.46	26.90	5.07	3.67	2.41	1.82	.859	7.89	26.56	.160	.202	3.38	1.44
Av. ...	53.22	27.35	5.00	3.72	2.71	1.98	.870	7.88	25.87	.185	.174	3.45	1.39
1930-31..	57.28	29.79	5.22	3.69	3.00	2.54	.976	8.86	27.49	.264	.200	3.65	1.39
1931-32..	55.27	26.01	4.27	3.47	2.53	2.10	.991	7.32	29.26	.296	.200	3.51	1.32
1932-33..	55.27	28.65	4.99	3.58	3.18	2.16	1.186	8.00	26.62	.300	.200	3.71	1.34
1933-34..	56.80	30.66	5.26	3.60	3.12	2.41	1.108	9.38	26.14	.337	.200	3.77	1.48
1934-35..	52.62	26.50	4.60	3.40	2.86	2.22	1.204	6.87	26.12	.331	.200	3.54	1.28
Av. ...	55.45	28.32	4.87	3.55	2.94	2.29	1.093	8.08	27.13	.306	.200	3.64	1.36
1935-36..	52.07	28.49	5.08	3.73	2.93	2.37	1.208	7.61	23.58	.342	.200	3.84	1.18
1936-37..	57.90	29.62	4.80	3.90	2.10	2.59	1.266	8.92	28.27	.319	.200	3.99	1.54
1937-38..	58.01	30.88	4.65	3.89	2.84	3.58 <sup>a</sup>	1.223	8.79	27.13	.299	.200	3.94	1.47
1938-39..	56.14	31.94	5.45	4.20	2.82	3.20 <sup>a</sup>	1.301	8.73	24.20	.341	.200	4.17	1.53
1939-40..	55.63	29.97	4.73	4.00 <sup>a</sup>	2.86	1.90 <sup>a</sup>	1.213	9.14	25.66	.335	.200	4.09	1.50
Av. ...	55.95	30.18	4.94	3.94	2.71	2.73 <sup>a</sup>	1.242	8.64	25.77	.327	.200	<sup>a</sup> 4.00	1.44

\* For sources of data and methods of computation see Statistical Notes for individual countries. Dots (...) indicate that data are not available.

<sup>a</sup> Including our approximations for missing data, 1910-11 through 1919-20.

<sup>b</sup> Calendar years beginning with 1910. Data prior to 1916 for irrigated fields only.

<sup>c</sup> See Statistical Notes.

<sup>d</sup> Estimated.

TABLE III.—RICE YIELDS IN ELEVEN ASIATIC COUNTRIES, 1910-11 TO 1939-40\*

(Quintals of cleaned rice per hectare)

Crop year	Total 11 countries	Total 10 countries (ex-India)	Burma	French Indo-China	Thailand (Siam)	Chosen (Korea)	Taiwan (Formosa)	Japan	India	British Malaya	Ceylon	Java and Madura <sup>a</sup>	Philippine Islands
1910-11..	....	....	9.7	...	12.6	12.3	12.2	21.1	12.1	....	...	11.6	5.5
1911-12..	....	....	11.3	...	11.4	11.6	12.4	23.2	10.9	....	...	12.3	3.0
1912-13..	....	....	11.3	9.8	11.6	10.9	11.1	22.3	9.7	....	...	11.1	6.0
1913-14..	....	....	10.1	9.4	8.2	11.4	13.7	22.2	9.4	....	...	11.2	5.1
1914-15..	....	....	9.2	10.2	9.5	12.9	12.2	25.1	8.8	....	...	10.3	4.4
Av. ....	....	....	10.3	9.8	10.4	11.8	12.3	22.8	10.1	....	...	11.3	4.8
1915-16..	....	....	10.1	9.1	9.1	11.4	12.9	24.4	10.5	....	...	10.4	5.1
1916-17..	....	....	10.9	7.4	10.9	12.2	13.0	25.4	10.9	....	...	9.7	6.5
1917-18..	....	....	11.1	6.9	8.4	11.9	13.7	23.6	11.2	....	...	10.0	7.3
1918-19..	....	....	9.7	6.9	9.7	13.2	12.7	23.6	7.6	....	...	9.5	6.8
1919-20..	....	....	8.8	6.2	5.7	11.0	13.1	26.2	10.3	....	...	10.2	6.9
Av. ....	....	....	10.1	7.3	8.7	11.9	13.1	24.7	10.1	....	...	9.9	6.6
1920-21..	9.8	11.4	9.9	6.0	10.9	12.8	12.8	27.0	8.6	10.5	4.7	8.9	6.9
1921-22..	10.5	11.1	10.6	7.4	10.1	12.5	13.2	23.5	10.1	8.1	4.5	8.0	7.9
1922-23..	10.8	11.5	10.3	6.9	10.7	12.9	14.1	25.8	10.3	8.8	4.6	9.5	7.3
1923-24..	9.8	10.9	8.8	7.1	10.2	13.1	12.7	23.5	9.0	8.5	4.7	9.5	6.7
1924-25..	10.4	11.5	10.5	7.4	11.1	11.2	15.2	24.3	9.4	9.0	5.1	9.7	7.4
Av. ....	10.3	11.3	10.0	7.0	10.6	12.5	13.6	24.8	9.5	9.0	4.7	9.1	7.1



1925-26..	10.2	11.2	9.8	7.1	9.5	12.4	15.6	25.3	9.3	6.8	5.0	9.3	7.6
1926-27..	10.2	11.4	10.3	7.2	11.2	12.9	14.5	23.5	9.2	7.3	5.0	9.9	7.7
1927-28..	10.2	11.6	9.9	7.4	9.7	14.4	15.6	26.1	8.9	7.5	5.1	9.8	7.8
1928-29..	10.2	10.8	9.7	6.5	8.5	11.9	15.4	25.2	9.7	6.8	5.0	9.5	7.8
1929-30..	10.2	10.6	9.7	6.5	7.9	11.2	15.8	24.8	9.7	6.0	6.3	9.4	8.0
Av. ...	10.2	11.1	9.9	6.9	9.4	12.6	15.3	25.0	9.4	6.9	5.2	9.6	7.8
1930-31..	10.6	11.5	9.9	6.8	9.4	15.4	15.9	27.6	9.7	9.2	6.2	10.0	7.8
1931-32..	10.2	10.4	8.4	6.5	8.2	12.7	15.9	22.7	10.1	10.1	5.9	9.5	7.4
1932-33..	10.2	11.2	9.7	6.5	9.9	13.3	17.9	24.8	9.4	9.7	5.9	9.7	7.2
1933-34..	10.4	11.8	10.0	6.7	9.6	14.3	16.4	29.8	9.2	10.9	5.9	9.5	7.4
1934-35..	9.7	10.2	9.0	6.4	8.6	13.0	18.0	21.8	9.2	11.1	5.9	8.8	6.5
Av. ...	10.2	11.0	9.4	6.5	9.2	13.7	16.8	25.3	9.5	10.4	6.0	9.5	7.3
1935-36..	9.5	10.9	10.0	6.8	8.7	14.1	17.8	23.9	8.2	11.6	5.9	9.6	5.8
1936-37..	10.4	11.3	9.4	6.9	6.5	16.3	18.6	28.0	9.7	10.7	5.9	10.0	7.5
1937-38..	10.4	11.8	8.9	7.0	8.4	22.0 <sup>b</sup>	18.6	27.5	9.2	10.2	5.9	9.8	7.7
1938-39..	10.0	11.9	10.5	7.0	8.0	19.4 <sup>b</sup>	20.8	27.3	8.2	11.2	5.9	10.2	7.8
1939-40..	....	....	9.1	...	8.0	15.5 <sup>b</sup>	....	28.9	8.8	10.4	5.9	10.2 <sup>c</sup>	7.6
Av. ....	....	....	9.6	...	7.9	17.6 <sup>b</sup>	....	27.1	8.8	10.8	5.9	10.0 <sup>c</sup>	7.3

\* Calculated from data in Tables I and II.

<sup>a</sup> Calendar years beginning with 1910. Data prior to 1916 for irrigated fields only.

<sup>b</sup> See Statistical Notes.

<sup>c</sup> Yield on harvested area for 1939.

