WHEAT STUDIES

OF THE

FOOD RESEARCH INSTITUTE

VOL. XII, NO. 3 (Price $.75) NOVEMBER 1935

JAPANESE SELF-SUFFICIENCY IN WHEAT

BETWEEN 1932 and 1935, Japan increased wheat production 60 per cent and became self-sufficient. High wheat prices relative to barley and systematic governmental encouragement caused acreage to expand, mostly at the expense of barley. The reimposition of the gold embargo and a modest tariff increase supported domestic wheat prices. Yields, though greatly increased, contributed rather less than acreage expansion. The government conducted educational programs to improve methods and introduce superior varieties. Growing of superior seed wheat and small-scale milling were subsidized. Research to develop superior varieties was intensified. Growers were not subsidized. It is uncertain whether improvement of yield was solely due to governmental efforts or also to favorable weather.

In the immediate future, Japan will probably remain self-sufficient, or nearly so. The trend of per capita wheat disappearance in recent years has been stationary or slightly downward. Immediate considerable increase in per capita consumption is unlikely. Unless there is, and unless forecasts of population growth are wrong, Japan will probably require about 63 million bushels of wheat annually, and perhaps only 53 million bushels, when population becomes stationary soon after 1950. This volume of wheat she is capable of producing.

As long as Japan remains self-sufficient, she is likely to import for domestic use only modest amounts of strong wheat. She will continue to import a large volume to mill for export. She has lost most of her market in China, but increased exports to Manchukuo, Kwantung Leased Territory, and her other dependencies have more than compensated for this loss. The greater part of her exports now go to points within the Empire.

STANFORD UNIVERSITY, CALIFORNIA

November 1935

WHEAT STUDIES
OF THE
FOOD RESEARCH INSTITUTE

Entered as second-class matter February 11, 1925, at the Post Office at Palo Alto, Stanford University Branch, California, under the Act of August 24, 1912.

Published ten times a year by Stanford University for the Food Research Institute.

JAPANESE SELF-SUFFICIENCY IN WHEAT

I. BACKGROUND OF THE FIVE-YEAR PLAN

Japan's balance of merchandise trade has been adverse or negative for many years. It is natural that each ministry should endeavor to approach a less unfavorable balance by stimulating exports while discouraging imports. The Japanese policy seems to be to encourage industrialization in the most modern sense; at the same time she refuses, like the United States, to grasp either horn of the identical dilemma that England faced and resolved when she repealed the Corn Laws in 1846. Both the United States and Japan hope to "balance" agriculture and industry in such a way that the farmer as well as the industrial worker may enjoy a rising internal standard of living.

For the United States, this might mean a high domestic price level for the products of agriculture, together with the export of a considerable agricultural surplus at world prices, while at the same time maintaining in operation a considerable industrial plant also working for the export market. Many factions in the United States acclaim high prices for the food, clothing, and other products of agriculture the industrial worker must buy. These are factors tending to reduce *real* urban wages. Yet at the same time, high *real* wages are sought, and this is a factor tending to raise manufacturing costs and to weaken the competitive position of the United States in the world's markets for manufactured goods.

Japan's dilemma is similar: where the United States exports such agricultural goods as cotton, tobacco, pork products, and (until latterly) wheat, Japan exports raw silk. But there are two important differences which make Japan's dilemma more difficult than that of the United States. In the main, the manufactures which the United States mostly exports (e.g., machinery and motor cars) are made from domestic raw materials, whereas in the main the manufactures Japan exports (e.g., cotton textiles and flour) are made from imported raw materials. The other difference lies in the character of the international accounts of the two countries. In recent years, the United States has been on balance a heavy net long-term creditor. Any decrease of imports, therefore, hampers the collection of the credits due to us; Japan on the contrary is on balance a net debtor nation on long-term account. A decrease of imports facilitates the balancing of her international accounts. Regarded from this point of view, her international economic policy should, in theory, be the opposite of that of the United States. The position of Japan resembles that of Germany.

But in Japan, as in the United States, the government would like to promote both industry and agriculture, and it has spent in excess of 250 million yen since 1921 in administering the rice-control law—many competent students believe to little purpose. Except for tariffs, monetary policy, and valorization of silk, there has been little other conscious economic interference with agriculture, directly or indirectly, on the part of the government. The rice law is characteristic of the widespread and popular attempt to carry water on both shoulders. The government wants the farmers to be prosperous, but not too prosperous; otherwise food prices rise, the cost of living goes up, real wages go down, and money wages in industry must be raised in compensation. But high money wages of industrial labor are a handicap on export, even for technically efficient plants.

CONTENTS

With such a policy—whether consciously adopted or merely the resultant of conflicting economic forces—it is not astonishing that the Japanese farmer has not been prosperous, certainly not as prosperous as during the war-time boom. His war-time prosperity led him to improve his standard of living. Very naturally, he resists lowering it, in the face of a reduction of income, which in recent years has dropped materially—perhaps by as much as 30 per cent. The consequence is mounting indebtedness. In the better farming regions, about 40 per cent of the cultivators are steadily sinking into debt; in the poorest farming districts, up to 80 per cent. "Most farmers and peasants are unable to make both ends meet no matter how hard they work . . . . their earned income is below actual expenditure, while in the case of factory workers, earned income is more than sufficient to meet actual expenditure."[1]

Japan, like England in the early nineteenth century, must choose either to promote industry and sacrifice agriculture or to promote agriculture and sacrifice industry. Today she feels that she can sacrifice neither, and tries to promote both. She feels she must be self-sufficient with respect to her food supply, but at the same time that she must industrialize to give employment not merely to her growing population but also to the surplus population on her farms.[2] So she is compromising—trying to promote industry with the minimum injury to agriculture. Very likely she will continue compromising, for this is a method of cushioning the blow to farmers. The ultimate end is likely to be the sacrifice of agriculture so far as necessary to give industrial workers cheap food, thereby keeping *real* wages down and thus favoring exports.

Such an outcome, for the foreseeable future, seems inevitable for at least two reasons. One is that the character and extent of the arable land of Japan proper is such that she can produce enough food on it for her growing population only at increasing cost. But rising food costs reduce real wages, and would be resisted, since higher money wages would result. Higher money wages would raise manufacturing costs and weaken Japan's position in the markets of the world where she sells her manufactures. She must, therefore, keep food costs down and in the end she will have to reorganize a goodly fraction of her agriculture and depend more, as England did, on imported foodstuffs. Unlike England in the days before Australia and Canada sent wheat to the United Kingdom, Japan[3] may draw the food she needs from within the Empire. That Empire, taken as a whole, is even today to a slight extent a net exporter of foodstuffs.[4]

The second reason is to be found in Japan's imperialism. Already Japanese farmers are feeling the competition of rice from Chosen and Taiwan. Her sugar-beet farmers on Hokkaido will feel the competition of the sugar-cane plantations of Taiwan. She may one day find Chosen and Taiwan as embarrassing economically as the United States has found the Philippines—and with no easy method to sever the bond that binds them to her. Difficulties with Manchukuo have already appeared in the form of a new tariff promulgated in the fall of 1934, superseding the old Chinese tariff. Against this, Japanese industrialists have complained bitterly. It is temporary and will be replaced by a permanent agreement between Manchukuo and Japan. Fears are widely expressed in manufacturing circles that this agreement will be even more protective for Manchukuo, and therefore harmful to Japan's interests. However, Manchukuo is not an integral part of the Empire and Japan could isolate herself politically at any time more easily than from Chosen or Taiwan, though by no means very easily. If Japan continues in her imperialistic policies, her farmers will face the competition of the cheaper land and cheaper

[1] I. Asahi, *The Secret of Japan's Trade Expansion* (Tokyo, International Association of Japan, 1934), p. 63.

[2] E. F. Penrose, *Population Theories and Their Application, With Special Reference to Japan* (Food Research Institute Miscellaneous Publication 7), 1934, pp. 137 ff.

[3] Unless otherwise specified, "Japan" as used in this study means Japan proper, i.e., the Japanese archipelago without Chosen (Korea), Taiwan (Formosa), or other dependencies.

[4] G. B. Sansom and H. A. Macrae, *Economic Conditions in Japan, 1933–1934* (Great Britain, Department of Overseas Trade, No. 604), 1935, p. 47.

labor of her colonies, possessions, dependencies, and spheres of influence.

With this policy of fostering exports and restricting imports in the interest of balancing her international accounts, it is not astonishing that Japan should endeavor to become self-sufficient with respect to wheat. Since the 1890's, Japan has been a net importer of wheat, and since the war in considerable amounts, chiefly from North America and Australia (see Table IV). Thus she supplemented her increasing domestic crop as her population grew apace and her per capita consumption rose.[1] For the decade ending in 1931–32, net imports on average amounted to 16 million bushels a year, valued at 45 to 50 million yen. If Japan achieved self-sufficiency, her balance of merchandise trade would be improved correspondingly.