TABLE IV.—NET EXPORTS AND NET IMPORTS OF RICE IN EAST ASIA AND ISLANDS, 1911-40\*

## A. NET EXPORTS

*(In terms of cleaned rice; thousand metric tons)*

Year	Burma* (1)	French Indo-China (2)	Thailand (Siam)* (3)	Total (1) (2) (3)	Chosen (Korea) (4)	Taiwan (Formosa) (5)	Total (4) (5)	Total (1) to (5) inclusive
1911.....	2,163	754	552	3,469	69	74	143	3,612
1912.....	2,331	724	520	3,575	69	67	136	3,711
1913.....	2,673	1,122	1,031	4,826	77	116	193	5,019
1914.....	2,266	1,094 <sup>d</sup>	970	4,330 <sup>d</sup>	136	67	203	4,533 <sup>d</sup>
1915.....	2,122	1,085 <sup>d</sup>	997	4,204 <sup>d</sup>	323	106	429	4,633 <sup>d</sup>
Av.....	2,311	956	814	4,081	135	86	221	4,302
1916.....	2,219	1,179	1,072	4,470	213	91	304	4,774
1917.....	2,070	1,232	1,028	4,330	210	90	300	4,630
1918.....	2,500	1,479	776	4,755	232	95	377	5,132
1919.....	2,336	899	405	3,640	370	102	472	4,112
1920.....	2,009	1,093	250	3,352	264	69	333	3,685
Av.....	2,227	1,176	707	4,110	268	89	357	4,467
1921.....	2,226	1,525	1,130	4,881	457	118	575	5,456
1922.....	2,457	1,247	1,119	4,823	394	55	449	5,272
1923.....	2,315	1,169	1,151	4,635	516	148	664	5,299
1924.....	2,479	1,056	988	4,523	573	220	793	5,316
1925.....	3,321	1,330	1,181	5,832	496	201	697	6,529
Av.....	2,560	1,265	1,114	4,939	487	148	635	5,574

1926.....	2,481	1,460	1,153	5,094	646	246	892	5,986
1927.....	2,938	1,499	1,525	5,962	717	217	934	6,896
1928.....	2,736	1,584	1,313	5,633	844	251	1,095	6,728
1929.....	3,102	1,308	1,009	5,419	658	175	833	6,252
1930.....	2,949	1,015	929	4,893	590	261	851	5,744
Av.....	2,841	1,373	1,186	5,400	691	230	921	6,321
1931.....	3,348	878	1,197	5,423	1,161	376	1,537	6,960
1932.....	2,679	1,089	1,507	5,275	955	450	1,405	6,680
1933.....	3,300	1,176	1,511	5,987	1,018	492	1,510	7,497
1934.....	3,563	1,370	1,844	6,777	1,261	668	1,929	8,706
1935.....	2,934	1,520	1,384	5,838	1,126	564	1,690	7,528
Av.....	3,165	1,207	1,488	5,860	1,104	510	1,614	7,474
1936.....	2,858	1,556	1,416	5,830	1,129	630	1,759	7,589
1937.....	2,874	1,345	985	5,204	996	630	1,626	6,830
1938.....	3,118	937	1,398	5,453	1,157	603	1,760	7,213
1939.....	3,149	1,454	1,862	6,465	.....	...	1,300 <sup>a</sup>	7,765 <sup>a</sup>
1940.....	2,500 <sup>a</sup>	..... <sup>f</sup>	2,000 <sup>a</sup>	.....	..... <sup>f</sup>	... <sup>f</sup>	.....	.....

\* For sources of data and methods of computation see Statistical Notes for individual countries. Dots (...) indicate that data are not available.

<sup>a</sup> April-March 1911-12 and following years.

<sup>b</sup> Net exports.

<sup>c</sup> Gross imports.

<sup>d</sup> Incomplete; exports of broken rice from French Indo-China not included.

<sup>e</sup> Approximate only; estimate based on preliminary or incomplete data.

<sup>f</sup> Publication of data discontinued during the war.

TABLE IV.—NET EXPORTS AND NET IMPORTS OF RICE IN EAST ASIA AND ISLANDS, 1911-40\* (Concluded)

## B. NET IMPORTS

(In terms of cleaned rice; thousand metric tons)

Year	India*	Japan	Netherlands Indies	China	British Malaya	Ceylon	Philippine Islands	Total
1911.....	(362) <sup>b</sup>	295	564	321°	...	374	184	.....
1912.....	(323) <sup>b</sup>	389	396	161	...	380	301	.....
1913.....	340	691	443	322	...	400	87	.....
1914.....	835	446	421	410	...	394	97	.....
1915.....	940	349	547	508	...	383	218	.....
Av.....	286	434	474	344	...	386	177	.....
1916.....	735	166	679	681	...	435	190	.....
1917.....	240	190	749	593	...	420	147	.....
1918.....	584	987	650	420	...	347	184	.....
1919.....	1,757	1,118	274	35	...	296	51	.....
1920.....	1,022	381	218	51	...	309	77	.....
Av.....	868	568	514	356	...	361	130	.....
1921.....	957	761	762	641	244	328	59	3,752
1922.....	445	764	604	1,156	375	387	42	3,773
1923.....	248	873	389	1,353	367	401	66	3,697
1924.....	329	1,212	411	796	399	399	151	3,697
1925.....	760	1,366	503	762	411	441	101	4,344
Av.....	548	995	534	942	359	391	84	3,853

1926.....	444	1,314	598	1,129	484	468	70	4,507
1927.....	852	1,534	459	1,270	557	478	11	5,161
1928.....	1,123	1,358	575	764	528	496	43	4,887
1929.....	790	1,112	724	653	574	500	105	4,458
1930.....	698	1,039	621	1,201	603	483	11	4,656
Av.....	782	1,271	596	1,003	549	485	48	4,734
1931.....	1,019	1,485	592	648	525	455	12	4,736
1932.....	846	1,536	412	1,358	417	463	18	5,045
1933.....	1,564	1,633	344	1,289	444	454	20	5,748
1934.....	1,981	1,863	267	764	465	493	(1) <sup>b</sup>	5,832
1935.....	1,558	1,683	364	1,289	482	558	5	5,939
Av.....	1,393	1,640	396	1,069	467	485	10	5,460
1936.....	1,404	1,798	210	283	545	536	91	4,867
1937.....	1,139	1,644	147	325	586	527	72	4,440
1938.....	1,325	1,719	317	406	625	537	9	4,938
1939.....	1,900 <sup>c</sup>	1,300 <sup>c</sup>	256	313	702	602	84	5,157
1940.....	..... <sup>f</sup>	..... <sup>f</sup>	60 <sup>e</sup>	645	700 <sup>e</sup>	...	..	.....

\* For sources of data and methods of computation see Statistical Notes for individual countries. Dots (...) indicate that data are not available.

<sup>a</sup> April-March 1911-12 and following years.

<sup>b</sup> Net exports.

<sup>c</sup> Gross imports.

<sup>d</sup> Incomplete; exports of broken rice from French Indo-China not included.

<sup>e</sup> Approximate only; estimate based on preliminary or incomplete data.

<sup>f</sup> Publication of data discontinued during the war.

TABLE V.—RICE TRADE (GROSS IMPORTS AND EXPORTS) OF INDIA, BRITISH MALAYA, NETHERLANDS INDIES, AND JAPAN, 1911-39\*

(In terms of cleaned rice; thousand metric tons)

Year	India <sup>a</sup>			British Malaya		Netherlands Indies				Japan				
	Imports		Ex-ports	Im-ports	Ex-ports	Imports			Ex-ports	Imports			Ex-ports	
	Total	From Burma <sup>b</sup>				Total	Java and Madura	Outer Provinces		Total	Chosen <sup>b</sup> (Korea)	Taiwan <sup>b</sup> (Formosa)		For- eign
1911....	329	208	691	...	...	620	396	224	56	956	93	86	237	61
1912....	377	241	700	...	...	447	241	207	51	431	39	84	308	42
1913....	941	796	601	...	...	509	258	251	66	735	87	146	502	44
1914....	1,275	1,122	440	...	...	471	216	255	50	501	144	78	279	55
1915....	1,350	1,147	410	...	...	583	334	250	36	463	289	111	63	114
Av. ...	854	708	568	...	...	526	289	237	52	497	118	101	278	63
1916....	1,160	984	425	...	...	693	391	302	14	290	160	87	43	124
1917....	697	538	457	...	...	755	406	349	6	328	146	104	78	138
1918....	1,000	843	416	...	...	650	344	305	0	1,051	269	141	641	64
1919....	1,894	1,816	137	...	...	275	140	135	1	1,158	365	152	641	40
1920....	1,149	1,039	127	...	...	220	114	106	2	416	259	92	65	35
Av. ...	1,180	1,044	312	...	...	519	279	240	5	649	240	115	294	80
1921....	1,111	965	154	458	213	764	576	188	2	798	441	137	220	37
1922....	783	650	338	612	237	626	401	225	22	921	409	92	420	157
1923....	668	504	420	575	208	418	200	218	29	935	530	160	245	62
1924....	764	587	435	593	194	451	243	208	40	1,323	636	236	451	111
1925....	1,067	993	307	663	251	534	253	281	31	1,635	621	305	709	269
Av. ...	879	740	331	580	221	559	335	224	25	1,122	527	186	409	127

1926....	737	678	293	769	285	630	312	318	32	1,383	756	309	318	69
1927....	1,171	1,034	319	856	299	470	104	366	11	1,730	852	337	541	196
1928....	1,425	1,195	302	813	284	585	183	402	10	1,476	917	298	261	118
1929....	1,097	1,034	307	812	238	735	346	389	11	1,211	756	271	184	99
1930....	1,008	935	310	815	212	628	249	379	7	1,119	667	272	180	80
Av...	1,088	975	306	813	264	610	239	371	14	1,384	790	297	297	112
1931....	1,284	1,210	265	703	178	608	287	321	16	1,674	1,170	378	126	189
1932....	1,102	1,021	256	604	187	424	150	274	12	1,603	966	484	153	67
1933....	1,811	1,756	247	607	163	353	106	252	14	1,661	1,019	499	143	28
1934....	2,219	2,151	238	634	169	280	62	218	13	1,947	1,272	668	7	84
1935....	1,775	1,708	217	670	188	378	108	270	14	1,752	1,148	565	39	69
Av...	1,638	1,569	245	644	177	410	143	267	14	1,727	1,115	519	93	87
1936....	1,668	1,614	264	730	185	233	9	224	23	1,835	1,149	631	55	37
1937....	1,394	1,324	255	727	141	177	9	168	30	1,679	1,015	631	33	35
1938....	1,633	1,560	308	831	206	334	22	312	17	1,737	1,119	595	23	18
1939....	2,200 <sup>a</sup>	2,100 <sup>a</sup>	300 <sup>a</sup>	871	169	278	34	244	22	1,344 <sup>a</sup>	1,300 <sup>a</sup>		44	...