But balancing her merchandise trade was not Japan's sole reason to endeavor becoming self-sufficient with respect to wheat. She hoped also to achieve a greater degree of security with respect to her food supply and to relieve agricultural distress.[2]

Security as an objective requires little comment. Japan, in common with most modern nations, desires to make her food supply secure in time of war. But it is a significant commentary on the position wheat has gained in this rice-eating country that wheat should have been considered a sufficiently important element of the food supply from the standpoint of security to warrant special attention. Be it noted, however, that very little was said by advocates of a new wheat policy regarding the need to enlarge the food supply of the inhabitants of Japan proper. It was not suggested that more wheat was needed to feed the masses adequately. In a world which thinks it is suffering from agricultural surpluses, peoples need be undernourished only if they lack purchasing power. The problem of preventing food shortage in peace time was not an element of the wheat question of Japan. There were, however, statements in some quarters that wheat is a better food than rice and that it would be good for the Japanese if they ate more bread and less rice.

As shown above, the need of the farmer for assistance has been very real. Making wheat growing more remunerative promised to be especially helpful to tenant farmers, because land rents are commonly paid in rice and amount to 50 to 60 per cent of the rice crop. Since rice and wheat do not compete with one another for land (see p. 66), the tenant farmer need not share with the landlord any return he gets from his wheat crop. In the long run, if more wheat is grown, of course gradual readjustment of land rents was bound to follow by which the tenant would lose a part of this advantage, but the agricultural crisis has been so severe that even temporary assistance lasting some years promised to be of great importance. Moreover, making wheat growing more remunerative did not threaten seriously to raise the cost of living of the urban and industrial worker, for wheat is a minor element in his food costs. Real wages would not be threatened.

Proposals to make Japan self-sufficient with respect to wheat, therefore, had the support of most classes: of the military classes on the score of security, of the industrial classes (the large milling corporations excepted) on the ground that it might assist in the balancing of international accounts, of the farmers naturally, and of other groups from sympathy for the tenant farmer. General sympathy for the agricultural classes has been a potent factor in shaping agricultural policy in Japan as it has in America. Sympathy for the farmer was especially felt by the military class, so many of whom are drawn from the agricultural and land-holding elements.

A general plan to render Japan more self-sufficient in many directions seems first to have been made public in 1930 by Jotaro Yamamoto, chairman of the economic committee of the Seiyukai Party, then in opposition. It included proposals to make Japan self-sufficient with respect to wheat. Originally, it was a ten-year plan, but to adapt it to depression conditions it was gradually scaled down until it had become a Five-Year Plan[3] when the President of the Seiyukai Party, Inukai,

[1] See data in Tables IV, VI, and IX.

[2] Asahi, *op. cit.*

[3] Cf. S. Washio, "Seiyukai Adopts Yamamoto Plan in Party's Campaign Platform . . . . ," *The Trans-Pacific* (Tokyo), Feb. 4, 1932, XX, 4.

formed a new cabinet of Seiyukai members on December 12, 1931. This ministry began forthwith to put portions of the Plan into effect, beginning with the reimposition of the embargo on gold on December 13, 1931.[1] Measures to stimulate wheat production which were introduced later were merely part of a general plan for self-sufficiency, exactly as were analogous measures in Western countries.[2]

In the first week of April 1932, the Ministry of Agriculture and Forestry announced its decision to carry out a plan to increase production of wheat at a total cost of about 10 million yen of which 2.04 million yen were to be allocated to the year 1932.[3] At about the same time, this ministry appointed a commission to work out a practical plan which was promptly put into effect. Although this entailed a 50 per cent increase in production, the objective was soon reached, with government measures reinforced by other favorable influences. Following a marked increase in output in 1933, the crop of 1934 practically equaled the usual domestic disappearance and that of 1935 exceeded it.[4]

Five years ago, when we published an analysis of "Japan as a Producer and Importer of Wheat,"[5] so large an expansion was not in prospect. Why the new policy and program were adopted, what steps were taken, what actually transpired, how non-governmental factors figured in the outcome, how permanent the change in position and trend are likely to prove, and what the outlook is in other respects—to some of these questions this WHEAT STUDY endeavors to give answers. First, however, we need briefly to survey some aspects of Japanese agriculture and to envisage the place of wheat among the crops.