\* For sources of data and methods of computation see Statistical Notes for individual countries. Dots (...) indicate that data are not available.

<sup>a</sup> April-March 1911-12 and following years.

<sup>b</sup> Exports reported from country of origin rather than imports recorded by country of destination.

<sup>c</sup> Estimate based upon preliminary or incomplete data.

TABLE VI.—EXPORTS OF RICE FROM BURMA, THAILAND (SIAM), AND FRENCH INDO-CHINA  
TO EAST ASIATIC AND OTHER COUNTRIES, 1911-14 AND 1917-37\*

(In terms of cleaned rice; thousand metric tons)

April-March	Three countries			Burma		Thailand (Siam)		French Indo-China*	
	Total	East Asia	Others	East Asia	Others	East Asia	Others	East Asia	Others
1911-14.....	3,957	2,391	1,566	1,188	1,201	564	137	639	228
1917-18.....	4,330	3,221	1,109	1,176	894	976	52	1,069	163
1918-19.....	4,755	3,882	873	1,702	798	750	26	1,430	49
1919-20.....	3,640	3,339	301	2,216	120	332	73	791	108
1920-21.....	3,352	2,660	692	1,635	374	229	21	796	297
1921-22.....	4,881	3,809	1,072	1,648	578	905	225	1,256	269
1922-23.....	4,823	3,628	1,195	1,653	804	1,010	109	965	282
1923-24.....	4,635	3,434	1,201	1,515	800	1,067	84	852	317
1924-25.....	4,523	3,212	1,311	1,507	972	843	145	862	194
1925-26.....	5,832	4,316	1,516	2,296	1,025	1,015	166	1,005	326
1926-27.....	5,099	3,799	1,300	1,624	862	1,012	141	1,163	297
1927-28.....	5,967	4,533	1,434	1,998	945	1,374	151	1,161	338
1928-29.....	5,638	4,339	1,299	2,026	715	1,172	141	1,141	443
1929-30.....	5,422	4,180	1,242	2,269	836	897	112	1,014	294
1930-31.....	4,899	3,768	1,131	2,277	678	784	145	707	308



1931-32.....	5,427	3,986	1,441	2,441	911	1,034	163	511	367
1932-33.....	5,280	3,990	1,290	2,016	668	1,285	222	689 <sup>a</sup>	400 <sup>a</sup>
1933-34.....	5,990	4,399	1,591	2,613	690	1,233	278	553 <sup>a</sup>	623 <sup>a</sup>
1934-35.....	6,782	5,126	1,656	2,957	611	1,499	345	670 <sup>a</sup>	700 <sup>a</sup>
1935-36.....	5,844	4,521	1,323	2,455	485	1,108	276	958 <sup>a</sup>	562 <sup>a</sup>
1936-37.....	5,833	3,812 <sub>u</sub>	2,021	2,347	514	1,045	371	420 <sup>a</sup>	1,136 <sup>a</sup>

\* For sources of data and methods of computation see Statistical Notes for individual countries.

<sup>a</sup> Calendar years 1911-13 and 1917 and following years.

<sup>b</sup> Distribution partly estimated.

TABLE VII.—CHANGES IN THE RICE POSITION OF ELEVEN ASIATIC COUNTRIES, ANNUAL AVERAGES FOR FIVE-YEAR PERIODS, 1916-20 to 1936-40\*

Period	Production	Imports	Exports	Available supplies	Popula- tion	Per capita utiliza- tion <sup>a</sup>	Production	Imports	Exports	Available supplies	Popula- tion	Per capita utiliza- tion <sup>a</sup>		
	(In terms of cleaned rice; million metric tons)						(Mil- lions)	(In terms of cleaned rice; million metric tons)						(Mil- lions)
	Burma <sup>a</sup>							India						
1916-20....	4.31		2.25	2.06	12.9	160	28.11	1.20 <sup>b</sup>	.34 <sup>b</sup>	28.97	308.2	94		
1921-25....	4.58		2.30	2.28	13.5	159	26.67	.89	.29	27.27	311.2	88		
1926-30....	5.00		2.92	2.09	14.2	149	25.87	1.10	.31	26.66	328.6	81		
1931-35....	4.87		3.17	1.70	14.9	115	27.13	1.48	.26	28.35	346.4	82		
1936-40....	4.94		2.99	1.95	15.9	123	25.77	1.73	.33	27.17	363.5	75		
	French Indo-China							Java and Madura						
1916-20....	3.07		1.18	1.89	18.3	103	3.30	.28	.00	3.58	33.5	107		
1921-25....	3.34		1.26	2.08	19.8	105	3.20	.33	.02	3.51	36.6	96		
1926-30....	3.72		1.37	2.34	21.4	109	3.52	.24	.01	3.75	39.9	94		
1931-35....	3.55		1.21	2.34	22.1	106	3.67	.14	.01	3.81	43.6	87		
1936-40....	3.94		1.32 <sup>c</sup>	2.61 <sup>c</sup>	23.4	112 <sup>c</sup>	4.05 <sup>c</sup>	.02 <sup>c</sup>	.01 <sup>c</sup>	4.06 <sup>c</sup>	47.0	86 <sup>c</sup>		
	Thailand (Siam) <sup>a</sup>							Philippine Islands						
1916-20....	1.92		.86	1.07	9.1	125	.87	.13		1.00	10.2	98		
1921-25....	2.76		.93	1.83	10.1	172	1.21	.08		1.29	11.1	116		
1926-30....	2.71		1.24	1.47	11.2	134	1.39	.05		1.44	11.9	121		
1931-35....	2.94		1.40	1.54	12.9	116	1.36	.01		1.37	12.8	107		
1936-40....	2.77		1.41	1.36	14.9	91	1.44	.06 <sup>c</sup>		1.49 <sup>c</sup>	13.7	110 <sup>c</sup>		

	Chosen (Korea)						British Malaya					
	1916-20....	1.81	.01	.28	1.55	17.1	90	...	...	...	...	...
1921-25....	1.92	.05	.54	1.44	18.6	77	.23	.58	.22	.59	3.6	167
1926-30....	1.98	.10	.79	1.29	20.4	63	.18	.81	.27	.73	4.1	181
1931-35....	2.29	.02	1.12	1.18	22.1	54	.31	.64	.18	.77	4.6	170
1936-40....	2.73	.02 <sup>b</sup>	1.11 <sup>b</sup>	1.41 <sup>b,c</sup>	23.8	60 <sup>d</sup>	.33	.79 <sup>e</sup>	.18 <sup>e</sup>	.94 <sup>e</sup>	5.2	184 <sup>e</sup>
	Taiwan (Formosa)						Ceylon					
	1916-20....	.63	.03	.12	.54	3.5	155	...	...	...	...	...
1921-25....	.69	.04	.19	.55	3.8	142	.15	.39	.54	4.7	116	
1926-30....	.87	.07	.30	.64	4.3	148	.17	.48	.66	5.1	129	
1931-35....	1.09	.01	.52	.58	4.9	118	.20	.48	.68	5.5	123	
1936-40....	1.24	.00 <sup>b</sup>	.62 <sup>b</sup>	.62 <sup>b</sup>	5.5	113 <sup>b</sup>	.20	.55 <sup>e</sup>	.75 <sup>e</sup>	5.8	129 <sup>e</sup>	
	Japan						Total 11 countries					
	1916-20....	7.54	.65	.08	8.11	54.7	148	51.56 <sup>e</sup>	2.30 <sup>e</sup>	5.11 <sup>e</sup>	48.76 <sup>e</sup>	467.5 <sup>e</sup>
1921-25....	7.73	1.12	.13	8.72	58.0	150	52.48	3.48	5.88	50.08	491.0	102
1926-30....	7.88	1.38	.11	9.15	62.3	147	53.29	4.23	7.32	50.20	523.4	96
1931-35....	8.08	1.73	.09	9.72	66.6	146	55.50	4.51	7.96	52.05	556.4	94
1936-40....	8.64	1.65 <sup>e</sup>	.03 <sup>e</sup>	10.13 <sup>e</sup>	72.0	142 <sup>e</sup>	55.99	4.82 <sup>f</sup>	8.00 <sup>f</sup>	52.41 <sup>f</sup>	590.8	89 <sup>f</sup>

\* Data from Tables II, IV, and V refer mainly to crops harvested in late autumn of 1915 and following years, and trade of calendar year 1916 and following years; trade of India, Burma, and Thailand, however, for years April-March 1915-16 and following years. All 1936-40 averages are preliminary owing to incomplete trade returns and some unrevised crop figures for 1939-40.

\* Too much importance should not be attached to per capita utilization data for particular five-year periods, especially for countries where exports or imports are large in relation to production. Difficulties in combining trade data for Burma and Thailand (on April-March basis) with appropriate crop data for the purpose of calculating per capita utilization have been partially resolved by using a two-year moving average of the trade figures. For some other countries, per capita utilization for the 1936-40 period has been computed or estimated from incomplete information. There are also important qualifications to be made with regard to the reliability and significance of these estimates. See chapters ix and x.

<sup>b</sup> Three-year average.

<sup>c</sup> Four-year average.

<sup>d</sup> Estimate based on assumption that Chosen crop of 1937-38 was overstated. See Statistical Notes, pp. 342-43.

<sup>e</sup> Excluding British Malaya and Ceylon.

<sup>f</sup> Estimate only.