II. WHEAT IN JAPANESE AGRICULTURE

SUMMER CROPS AND WINTER CROPS

Wheat culture in Japan and in many other rice-growing regions with similar climate has a character of its own. In such countries, two kinds of agriculture exist side by side: farming with and without irrigation. Irrigated land is known to Western agronomists as "paddy land," from the Malay word for unhusked rice. Unirrigated land is known as "upland," although some paddy fields may be on a hillside at a higher level than some unirrigated fields. Slightly more than half of Japan's 15 million acres of "arable" land is paddy fields, though the upland arable area has increased at a more rapid rate until the past decade.[6]

The irrigated land in Japan produces at least one crop in summer and also, where climate and drainage permit, at least one in winter, unless the field has been planted to perennials or to crops requiring a year to mature. The area in such crops is small. Irrigated land almost everywhere is planted to rice in summer; only three per cent of the area officially classed as paddy land is not sown to this grain. It may be in mulberry, in fruit trees of many kinds, in osiers, in vines, lotus roots, sugar cane, peppermint, and various kinds of truck crops; and some of it is even devoted to fish culture. Most of these crops are perennials and occupy the land for the whole year or longer (exceptions are lotus and vegetables). Even peppermint is planted as root cuttings in the fall and occupies the land for a year, the herb being harvested several times during the summer.

The summer rice crop is followed by some winter or "second" crop, provided climate and drainage permit. The designation "second" does not necessarily imply second in income return, although by and large rice yields a greater return per unit area than do most of

[1] G. B. Sansom and D. W. Kermode, *Economic Conditions in Japan to December 31st, 1931* (Great Britain, Department of Overseas Trade, No. 541), 1933, pp. 11–12.

[2] See A. E. Taylor, "Economic Nationalism in Europe as Applied to Wheat," WHEAT STUDIES, February 1932, VIII, 261–76; "The International Wheat Conferences during 1930–31," *ibid.*, August 1931, VII, 439–75; J. S. Davis, "The World Wheat Problem," *ibid.*, July 1932, VIII, 409–44.

[3] "Ministry Wants More Wheat Here . . . . ," *The Trans-Pacific* (Tokyo), April 7, 1932, XX, 14.

[4] See Chart 3 and Tables IV and VI.

[5] By W. Y. Swen and C. L. Alsberg, WHEAT STUDIES, July 1930, VI, 351–78.

[6] *Ibid.*, p. 371.

the winter or second crops. The term is merely expressive of the attitude of the Japanese farmer whose activities center around rice and for whom other crops tend to be of secondary or subsidiary importance.

Where the climate is warm enough the year 'round, the second or winter crop may be rice again. Since very little of Japan proper has so favorable a climate, the total area in second crops of rice is insignificant.[1] Over much of Japan wherever drainage is good, the most important second crops are naked barley,[2] common barley, and wheat. Where the climate is least favorable because winters are severe and snowy, very little irrigated land is double-cropped and second crops of wheat, naked barley, and common barley are not important on paddy fields. This is the situation along most of the western shore line bordering the Sea of Japan, and especially in the northern and northeastern prefectures of Honshu, and also on the northern island, Hokkaido. It is in these regions that rice culture is most hazardous and failure in cool summers not infrequent. Elsewhere in Japan, the principal danger to rice is from typhoons, and in a few regions occasionally from a lack of irrigation water.

The area of paddy fields that lies fallow from choice at any time of the year is almost nil. Practically all of them are planted to rice in summer. A good deal, however, remains uncultivated in winter, because the climate is too cold or because the fields are so situated that they cannot be drained, but are either submerged or too wet and cold for cropping. "Of these single-crop fields, the portion which cannot be made double-crop on account of difficulty in irrigation or drainage covers 693,000 *cho*[3] [1.69 million acres]; of which the portion with insufficient irrigation is 136,000 *cho* [0.33 million acres], and the portion with imperfect drainage, 557,000 *cho* [1.36 million acres], the former representing 4.4 per cent of the total area of the paddy fields, and the latter 15 per cent. By improving the facilities for irrigation or drainage 475,000 *cho* [1.16 million acres] of the one-crop paddy field could probably be changed into a two-crop field. In the case of the rest it is impossible to make such a change, owing to the climate [including altitude] and other conditions."[4]

However, there are a few minor crops that can be grown in winter on land too wet for winter grain where the climate is mild. Examples are *shichito-i* (*Cyperus malaccensis*),[5] which occupied about 6,520 acres, and *bingo-i*, the matting rush which occupied about 11,424 acres in 1931 and is used in the manufacture of *tatami*, the almost universal floor covering. Much of the very considerable area of paddy fields that yields only one crop because of cold winters lies in northern Japan, namely in Tohoku and Hokuriku. The very limited area of it which is used twice is planted with green

[1] Second-crop rice is grown regularly in one prefecture only, Kochi, which forms the southern seaboard of the island of Shikoku. This is the island that forms the southern shore of the Inland Sea. Kochi is open to the Pacific on the south and shut off by mountains to the north; hence its warm winters. Recently, there has been some experimentation with second crops of rice in the prefecture of Wakayama, which lies to the east of Kochi on the main island, Honshu. S. Nasu, *Land Utilization in Japan*, Prepared for the Third Session of the Institute of Pacific Relations (Tokyo, 1929), pp. 95–96; J. W. R. Scott, *The Foundations of Japan* (London, Murray, 1922), p. 70.