TABLE VIII.—PRICES OF SOUTHEASTERN ASIATIC EXPORT RICE AT RANGOON, BANGKOK, SAIGON; AND IN SINGAPORE AND JAVA, ANNUAL AVERAGES, 1920-39\*

Year	Burma (Rangoon)		Thailand (Bangkok)		French Indo-China (Saigon)		British Malaya (Singapore)			Java (8 cities)*	
	Small Mills Specials	Big Mills Specials	White No. 1	Straits Quality	Round White No. 1	Whole White No. 2	Rangoon No. 1	Siam No. 2 †	Saigon No. 1	Rangoon rice	Saigon rice
	Rupees per 7,500 lbs.		Babts per picul of 132.3 lbs.		Piasters per 100 kilos		Straits \$ per picul of 133.3 lbs.			Florins per picul of 136.2 lbs.	
1920 .....	510	477	9.8	9.2	...	11.5	...	...	...	17.8	17.8
1921 .....	508	496	7.8	7.2	...	7.8	...	...	...	10.7	9.5
1922 .....	491	455	7.3	6.8	...	7.6	...	...	...	8.1	7.2
1923 .....	466	434	7.9	7.4	9.3	8.8	6.0	8.5	6.7	7.9	7.6
1924 .....	509	489	9.5	9.0	10.5	10.2	7.1	10.5	7.8	9.6	9.0
Av. ....	497	470	8.5	7.9	...	9.2	...	...	...	10.8	10.2
1925 .....	456	439	8.8	8.4	10.0	9.6	6.9	9.8	7.3	9.3	8.8
1926 .....	514	486	9.5	9.1	11.0	10.4	7.5	11.1	7.8	9.8	9.1
1927 .....	460	438	8.6	7.9	10.6	9.7	6.9	10.9	7.4	8.7	8.2
1928 .....	424	396	8.0	7.6	9.6	8.9	6.2	9.9	4.5	8.7	8.1
1929 .....	433	412	8.3	8.2	11.6	11.1	6.4	9.9	7.0	8.7	8.5
Av. ....	457	434	8.6	8.2	10.6	9.9	6.8	10.3	6.8	9.0	8.5

1930 .....	359	344	7.3	7.0	11.4	10.9	5.6	6.6	6.1	7.4	7.4
1931 .....	216	200	4.3	4.0	6.7	6.2	3.7	4.1	4.1	4.7	4.4
1932 .....	231	217	3.8	3.7	5.5	5.1	3.7	4.0	3.9	4.0	3.7
1933 .....	166	157	3.7	3.6	4.1	3.9	3.0	3.5	3.3	3.1	2.8
1934 .....	176	168	3.1	3.0	3.3	3.1	2.8	2.9	2.8	2.9	2.8
Av. ....	230	217	4.4	4.3	6.2	5.8	3.8	4.2	4.0	4.4	4.1
1935 .....	227	220	4.1	4.2	4.2	4.0	3.6	4.0	3.6	3.4	2.9
1936 .....	223	215	4.1	4.0	5.0	4.8	3.4	3.9	3.6	3.6	3.3
1937 .....	236	229	...	...	7.9	7.6	3.7	4.4	3.9	4.3	4.2
1938 .....	220	207	...	...	10.7	10.1	3.7	4.3	3.9	4.1	4.0
1939 .....	232	227	...	...	9.3	8.5	3.6	4.0	3.5	...	...
Av. ....	228	220	...	...	7.4	7.0	3.6	4.1	3.7	3.8 <sup>a</sup>	3.6 <sup>a</sup>

\* For sources of data see Statistical Notes (Prices) for individual countries. Dots (...) indicate that comparable data are not at hand.

<sup>a</sup> Average wholesale prices of foreign rice at Batavia, Surabaya, and Semarang.

<sup>b</sup> Siam No. 1 (1923-29).

<sup>c</sup> Four-year average.

TABLE IX.—RICE AND PADDY PRICES IN SELECTED MARKETS OF MONSOON ASIA,  
ANNUAL AVERAGES, 1910-39\*

Year	Burma			India	Java		Philippine Islands		Japan	China	
	Burma No. 2 (London)	Burma No. 2 (Rangoon)	Boat Paddy (Rangoon)	Balam No. 1 (Calcutta)	Beras White No. 2	Padi Boeloe No. 1	Native cleaned (Manila)	Palay "ordina- rios" <sup>1</sup>	Average quality brown (Tokyo)	Rice Price Index (Canton)	"Long Changshu" (Shanghai)
	Shillings per 112 lbs.	Rupees per 7,500 lbs.	Rupees per 4,800 lbs.	Rupees per 82.8 lbs.	Florins per picul of 136.2 lbs.		Pesos per 57 kilos	Pesos per 44 kilos	Yen per koku of 1.8 hectoliters	1918 = 100	Standard yuan per hectoliter
1910 .....	....	...	110	...	....	...	...	3.0	....	...	....
1911 .....	....	...	144	...	....	...	9.3	3.0	....	...	....
1912 .....	11.8	...	166	4.8 <sup>b</sup>	....	...	...	3.4	20.7	111	....
1913 .....	9.9	321	130	5.6 <sup>b</sup>	....	...	...	2.4	21.4	100	....
1914 .....	9.0	...	121	5.7 <sup>b</sup>	....	...	5.5	2.5	16.1	96	....
Av. ....	10.2 <sup>c</sup>	...	134	5.3 <sup>c</sup>	....	...	...	2.9	19.4 <sup>c</sup>	102 <sup>c</sup>	....
1915 .....	12.4	...	127	6.1 <sup>b</sup>	....	...	5.8	2.8	13.1	107	....
1916 .....	16.3	...	117	6.0	....	...	6.2	2.7	13.7	109	....
1917 .....	24.4 <sup>d</sup>	...	101	5.5	....	...	6.8	2.9	19.8	93	....
1918 .....	25.0 <sup>d</sup>	...	115	5.4	....	...	9.3	3.8	32.5	109	....
1919 .....	25.5 <sup>d</sup>	...	142	6.9	....	...	13.8	5.6	45.9	133	....
Av. ....	20.7	...	120	6.0	....	...	8.4	3.6	25.0	110	....
1920 .....	38.6 <sup>d</sup>	...	190	8.8	17.1	7.3	14.0	7.0	44.3	126	....
1921 .....	17.8	...	205 <sup>e</sup>	7.8	15.1	6.8	7.6	3.8	30.8	134	....
1922 .....	14.2	...	198	7.0	11.2	5.2	7.7	3.2	35.1	147	....
1923 .....	13.7	...	183	6.1	9.9	4.7	8.3	3.4	32.8	157	....
1924 .....	15.5	...	204	6.8	11.2	5.2	9.7	4.2	38.5	174	....
Av. ....	20.0	...	196	7.3	12.9	5.8	9.5	4.3	36.3	148	....

1925 .....	14.8	523	189	7.9	10.8	5.3	9.4	4.2	41.6	179	....
1926 .....	15.3	567	202	7.8	11.4	5.6	9.3	4.2	37.6	187	14.4
1927 .....	14.6	520	190	8.2	10.2	5.1	7.6	3.3	35.0	192	13.8
1928 .....	13.7	468	169	7.3	10.2	4.8	7.9	3.4	30.6	183	10.2
1929 .....	13.2	465	169	6.6	10.8	4.9	8.9	3.8	28.9	194	12.5
Av. ....	14.3	509	184	7.6	10.7	5.1	8.6	3.8	34.8	187	12.7 <sup>f</sup>
1930 .....	11.0	395	133	6.4	10.1	4.5	6.5	2.7	25.2	212	15.9
1931 .....	7.8	250	80	4.4	6.8	2.8	4.8	1.9	18.3	191	12.1
1932 .....	8.3	269	92	3.5	5.1	2.1	4.2	1.8	21.2	179	11.4
1933 .....	6.6	194	64	3.1	3.9	1.6	4.8	2.1	21.6	157	8.4
1934 .....	6.7	203	70	3.8	4.0	1.7	4.3	1.7	26.1	140	10.4
Av. ....	8.1	262	88	4.2	6.0	2.5	4.9	2.0	22.5	176	11.6 <sup>f</sup>
1935 .....	7.7	254	93	3.5	4.1	1.8	5.6	2.4	29.9	146	12.3
1936 .....	7.8	243	89	4.0	3.7	1.6	...	3.0	30.7	195	10.4
1937 .....	9.2	263	97	4.0	4.4	2.1	...	2.5	32.4	217	12.6
1938 .....	8.2	256	90	4.0	4.7	2.2	...	3.0	34.3	...	13.6
1939 .....	7.7	255	97	...	...	2.0	...	2.9	37.3	...	24.6
Av. ....	8.1	254	93	3.9 <sup>f</sup>	4.2 <sup>f</sup>	1.9	...	2.8	32.9	186 <sup>e</sup>	14.7

\* For sources of data see Statistical Notes (Prices) for individual countries. Dots (...) indicate that comparable data are not at hand.

<sup>a</sup> Annual average prices in municipal markets of 48 provinces for years ending June 30, 1910-25; at Cabanatuan, Nueva Ecija, for 1926 and following years.

<sup>b</sup> Incomplete.

<sup>c</sup> Three-year average.

<sup>d</sup> From May 1917 to June 1920 prices fixed by the government.

<sup>e</sup> Rose to Rs. 262.

<sup>f</sup> Four-year average.

## STATISTICAL NOTES

The following pages present a complete list of sources for the rice statistics used in the present study, indications of the methods employed in making conversions, and other information pertinent to use of the Appendix Tables. These notes are arranged alphabetically by countries as follows:

British Malaya	Chosen (Korea)	Netherlands Indies
Burma	French Indo-China	Philippine Islands
Ceylon	India	Taiwan (Formosa)
China	Japan	Thailand (Siam)

Generally data have been drawn from the original government annual reports of the various countries. In some cases, however, statistics for recent years (especially since 1937-38) have been obtained from secondary sources, chiefly the publications of the International Institute of Agriculture in Rome (*International Yearbook of Agricultural Statistics* and *Monthly Crop Report and Agricultural Statistics*).

The metric system of weights and measures has, with few exceptions, been used throughout. United States equivalents for units used frequently in the text and tables are given below:

- 1 hectare (ha.) = 2.471 acres
- 1 kilogram (kg.) = 2.2046 pounds
- 1 metric quintal (q.) = 100 kg. = 220.46 pounds
- 1 metric ton = 1,000 kg. = .9842 long ton = 1.1023 short tons
- 1 hectoliter, dry (hl.) = 2.8378 bushels

Comments applying specifically to area, production, yield, trade, or price statistics presented in Appendix Tables I-IX will be found under the subheadings for each country.



## BRITISH MALAYA

**Sources of basic data:** (1) British Malaya Registrar of Imports and Exports, *Return of Foreign Imports and Exports* (annual); (2) Great Britain Board of Trade, *Statistical Abstract for the British Empire* (annual); (3) Straits Settlements, *Annual Departmental Reports of the Straits Settlements*, and Registrar of Imports and Exports, *Annual Summary of Monthly Return of Foreign Imports and Exports of British Malaya*; (4) Straits Settlements and Federated Malay States Dept. Agr., *Annual Report, Malayan Agricultural Journal* (monthly), and *Malayan Agricultural Statistics* (annual).

**Crop year:** All paddy (padi) is grown during the monsoon or rainy seasons, the more important of which includes the months of September to January. Harvesting takes place during the first quarter of the year, extending the crop year over parts of two calendar years.

**Area:** Reported in terms of acres planted to *wet padi* and *dry padi* (Unfederated Malay States, Federated Malay States, Straits Settlements); there are no data on areas harvested. The figures used here are derived from the latest issue of *Malayan Agricultural Statistics*, though they do not agree precisely with earlier data.

**Yield:** The Rice Cultivation Committee in 1931 considered the figures of yield unreliable, there being a universal tendency to understate yields with the result that actual production of rice in British Malaya probably exceeded reported figures for earlier years. At the time the Committee issued its final report, official statistics showed that local production supplied about 24 per cent of total consumption. The Committee believed: "It would probably not be very far from the truth to assume that the total domestic production of rice in Malaya is approximately  $\frac{1}{3}$  of the consumption" (Federated Malay States, *Report of the Rice Cultivation Committee*, 1931, I, 18).

**Production:** Reported in terms of gantangs (1 gantang = 1 Imperial gal. or 1.2 U.S. gals.) of wet and dry paddy. Production for Malaya as a whole was unknown prior to 1915, though data for the Federated Malay States are available for earlier years. Production statistics are approximations only, and less reliable than those for area. Official practice in converting capacity measures of paddy to weight units of cleaned rice has changed from time to time without correction of earlier figures, the conversion ratio having varied between .512 and .630. In this study, 420 gantangs of paddy have been regarded as the equivalent of a long ton (2,240 lbs.). Paddy has been converted to a cleaned-rice basis by the factor .62. Production data for earlier years have been adjusted accordingly.

**Imports and exports:** Trade returns have been presented in various ways during the past two decades. Commerce is now reported in terms of white rice, parboiled rice, broken rice, cargo rice, and paddy. Prior to 1928, cargo rice was included with white rice; prior to 1934 parboiled and broken rice were included with white rice. Since 1924 the unit used has been the long ton; earlier reports were in Straits piculs (1 Straits picul = 60.48 kgs. or 133.3 lbs.). These earlier reports also provided a breakdown of the data by (1) "Colony," (2) the Federated Malay States, and (3) the Unfederated Malay States.

The classification of "rice meal and bran" has been excluded from the trade figures presented here, and paddy has been converted by the factor .62. Goods imported on through bills of lading for re-export are not included in Malayan

trade returns. Presumably in most cases, final destination is unknown when rice is shipped to Singapore or other Malayan ports for re-export, hence trade conducted on a through bill-of-lading basis is uncommon.

**Prices:** Quotations of foreign rice at Singapore (Appendix Table VIII) are probably more trustworthy than the scattered information on paddy and rice prices at other points in British Malaya for various periods back to 1898. The series for Thai rice is a composite, prices for 1923-29 being for Siam No. 1, and for later years Siam No. 2. In January 1906, the Straits dollar was pegged to the British pound at 2s. 4d. per dollar.

### BURMA

**Sources of basic data:** Until 1937 statistics on rice in Burma were included with the reports for British India (see pp. 340-41). (1) Burma Customs Dept., *Annual Statement of the Sea-borne Trade and Navigation of Burma with Foreign Countries and Indian Ports*, and *Report on the Maritime Trade and Customs Administration [of Burma]* (annual); and Dept. of Land Records and Agriculture, *Season and Crop Report of Burma* (annual).

**Crop year:** The main crop, planted in June, is harvested in December-January; a secondary crop (spring rice) is planted in January and harvested in May. The crop year, April 1-March 31, corresponds with the fiscal year. Both production statistics and trade returns are reported on this basis.

**Area:** Reported as acres sown to rice, although some data are also available on harvested areas (Lower Burma, Upper Burma).

**Yield:** The rice forecast for Burma differs from that for India in that "normal" refers to yield on the area matured rather than on the area sown, and condition reports (five monthly reports beginning in October) are made accordingly.

**Production:** Reported as long tons of cleaned rice. Government statements indicate that the weight of cleaned rice produced is obtained by deducting from 33 to 38 per cent of the reported paddy production.

**Exports:** Reported in terms of long tons of boiled, cleaned, broken cleaned, unclassified (not in the husk), rice in the husk (paddy), rice bran, etc. "Rice bran, etc." has been excluded; and paddy converted to cleaned rice by the factor .625. A very small amount of rice is imported into Burma (averaging about 4,000 tons), upon which data are available since 1926-27. (See also comments under "India: Imports and Exports," pp. 340-41.)

**Prices:** Burma No. 2 in London and at Rangoon (Appendix Table IX) are taken from the *International Yearbook of Agricultural Statistics*. Quotations on Small Mills Specials and Big Mills Specials (Appendix Table VIII) are computed from data in India Commercial Intelligence Dept., Statistical Research Branch, *Review of the Trade of India* through 1934, and are the mean of four quotations using the maximum prices for the first week of January, April, July, and October; from 1935 on, data are from the International Institute of Agriculture and are monthly averages of Friday prices. The series on boat paddy (Appendix Table IX) is taken from Burma Dept. Agr., *Rice* (Markets Section Survey 9, 1940), p. 90. All prices quoted at Rangoon are in terms of baskets of a certain weight: 75 lbs. for rice and 46 lbs. for paddy. In March 1927 the rupee was pegged to the British pound at 1s. 6d. per rupee.

## CEYLON

**Sources of basic data:** (1) Ceylon Director of Agriculture, *Administration Report* (annual); (2) Great Britain Board of Trade, *Statistical Abstract for the British Empire* (annual); Colonial Office, *Annual Report on the Social and Economic Progress of the People of Ceylon* (Colonial Reports); and Imperial Economic Committee, *Grain Crops* (annual); (3) *International Yearbook of Agricultural Statistics*; (4) U.S. Dept. Agr., *Yearbook*.

**Crop year:** The *maha* (6-month crop), planted in late August to mid-October, is harvested in February-March; the *yala* (4-month crop), planted in March-April, is harvested in July-September. As in India, Burma, and Thailand, however, the main crop season extends from April 1 in one year to March 31 of the following year.

**Area and production:** Reliable information is not available. A government publication (Ceylon Director of Statistics and Office Systems, *Handbook of Commercial and General Information for Ceylon*, annual) remarks in connection with some very general estimates that the figures are of "doubtful accuracy." Both the International Institute of Agriculture and the United States Department of Agriculture have published data on area and production of rice in Ceylon, stated to have been obtained "from the government." However, only the figures on area agree with those published in British sources, and the International Institute of Agriculture has now discontinued presentation of any production data for Ceylon. The *Statistical Abstract for the British Empire* states that none have been available for some years. Area, production, and yield data since 1928 included in the Appendix Tables have been derived from *Grain Crops*, which describes the figures there presented (in terms of acres under rice and long tons of cleaned rice produced) as "rough estimates." Earlier data have been taken from the United States Department of Agriculture and the International Institute of Agriculture, converted to a cleaned-rice basis by means of the factor .654.

**Imports:** Original reports are in terms of hundredweights of (a) rice and (b) paddy (1 cwt. = .0508 metric ton). Paddy imports (practically all from India and Burma) are small and have tended to become insignificant. Since 1929 imports have been reported in detail by country of origin; earlier a three-way breakdown (Burma, India, other countries) is available.

## CHINA

**Sources of basic data:** (1) China Maritime Customs, *The Trade of China* (Shanghai, annual); and Ministry of Industry, National Agricultural Research Bureau, *Crop Reports* (Nanking, monthly); (2) *International Yearbook of Agricultural Statistics*; (3) U.S. Dept. Agr., various publications.

**Crop year:** Rice is a summer crop in China (early, medium, late); planting begins in March (first crop in South China), and harvesting in July. Thereafter rice is being harvested in some part of China throughout the remainder of the year. The crop year for rice falls within the calendar year.