[2] This is a true barley which when threshed out somewhat resembles wheat. In all races of cultivated barley, the true grain lies between two chaffy scales which usually fuse with the grains so that at maturity the grain cannot be separated from them except by a special hulling operation. In all races, however, there are varieties in which the grain is not fused with the chaff and in threshing the kernels separate from the chaff almost as readily as wheat. These are the "naked" barleys. They are an important foodstuff not merely in Japan but also in India and Tibet, and are grown to some extent in parts of eastern Europe, e.g., Rumania, Russia, and eastern Austria. Foreigners writing about Japanese agriculture sometimes term naked barley rye. However, the only reference in official statistics of agricultural production in Japan to rye is to a small acreage grown on Karafuto. There does not even seem to be a native word for rye. Rye bread is *raimugi-pan*. *Pan* is bread; *mugi* is a general term for grain of the wheat and barley type. Common barley is *ōmugi*, naked barley is *hadakamugi*, wheat is *komugi*. In Japan, almost all barley is fall-sown, whereas in most Occidental countries agronomic practice demands that it be sown in spring. The labor required when the husking of common barley is done by hand, as it is for the most part in Japan, is quite hard work and is no doubt a factor contributing to the Japanese preference for naked barley as a food.

[3] One *cho* = 2.45 acres.

[4] Nasu, *op. cit.*, p. 136.

[5] This is classed in Japanese statistics with the fiber crops. It is a rush.

manure crops for the most part, if planted at all in winter. These are hoed under in spring or early summer in preparation for the rice crop, though a little is cut for forage. The predominating green manure is *renge* (*Astragalus sinicus*), a legume belonging to the same family as some of the loco weeds of the Great Plains region of North America. It is cultivated to some extent everywhere, even in the south, but becomes less and less important to the southwest where it yields ground to the barleys. About 13 per cent of the total area of paddy fields is planted to it. In the spring before the planting of rice, the purplish-blue patches of blossoming *renge* are a conspicuous feature of the landscape.

To speak of this rice–winter grain alternation[1] on Japanese irrigated land as rotation would be misleading to the western farmer who grows but one crop a year and rotates in successive years; it is more properly referred to as an alternation of crops or double-cropping. The crop-rotation systems of the Occident are designed to maintain or improve the fertility of the soil as well as to get the maximum return consistent with such fertility maintenance. The double-cropping of Japan is designed primarily to get the maximum out of the land. Rice and winter grain alternate year after year without rest for the land; the extensive use of fertilizer seems to be sufficient to maintain fertility. Perhaps also the irrigation water leaches out of the soil such toxic substances as may be left in it by the crops. Still, in western farming there are analogous practices. Thus winter wheat and clover are sown together, the wheat serving as "nurse" crop and being harvested in early summer, whereupon the clover takes possession of the field. Moreover, in western countries, the land in some truck-farming regions is sometimes cropped throughout the year.

The tendency of paddies to be wet and cold in winter is no doubt one of the reasons why wheat, and the barleys also, are grown on ridges 6 to 12 inches above the bottom of the furrows between the ridges. This has a number of advantages, of which perhaps the most important is drainage. In Japan, with its heavy winter rainfall, drainage may be important not merely upon paddy fields but also upon some upland. There are, however, other advantages. One is that the fields may be weeded by hoeing, the spreading of the grain by tillering sidewise prevented, and the furrows kept clear, so that the next crop can be interplanted. Another is that the cultivator can walk between the rows and apply liquid fertilizer directly at the base of the plant.

The winter grain is seeded on the ridges in clumps rather than evenly spaced in a continuous line as it is in the Occident when the seed is planted with a drill. It is held in Japan that grain thus planted in clumps is less liable to lodge and less liable to be beaten down in a storm.

Multiple Cropping and Minor Crops

Where climate, soil, and marketing conditions are suitable, i.e., in the neighborhood of many towns and cities, the paddy field may not even get the few weeks' rest that would intervene between the rice harvest and the sowing of winter grain, for on the same land in the same year one or more rapidly growing crops may be produced in addition to rice and winter grain. In these localities winter grain does not immediately follow the rice crop harvested in the fall. Among the more common of these rapidly growing crops are radish (*daikon, Raphanus sativus,* L.)[2] and egg-

[1] Similar alternations are commonly practiced in many tropical or sub-tropical regions, for example in China, the Netherlands Indies, and British India.