**General:** Most statistics relating to China are notoriously poor; those on rice are no exception. During the past decade this situation began to improve with the establishment of a system of crop reporting for the forecast and estimate of crop production by the National Agricultural Research Bureau. Some

6,000 volunteer reporters in 22 provinces supplied information for the estimates published in *Crop Reports* until the Sino-Japanese war interfered. Within rather broad limits, it is possible to secure an impression of the magnitude of the crop, but it is impossible to relate such impressions to pertinent earlier data for the purpose of determining changes in the Chinese rice position.

**Area and production:** Chinese statistics, when published, reported the area planted to glutinous and nonglutinous rice in shi mow (1 shi mow = .0667 hectare) and also the area harvested in most provinces for which estimates were made. Production data for 21 provinces were given in terms of shi piculs of padi (1 shi picul = .05 metric ton). The production series has been carried by the International Institute of Agriculture and by the League of Nations, but the United States Department of Agriculture continues to prefer estimates made by the Shanghai office of its Bureau of Agricultural Economics (for 1930-35 inclusive) and states that official statistics are not available. The difference between the Chinese data and the United States Department of Agriculture data is considerable (8-12 million metric tons) and is only partly accounted for by the various methods of conversion (factors ranging from .62 to .75).

Before 1930 or 1931, various estimates of China's rice production for isolated years were presented in a number of Chinese and foreign publications, and were labeled "unofficial." These guesses covered a range as wide as earlier estimates of Chinese population. During the past decade there seem to be somewhat fewer divergences in the figures from various sources, presumably because of the acceptance of the Chinese data presented in *Crop Reports* as the best available. During the past few years, however, all figures on China's rice production have again been designated as "unofficial estimates."

The deficiencies in the rice statistics of China are so great that little use has been made of the data available on area and production, except in a few summary tables in the text. Only the reports of rice imports into China have been utilized to an important extent in various calculations and speculations. Figures for yields, per capita rice utilization, etc., are necessarily very rough.

**Imports and exports:** Trade statistics for China give no details on the kinds of rice involved for years prior to 1933, but merely report the aggregate quantities of "rice and paddy" imported and exported in piculs (1 picul = .06048 metric ton). From 1933 on, rice and paddy are reported separately (in quintals), but in this study all imports are treated as cleaned rice in order to keep the series comparable. (The reports on the new basis show paddy to comprise almost half of the 1935 imports, which were very large, while in 1938 practically no paddy was included in the total.) A large proportion of China's imports arrive via Hong Kong and were reported until about 1932 as from this port. Official returns for more recent years show imports by country of actual origin, and imports listed from Hong Kong have practically disappeared though this port continues to be the important transshipment point. Rice and paddy exports and re-exports from China normally amount to only a few thousand tons, and these are permitted only by special arrangement with governmental authorities. Since June 30, 1932, the trade of Manchurian ports has been excluded from the official Chinese trade returns.

**Prices:** No very satisfactory information is available on rice prices in China. Most of the series are broken, extending over a relatively short period of time. Some use is made in the text of price data available from special studies by Chinese; the index numbers (Appendix Table IX) of average wholesale

prices of rice in Canton (China National Tariff Commission, *Prices and Price Indexes in Shanghai*, Shanghai, monthly); prices (Appendix Table IX) of Long Changshu at Shanghai (China Institute of Economic and Statistical Research, *Chinese Economic and Statistical Review*, Shanghai, monthly); and data on wholesale rice prices in North China (Nankai Institute of Economics, *Nankai Index Numbers, 1936*, Nankai Univ., Tientsin, March 1937). The yuan has fallen in value from approximately 50 cents (U.S.) in 1926 to 12 cents (U.S.) in 1939.

### CHOSEN (KOREA)

(See Japanese Empire)

### FRENCH INDO-CHINA

Sources of basic data: (1) France Ministère de l'économie nationale, Direction de la statistique générale et de la documentation, *Annuaire statistique de la France*; (2) French Indo-China Administration des douanes et régies, *Rapport sur la navigation et le mouvement commercial de l'Indo-Chine* (annual); Direction des affaires économiques, *Annuaire statistique de l'Indochine*; and Direction des services économiques, *Bulletin économique de l'Indochine* (monthly); (3) *International Yearbook of Agricultural Statistics*, and *Monthly Crop Report and Agricultural Statistics*; (4) U.S. Dept. Agr., various publications.

Crop year: Planting of the early crop in French Indo-China takes place in May-June. The early crop is followed by the seasonal (principal) crop and the late crop. Harvesting begins in November and continues through May so that the crop year for rice extends over portions of two calendar years.

Area, production, and yield: Only within relatively recent years has any attempt been made to discover the area under rice or the annual production in the smaller rice-producing states of Indo-China. The record for Cochin China, the most important producer, is available for many years, however, and official estimates have been made for the other states so that data for Indo-China as a whole may be carried back to 1912.

The area under rice is reported in hectares, and production in quintals of paddy. Production statistics have been converted to a cleaned-rice basis by the factor .62. (A metric ton of paddy when milled yields 770-80 kgs. of cargo rice—20 per cent of which will be broken—and 80-100 kgs. of cargo flour. The cargo rice will give an average of 610-20 kgs. of white rice, including more broken and white flour.)

Statistics on area and production are probably less reliable than those for neighboring countries, but are "official" and the best available. The yields calculated from these data are consequently open to criticism but are not believed to be seriously misleading.

Exports: Statistics on rice exports are available in some detail for many years. Exports are reported in metric tons and classified as *paddy*, *rix cargo*, *brisures*, *farines*, and *entier blanc*. Figures for *farines* (presumably not for human consumption) have been excluded from data presented in the Appendix Tables; paddy has been converted to a cleaned-rice basis by the factor .617 and cargo rice converted by the factor .8. Data for 1932 and the following years

(taken from the International Institute of Agriculture) are not comparable with those for earlier years, as cargo rice has been included with white rice which raises the level 5-20 thousand metric tons as compared with earlier years.

**Prices:** Several price series for different grades of rice exported from Saigon are available on a monthly basis. Whole White No. 2, having 40 per cent broken (also called Japan No. 2), has been selected as probably the most representative grade, and in Appendix Table VIII annual average prices (calendar years) are included for this grade and for Round White No. 1. (Quotations since 1931 are monthly averages of Friday prices and hence are not quite comparable with the monthly averages for earlier years.) These prices are quoted for gross weight, in gunnies, delivered alongside, duty not paid. On May 31, 1930, the piaster was pegged to the French franc at 10 francs per piaster.

### INDIA

**Sources of basic data:** (1) Great Britain Board of Trade, *Statistical Abstract for the British Empire* (annual); and India Office, *Statistical Abstract for British India* (annual); (2) India Commercial Intelligence Dept., Statistical Research Branch, *Review of the Trade of India* (annual); and Dept. Commercial Intelligence and Statistics, *Agricultural Statistics of India* (annual), *Annual Statement of the Sea-borne Trade of British India with the British Empire and Foreign Countries*, and *Estimates of Area and Yield of Principal Crops in India* (annual).

**Crop year:** The main harvest is in December-January. An earlier, minor harvest takes place in September (autumn rice), and a later one in May-June (summer rice). Production statistics (and also trade returns) are on a fiscal-year basis (April 1-March 31) within which falls the crop year for rice.

**Area:** Reported as acres sown to rice. About 96 per cent of the total area under rice is included in the official estimates of area and yields. Included in the unreported area are: Punjab, North-West Frontier Province, Ajmer-Merwara, Delhi, Manpur Pargana, and certain Indian States. The area under rice for which no crop estimates are made is approximately 1,165 thousand hectares.

**Yield:** Official forecasts are based on estimates of the yield of the current crop in relation to a standard normal outturn. The "final" percentage (condition figure) multiplied by the "normal" yield per acre and by the area sown to rice gives the annual crop production. For a short history and explanation of the methods of crop reporting in India, see S. K. Bedekar, "Crop-Reporting in India," *Indian Journal of Economics* (Departments of Economics and Commerce, Univ. Allahabad, Allahabad), July 1938, XIX, 87-97; also for some of the deficiencies in the information on yields in India, see J. A. Hubback, *Sampling for Rice Yield in Bihar and Orissa* (India Agricultural Research Institute, Pusa, Bull. 166, Calcutta, 1927).

**Production:** Reported as long tons of cleaned rice. Government statements indicate that the weight of cleaned rice produced is obtained by deducting 33-38 per cent of the reported paddy production, the proportion varying slightly from province to province. (India is the only country, except Burma, reporting rice production in terms of cleaned rice.) To the rice-production statistics for India should be added about a million tons annually for areas for which no crop estimates are made.

**Imports and exports:** Statistics of commerce by sea have been reported since 1919-20 under four main heads: (1) paddy (rice in the husk); (2) rice

not in the husk—cleaned, broken, other sorts; (3) rice flour and ground rice; (4) rice bran. Earlier reports separated paddy from other sorts of rice and included rice meal under "brand and pollards." Paddy exports have been converted to a cleaned-rice basis by the factor .625; and rice flour has been excluded. Imports of paddy, by both sea and land, have been converted to a cleaned-rice basis by the factor .6172.

A considerable volume of rice was formerly imported into India across land frontiers, and smaller amounts were exported. This trade was poorly recorded, but beginning in 1926-27 the system of reporting was changed to provide more complete information. Imports by land (now a very small proportion of the total) are reported as "husked" and "unhusked"; exports as "husked" only. The unit employed is the maund (1 maund = .037 metric ton) rather than the long ton or hundredweight used in reporting trade by sea.

All trade reports are on an April 1-March 31 basis, though useful abstracts are also available giving data on a calendar-year basis.

Prices: Various types of price series on rice and paddy are available for certain parts of India and for certain periods, but their quality is difficult to appraise. Selected for inclusion in Appendix Table IX is the series for Ballam No. 1 grade at Calcutta (wholesale), which is believed to be representative and is more complete than other series, especially for the years since the first World War. Annual averages (calendar years) have been computed from reported maximum prices for the first week in January, April, October, and December, except for the period 1923-29, when monthly averages of weekly quotations were used. In March 1927 the rupee was pegged to the British pound at 1s. 6d. per rupee.

### THE JAPANESE EMPIRE (Japan, Chosen, Taiwan)

#### Sources of basic data:

*Area and Production.* (1) Chosen, *Agricultural Statistics of Chosen* [translated title], and *Statistical Yearbook*; (2) Japan Dept. Finance, *Financial and Economic Annual of Japan*; and Ministry of Agriculture and Forestry, *Statistical Annual on Rice* [translated title], and Section of Statistics, *The Statistical Abstract of the Ministry of Agriculture and Forestry* (annual); (3) Japan-Manchoukuo Year Book Co., *Japan-Manchoukuo Year Book* (Tokyo, annual).

*Exports and Imports.* (1) Chosen, *Agricultural Statistics of Chosen* [translated title], and *Monthly Return of Trade of Chosen* [translated title]; (2) *International Yearbook of Agricultural Statistics*, and *Monthly Crop Report and Agricultural Statistics*; (3) Japan Dept. of Finance, *Annual Return of the Foreign Trade of the Empire of Japan*, *Monthly Return of the Foreign Trade of Japan*, and *Monthly Trade Returns with Chosen*; and Ministry of Agriculture and Forestry, *Statistical Annual on Rice* [translated title]; (4) Taiwan, *Returns of the Trade of Taiwan (Formosa) for the Thirty Years from 1896 to 1925* (1926); (5) U.S. Dept. Agr., various publications.

*Crop year:* The Japanese rice year covers the period November 1-October 31. Harvesting in Japan extends from August through December (varying with the district); in Chosen the harvest is in September-October; and in Taiwan, October-November (second crop) though the first crop is harvested in June-July.

**General:** There is no lack of rice statistics for the Japanese Empire, but their use is often rendered extremely difficult by contradictions, inconsistencies, poor translations, insufficient details, and unannounced changes in statistical procedures. When resort is had to official publications printed in Japanese, many difficulties remain because of the absence of explanatory notes, the failure of data given in one publication to check with another from the same government department, the use of crop year in some cases and calendar year in others, different meanings of terms, and so on.

When inconsistencies have been of a minor nature, no attempt has been made to correct them. When major discrepancies have appeared, the practice in this study has been to reconcile them in so far as possible, and if this has not been accomplished to use the very arbitrary method of adopting the figures appearing in the greatest number of official sources. The difficulties in securing comparability have been great; the statistics presented in the Appendix Tables are sometimes patchwork. Possible errors, however, are not believed to be of sufficient import to alter any conclusions in the text based on these data.

**Area:** Reported in terms of cho for Japan and Chosen (1 cho = .9917 hectare), and in ko for Taiwan (1 ko = .9699 hectare). Until about 1933 the data for the area under rice in Japan showed such a consistent regular increase from year to year as to arouse some doubt regarding their accuracy. Smaller fluctuations are to be expected, but the absence of any irregularity for a period of two decades is quite unusual.

**Production:** Reported in koku of *genmai* (brown rice) for all parts of the Empire. The Japanese publications in English indicate that production statistics are in terms of unhusked rice, i.e., under the common interpretation, paddy. Actually, they are in terms of brown rice (nearer cleaned rice) and are only unhusked in the sense that the skin surrounding the rice kernel has yet to be removed. The koku is a measure of capacity, and there appear to be various ratios for converting *genmai* into weight units of cleaned rice. The conversions used in this study have been secured direct from the Chief of the Section of Statistics of the Ministry of Agriculture and Forestry. Data supplied by the Japanese government indicate that: 1 koku of *genmai* (brown rice) weighs .1451 metric ton and produces 91.3 per cent of *seimei* (cleaned rice) by weight.

For many years production was reported simply as "rice," and many of the statistics of the trade still record transactions under that general head. Changes in statistical methods are sometimes made without adequate warning that published figures are lacking in comparability. For example, the rice production of Chosen was reported as 3.6 million tons in 1937-38 and 3.2 million tons in 1938-39, a very substantial increase over the 2.4 million figure for 1935-36 and 2.6 million tons reported for 1936-37. If these data were accepted at their face value, one could conclude that harvests were quite exceptional as the area under rice changed very little.

**Yields in Chosen:** In 1936, H. K. Lee questioned the accuracy of the yield statistics for Chosen, stating that "we are strongly inclined to assert that the government figures for yield are too small . . ." (*Land Utilization and Rural Economy in Korea, A Report in the International Research Series of the Institute of Pacific Relations, Shanghai, 1936, p. 61*). Lee investigated 1,249 farm households in 48 "representative" localities, and apparently the Chosen authorities adjusted their statistics to the results obtained from this survey, for the official estimate for the 1937 crop was some 38 per cent larger than for the preceding



year. On the basis of such crop reports as are available, one is inclined to agree with A. J. Grajdanzev that Let's sample studies were much more favorable than the average ("Korea under Changing Orders," *Far Eastern Survey*, American Council, Institute of Pacific Relations, New York, Dec. 20, 1939, p. 294).

**Stocks:** Japan is the only country for which data are available over a period of years on the carryover of supplies from one crop year to the next. Year-end stocks of rice (in thousand metric tons of cleaned rice), and the percentage relationship of the annual carryover to the previous year's production (Appendix Table II), are shown below for October 31, 1913, and following:

Year	Stocks	Percentage of preceding crop	Year	Stocks	Percentage of preceding crop
1912-13.....	289	4.3	1925-26.....	791	10.0
1913-14.....	774	11.6	1926-27.....	764	10.4
1914-15.....	826	10.9	1927-28.....	1,039	12.6
1915-16.....	770	10.4	1928-29.....	931	11.7
1916-17.....	593	7.7	1929-30.....	758	9.6
1917-18.....	313	4.3	1930-31.....	1,211	13.7
1918-19.....	551	7.6	1931-32.....	1,180	16.1
1919-20.....	730	9.1	1932-33.....	1,193	14.9
1920-21.....	1,081	12.9	1933-34.....	2,177	23.2
1921-22.....	968	13.2	1934-35.....	1,316	19.2
1922-23.....	899	11.2	1935-36.....	1,061	10.6
1923-24.....	690	9.4	1936-37.....	995	11.2
1924-25.....	729	9.6	1937-38.....	1,125	12.8
			1938-39.....	538	6.2

**Exports and imports:** Trade statistics, when not reported in koku, are in weight units, the picul or kin (1 picul = 100 kin = 60 kg. = 132.28 lbs.), and in terms of brown rice (called "rough"), white rice (cleaned), broken rice, paddy, whole white rice, flour, and other. Brown rice has been converted to a cleaned basis by the factor .913, and paddy by the factor .7 (after conversion of koku or kin to metric-weight equivalent). One koku of paddy is taken as equivalent to .10204 ton of paddy; 1 koku of white rice as equivalent to .1429 ton of white rice; and 1 koku of brown rice as equivalent to .1451 ton of brown rice.

Imports of rice into Japan are, in general, not available by kind. In recent years foreign imports have been reported in detail, but in order to obtain the same detail regarding imports from colonies it is necessary to use the export statistics of Chosen and Taiwan. Discrepancies between the reported exports of the colonies to Japan and the imports into Japan from the colonies are numerous but generally of minor importance. In some of the government tabulations (in Japanese), paddy and all forms of rice are added together; in others a separation is made. The bulk of the intra-Empire trade is in brown or white rice. The foreign trade of Japan has been adequately recorded by kind of rice and country of origin and destination, and the trade returns of Taiwan are fairly satisfactory. But those for Chosen are lacking in detail and are often confusing because the totals given do not equal the sum of the individual items

reported, total exports are sometimes smaller than exports to Japan alone, etc. The re-export trade probably accounts for some of the differences.

**Prices:** Although data are available on prices of rice from Chosen and Taiwan in the Osaka and Kobe markets, the only series included in the Appendix Tables (IX) is for Japanese rice in the Fukagawa Rice Market in Tokyo. Data for the years 1912-31 are from Institute for Commercial Research, *The Eighth Annual Bulletin of the Financial and Economic Statistics of Japan, 1913-1932* (Kobe Univ. Commerce, Kobe, 1932), and for 1932-39 from *Monthly Crop Report and Agricultural Statistics*. Quotations since 1931 are not strictly comparable with those for earlier years. One koku is equivalent to 1.804 hectoliters. The Japanese yen has ranged in value from about 50 cents (U.S.) in 1912 to 26 cents (U.S.) in 1939.