[2] Radish is by far the most important of all Japanese vegetables both in area under cultivation and in total value of crop, if sweet potatoes are not classed with the vegetables. In some form, this long white root (there are, however, a number of other horticultural varieties), which in appearance resembles a giant, elongated parsnip rather than the red, globular French radish of the American truck farmer, is scarcely ever wanting in some form, fresh or pickled, from a Japanese meal. Its dietetic value is probably primarily to furnish vitamins and mineral salts. A typical analysis of the root in percentages is as follows: edible part, 100; water, 95.90; total nitrogen, 0.096; protein (N × 6.25), 0.60; fat, 0.31; carbohydrate, 1.60; fiber, 0.90; inorganic substance, 0.50; water-soluble inorganic substance, 0.35; water-insoluble inorganic substance, 0.15; alkali value, 5.0; alkali value due to soda and potash, 3.3; alkali value due to lime and magnesia, 1.7; phosphoric acid as P_2O_5, 0.028; calcium as CaO, 0.050; iron as Fe_2O_3, 0.001; salt, NaCl, 0.110. One hundred grams furnish 12 calories. See T. Saiki, T. Higuchi, M. Kondo, and K. Matsuzawa, *The Chemical Analysis of Food in Japan* (Tokyo, Kioto, Nankodo & Co. Ltd., 3d edition, enlarged, 1934), pp. 246–47.

plant. Radish seedlings are planted on ridges destined later to be planted to wheat or barley, and eggplant seedlings are planted along the bottom of the furrows between the ridges. The radish is ready to be pulled before the eggplant is large enough to interfere with it. The eggplant then has the field to itself for a while till the sprouting of the winter grain seeded on the ridges after the radish. When grain and eggplant begin to interfere, the eggplant is removed and the winter grain has the field to itself.

In the spring, moreover, a dwarf, rapidly growing variety of taro[1] (*Colocasia antiquorum*, Schott.), seedling melons, cucumber, or other rapidly growing crop may be planted along the bottom of the furrows between the ridges on which the winter grain is growing. The young plants are shaded by the growing grain but ultimately compete with it for sunlight. By that time, the grain crop should be ripe and ready for harvest so that the interplanted crop may have the paddy field to itself until the time when the field has to be cleared and the ridges leveled in preparation for the transplantation of rice seedlings. This type of farming is in essence a combination of truck with grain farming.

While the alternation on paddy fields is predominantly as described above, there are a number of minor annual crops besides *renge* which to an appreciable extent compete with winter grains for the land. The more important of these are rape, millet, and the millet-like grain, Bengal grass or *hie* (*Panicum frumentaceum*, Roxb.).[2] Some of these minor crops, such as vegetables and millet, are grown both on paddy and upland fields, and official statistics do not always segregate the two.

Unirrigated land is also double-cropped, but not quite to the same extent as paddy fields. However, many crops, aside from rice, are grown in summer.[3] Indeed, upland rice occupies less land than soy beans or sweet potatoes, and is planted for the most part on the southern island, Kyushu, and in Kwanto on Honshu. Other annual crops occupying considerable acreages on upland fields in summer are: various kinds of beans, maize, common potatoes, tobacco, buckwheat, hemp, pyrethrum or Dalmatian insect flowers, peanuts, peas, indigo, cotton, a variety of vegetables, millet, gourds (*Lagenaria vulgaris*, Sev.).[4] Some 83,803 acres were planted to *hie* in 1931. Millets, as well as rape, may be grown on paddy as a winter crop and in the

[1] This looks like the elephant's ear of American gardens. It is a major foodstuff in Polynesia; in the Hawaiian Islands, *poi* is made from it. The dasheen of Florida is a variety. The tuber is the edible part, although the foliage may be used as we use turnip greens.

[2] *Hie*, also spelled *hiye*, is almost regarded as a weed of the paddies in the south, but in the north it is quite extensively cultivated. Some botanists no longer place it in the genus *Panicum*. They regard it either as a variety of the common barnyard grass, *Echinochloa crusgalli*, and give it the varietal designation, *frumentacea*, or else as a species of *Echinochloa* distinct from *Echinochloa crusgalli*. It is also sometimes termed Japanese barnyard millet. In German, it is *Getreidefennich*. In the *Statistical Abstract of the Ministry of Agriculture and Forestry* (Tokyo), it is termed in English, "barnyard millets," and in French *panic crête de coq*.

[3] Acreages for 1931 are as follows in thousands; the first three crops are fall-sown:

Common barley (upland)	671	Beans (azuki)	289
Wheat (upland)	665	Common potatoes	259
Naked barley (upland)	441	Peas	114
Rice (upland)	328	Tobacco	90
Buckwheat	260	Pyrethrum	32
Maize	114	Hemp	16
Soy beans	866	Peanuts	15
Sweet potatoes	649	Cotton	1.4
		Indigo	1.2

[4] This is a form of the common gourd about the size of a squash or pumpkin, from which a foodstuff, *kampyo* or *campio*, is made which is indispensable in the preparation of certain rice dishes. The gourd is sliced transversely into large disks 1–2 inches thick and the rind removed with a paring tool working like a carpenter's plane. The disks are then mounted in a machine like a simple lathe and rotated while a knife is held against the disk's circumference. Thereby the flesh is cut into long ribbons very much as a wood turner produces wood shavings in working at a lathe. The ribbons are cut into convenient lengths, hung over sticks, the sticks placed on racks and dried very much like macaroni. The finished product is a somewhat tough, pliable, flat ribbon about ⅜ inch wide and ⅛ to ¼ inch thick. It looks rather like a narrow water noodle. Its chemical composition expressed in percentages is: edible part, 100; water, 33.70; total nitrogen, 1.216; protein (N × 6.25), 7.60; fat, 0.13; carbohydrate, 56.00; fiber, 1.00; inorganic substance, 0.73; water-soluble inorganic substance, 0.46; water-insoluble inorganic substance, 0.27; alkali value, 6.9; alkali value due to soda and potash, 3.9; alkali value due to lime and magnesia, 3.0; phosphoric acid as P_2O_5, 0.558; calcium as CaO, present; iron as Fe_2O_3, 0.005; salt, NaCl, 0.070. One hundred grams furnish 262 calories. See Saiki *et al.*, *op. cit.*, pp. 254–55.

north also on upland in summer. The total area in millet, *hie,* and *kibi*—a millet (*Panicum miliaceum,* L.) — was 329,785 acres in 1931, of which about 40 per cent was grown on paddy fields as a subsidiary or second crop. Therefore about 198,000 acres of these crops were planted on upland and competed to some extent with naked barley and wheat for dry land. Rape took 182,515 acres of paddy and upland combined in 1931. It furnishes rapeseed oil used in the arts, and in cookery also, despite its objectionable flavor.

In Hokkaido, spring wheat is a summer crop. The winters are said to be too severe for winter wheat, whether on paddy fields or upland.

The proportion of upland planted to perennials is much greater than for paddy fields. These crops include mulberry, citrus, and deciduous fruits, persimmons, grapes, tea, wax berries, and *kōzo* (*Broussonetia papyrifera*) and *mitsumata* (*Edgeworthia chrysantha*), used in paper making. Mulberry, grown primarily for silkworm culture, is by far the most important; in 1931 it covered about 1.7 million acres, almost entirely upland, although it occupies a few paddy fields and is sometimes planted on foot paths between paddy fields and even in gardens. It is second only to the barleys and wheat. Mulberry occupies about one-fifth of all the upland-field area of Japan. Fruit trees of all kinds occupied 380,000 acres in 1927. *Broussonetia* and *Edgeworthia* are grown on land which is hardly suitable for grain because of its steepness. This is also true, though in lesser degree, of mulberry, fruit trees, and tea; the area in tea was about 93,000 acres in 1931.[1]

Alternation of winter grain and rice is, therefore, not characteristic of upland farming. Common barley, wheat, and naked barley are the most important winter crops. Together, these occupied 1.8 million acres of upland in 1931.

[1] The statistics for tea are unsatisfactory. Much is produced and sold locally which is unreported. A great deal of this is of inferior quality and produced from half-wild bushes.

[2] See maps in Swen and Alsberg, *op. cit.,* pp. 354–56.

The Winter Grain Crops

The geographic distribution of the three winter cereals, whether grown on paddy fields or on upland, depends for the most part upon climate but also to a large extent upon other factors. In the south, naked barley is more widely grown as a second crop than common barley; it is not grown at all in Fukushima or in the northern and some of the western prefectures of Honshu where common barley takes its place. There is also some production of naked barley on Hokkaido. Common barley is grown as a second crop to some extent either on paddy fields or on upland in nearly every prefecture; but its acreage is comparatively small in some of the southwestern ones. These are also regions in which little or no naked barley is grown; the land is mountainous and volcanic. The area in common barley is also relatively small in the northernmost and the two northwestern prefectures of Honshu, where naked barley is not grown at all. Some common barley is grown on Hokkaido. The greatest concentration of common barley cultivation is in the region around Tokyo; the greatest concentration of naked barley cultivation is on the southern islands of Kyushu and Shikoku.