#### NETHERLANDS INDIES

**Source of basic data:** (1) *International Yearbook of Agricultural Statistics*, and *Monthly Crop Report and Agricultural Statistics*; (2) Netherlands Centraal Bureau voor de Statistiek, *Jaarcijfers voor het Koninkrijk der Nederlanden. Koloniën*; (3) Netherlands Indies Departement van Economische Zaken, Centraal Kantoor voor de Statistiek, *Indisch Verslag. II, Statistisch Jaaroverzicht van Nederlandsch-Indië over het Jaar*, and *Die Landbouwexportgewassen van Nederlandsch-Indië (Beplante Uitgestrektheden, Producties en Uitvoeren)* (Mededeelingen, annual); and Departement van Landbouw, Nijverheid en Handel, *Economisch Weekblad voor Nederlandsch-Indië*, (and its supplement) *De Inlandsche Landbouw* (annual), and *Korte Berichten voor Landbouw, Nijverheid en Handel* (weekly), and Centraal Kantoor voor de Statistiek, *Jaaroverzicht van den In- en Uitvoer van Nederlandsch-Indië Gedurende het Jaar* (Mededeelingen, Weltevreden).

**Crop year:** Planting and harvesting of rice in Java and Madura takes place throughout the year. The so-called early crop (Middle Districts and East Java) is harvested in March-April while the main crop (lowlands of West Java) is harvested in May-June. The crop year for rice is considered as coinciding with the calendar year. In Appendix Tables I-III inclusive data for Java and Madura refer to the calendar year indicated as the beginning of the crop year for most countries, i.e., 1910 production is combined with 1910-11 for other countries.

**Data available:** Reliable data are available on area and production only for Java and Madura, and only since 1916. In the past few years data for Bali and Lombok have also become available. Earlier reports are incomplete for all parts of the Netherlands Indies. Statistics on trade are available for all of the Outer Provinces as well as for Java and Madura. Frequent revisions in the statistics have been made, but they are usually published in later issues of official reports.

**Area:** Reports give details on both planted and harvested areas for irrigated (*sawahpaddy*) rice and the area planted to nonirrigated (*padigogo*) rice, in terms of bouw or hectares (1 bouw = .70965 hectare).

**Production:** Reported in piculs or quintals (depending upon source) of unhusked rice harvested on irrigated and nonirrigated lands (1 picul = .06176 metric ton). Official publications state that dry paddy and (shelled) rice are in proportion as 100 : 50. For 1925 and earlier years, the relation was stated

differently, i.e., wet paddy, dry paddy, and (shelled) rice are in proportion as 100 : 75 : 50. The former official conversion of paddy to a cleaned-rice basis by the factor .666 is nearer the rule for other countries, while the more recent rate of .5 seems to be nearer the proper figure for converting on a volume basis. However, the current official practice is confirmed by other government reports in which production statistics are presented in terms of cleaned rice, and we have used the factor .5 throughout.

**Imports and exports:** Changes in the form of reporting imports and exports have been numerous, making it difficult to compile comparable figures in detail. However, the trade movement without regard to direction is available for both the Outer Provinces and Java and Madura. Trade statistics have usually been presented in metric equivalents. Until about a decade ago, the subdivision of exports by kind was: peeled rice (*rijst gepelde*), unpeeled rice (*rijst ongepelde*), and others. Since then reports specify uncleaned, cleaned, broken, rice meal (feedstuffs), rice meal (*dedak*), and other rice. Rice products not intended for human consumption have been excluded in the data presented in the Appendix Tables. Imports have been reported in terms of cleaned rice, paddy (converted to a cleaned-rice basis by the factor .617), and "others."

**Prices:** Although not lacking in volume and variety, data on rice and paddy prices in the Netherlands Indies are lacking in continuity. Several series are available since about 1920, however, and are included in the Appendix Tables. Prices of foreign rice in the three leading markets of Java (Appendix Table VIII) are from *Korte Berichten voor Landbouw, Nijverheid en Handel, and Indisch Verslag. II, Statistisch Jaaroverzicht van Nederlandsch-Indië over het Jaar* from 1932 on. (Since October 1933, quotations are computed from telegraphic offers from Rangoon and Saigon.) Beras (white) No. 2 is probably the most representative grade of native rice and this series, along with average annual prices of paddy, are presented in Appendix Table IX. In addition to the sources mentioned above, Netherlands Indies Departement van Landbouw, Nijverheid en Handel, Centraal Kantoor voor de Statistiek te Weltevreden, *Prijzen, Indexcijfers en Wisselkoersen op Java 1913-1926* (Mededeelingen 46, 1927) and *Economisch Weekblad voor Nederlandsch-Indië* have been used to obtain quotations on native rice and paddy for certain years. Prior to 1940 the Netherlands Indies used Dutch guilders or florins.

#### PHILIPPINE ISLANDS

**Sources of basic data:** (1) Philippines, *Report of the Rice Commission to the President of the Philippines* (1936), pp. 60, 68; Bur. Comm. and Industry, *Statistical Bulletin of the Philippine Islands* (annual); Dept. Agr. and Comm., *Bulletin of Philippine Statistics* (quarterly); Dept. Agr. and Natural Resources, Bur. Agr., *Annual Report*; and Dept. Finance, Bur. Customs, *Annual Report of the Insular Collector of Customs*; (2) Philippines, National Rice and Corn Corporation, *The NARIC*.

**Crop year:** The rice harvest begins as early as October in some parts of the Philippine Islands and extends through May of the following year, but the main crop is harvested in the four months, December-March. Statistics are usually presented for years ending June 30.

**Area:** Reports presumably give the areas harvested (in hectares), though some official sources specify areas planted for identical figures.

**Production:** Reported in cavan and/or kilos of rough rice (*palay*). Weights and measures are not standardized in the Philippines, but the government has attempted to establish the weight of a cavan of *palay* at 44 kilos and a cavan of rice at 57 kilos. A cavan of *palay* yields, on the average, about 28 kilos of cleaned rice (*arroz*), giving a conversion factor for rough to cleaned of .636.

**Imports and exports:** No information is available upon the kind of rice imported into (or exported from) the Philippines. The assumption has been made that cleaned rice predominates. Export returns of Indo-China and Thailand, the chief sources of supply, indicate that shipments to the Philippines are mostly cleaned or white rice, or broken forms equivalent to cleaned rice. Trade returns express quantities involved in kilograms.

**Prices:** Changes in grades quoted or place of quotation prevent a strictly comparable series for either rice or paddy prices in the Philippine Islands. Those presented in Appendix Table IX are composites, but are the most complete available. Prices of *palay ordinario*, delivered at Cabanatuan, Nueva Ecija, an important paddy-gathering center in Luzon, are probably representative for later years (from 1926) but are not comparable with the average prices of paddy in 48 provinces for the earlier years. The series on native cleaned rice at Manila is for all kinds of rice quoted in the Manila market. Quotations on particular grades, e.g., Elon-Elon, second class, do not extend back for so many years and are not given in Appendix Table IX. Although this particular grade corresponds with a general quality which accounts for a very large proportion of the total production of the Islands, it sells at a higher price than the indicated average of all grades for earlier years. On June 13, 1922, the Philippine peso was pegged to the dollar (U.S.) at 50 cents (U.S.) per peso.

### TAIWAN (FORMOSA)

(See Japanese Empire)

### THAILAND (SIAM)

**Sources of basic data:** (1) *International Yearbook of Agricultural Statistics*; and *Monthly Crop Report and Agricultural Statistics*; (2) Thailand Dept. Customs and Excise, *Annual Statement of the Foreign Trade and Navigation of the Kingdom of Siam*, and *The Foreign Trade and Navigation of the Port of Bangkok* (annual); and Ministry of Economic Affairs, Bur. General Statistics, *Statistical Year Book of the Kingdom of Siam*.

**Crop year:** Although harvesting begins in the Central Plain in September and extends through May in the southern section, the main harvest occurs in December-January, and the crop year for rice falls within the Thai year April 1-March 31.

**Area:** Both the planted and harvested areas are reported in rai (1 rai = .16 hectare).

**Weights and measures:** The Thai picul is equal to 60.48 kilograms and all data herein have been converted on this basis, but the standard picul is defined as 60 kilograms. Since adoption of the principle of the metric system in 1923, it has been the government's policy to recognize existing weights in com-

mercial use "rounded off to whole numbers of metric units" with the idea that when the customary units have lost their force they can be removed from the law.

**Production:** Reported in piculs of *padi* and converted to a cleaned-rice basis by the factor .617. Before the first World War, it was rather difficult to obtain satisfactory information on production, but data published by the government for years since 1920-21 appear to be quite complete and understandable.

**Exports:** Reported in terms of piculs of white, white broken, cargo, cargo broken, paddy, white meal, and cargo meal, the latter two items being excluded from the Appendix Tables as they are presumably not for human consumption. Cargo rice is converted to cleaned by the factor .8, and paddy by the factor .617. Trade statistics prior to 1926-27 used in this study apply to the Port of Bangkok only; data are available on the small volume of trade originating at other points only since 1920-21, and are available to us only without details by classes or destinations prior to 1926-27. Since 1920-21 figures on rice exports include traffic passing across the southern frontier by rail as well as the sea-borne trade. Some rice is imported from Burma for transshipment to Penang and British Malayan states, but the record of this traffic (presumably small) is not readily available, or may not even be recorded.

**Prices:** Several series of wholesale rice and paddy prices are available for Thailand from official sources. Prices of Ordinary No. 1 white rice (15-25 per cent broken) and Ordinary No. 2 white rice or Straits Quality (25-50 per cent broken), which are consumed locally and also exported, are given in Appendix Table VIII. (These grades are also called Siam Garden No. 1 and Siam Garden No. 2.) The Straits Quality (No. 2 grade) is perhaps most representative and most nearly comparable with Burma's Small Mills Specials and Indo-China's Whole White No. 2. Data are also available since 1914-15 on prices of various grades of broken rice, rice meal, and since 1922 on paddy. Eleven bahts are approximately equivalent to a British pound.

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