Wheat is grown to some extent in every prefecture, including spring wheat on Hokkaido.[2] On Honshu, its acreage is comparatively small in the more mountainous sections, in the north, and along the whole western seaboard. Its greatest areas of concentration are on the islands of Kyushu, in Kagawa prefecture on Shikoku, in Hyogo prefecture of which Kobe is the capital, in the adjoining prefecture of Okayama, in Aichi prefecture of which Nagoya is the capital, and around and to the north and northwest of Tokyo. These several areas include much of the level land of Japan.

Naked barley and common barley are largely complementary in geographical distribution. Very little naked barley is grown north of Nagoya, and none at all very far north of Tokyo. Common barley is found mostly from Nagoya northward, although some is planted clear down to southern Kyushu, especially in mountainous sections and

along the Sea of Japan, where the climate is harsher than on the Pacific slope. The barleys can hardly be said to compete with one another, for their distribution is obviously determined predominantly by climate and by altitude, which also influences climate. Wheat is complementary geographically to neither barley. Its areas of concentration in the south are identical with those of naked barley and in the north with common barley. It competes for the land with both of them. Neither wheat nor the barleys compete with rice except in so far as the growing of winter grain affects the subsequent use of land for rice.

Since wheat competes with both barleys in the territory of each, it is obvious that other factors besides climate determine whether in a given region wheat or barley is grown. These factors are economic as well as agronomic, but for the moment only agronomic factors will receive attention. The most important of these factors involve yields, length of growing period, rankness of growth, and tendency to lodge.

Table 1 and Table II show that yields of wheat and naked barley are better on paddy fields than upon upland; but that for common barley the reverse seems to be true. However, in terms of food units, yield figures for common barley are not comparable with those for naked barley or wheat, because the hulls or husks have to be removed before it is fit for food. These may constitute as much as 11 per cent of the weight of the grain, especially in the coarser varieties of common barley.

Because of its longer growing period, wheat has to be planted earlier in the fall or harvested later in the spring than barley, or both. If it is sown so that it has to be harvested late, the land will be ready for rice late. This is a serious disadvantage in the north where there is danger that the weather may be too cold in the fall for the proper maturing of rice. In the south, this is less of a disadvantage because the fall there is practically always warm enough to ensure ripening of the rice crop. In any event, the Japanese farmer has greater leeway in the time of planting rice than most western grain farmers, because he transplants seedlings from a seed bed and does not sow directly in the open paddy field. He may elect to transplant from the seed bed early, and plant young and therefore small rice plants; or he may elect to transplant late, and plant older and therefore larger seedlings. In the north of the main island, therefore, the danger from late spring frosts is not to the paddies which are not yet planted to rice, but to seed beds. However, frost damage to seed beds is rare. While rice is transplanted mostly in June, in the south with its warm fall rice may be transplanted as late as the beginning of July.

TABLE 1.—AVERAGE YIELDS OF BARLEY AND WHEAT IN JAPAN, 1923–28*

Grain	*Koku* per *cho*		Measured bushels per acre		60-lb. units per acre	
	Paddy	Upland	Paddy	Upland	Paddy	Upland
Common barley ..	16.5	18.6	34.4	38.9	25.9	29.3
Naked barley	13.4	11.8	28.0	24.6	27.5	24.1
Wheat	13.4	11.4	28.0	23.9	26.4	22.5

* Data from *Statistical Abstract of the Ministry of Agriculture and Forestry* (Tokyo). One *koku* = 5.12 Winchester bushels. One *koku* of common barley = 3.86 sixty-pound units; of naked barley = 5.03; and of wheat = 4.82.

Nevertheless, the late maturing of wheat may be a disadvantage in central and southern Japan because the wheat harvest then tends to coincide with the beginning of the rainy season (*tsuyu*), which makes for wheat poor in condition. To be sure, barley may mature only a week or ten days earlier than wheat, but this may be enough to bring the harvest before the wet season. Moreover, even as little as a week's difference in maturity may render it advantageous for a farmer to grow both wheat and barley in the same season, since he thus has a better distribution of his labor.

Furthermore, as we have seen, it is a common practice to intercalate one or more rapidly maturing crops between the rice harvest and the sowing of winter grain as well as to interplant such crops between the rows of grain in the spring before the winter grain is harvested. Barley with its shorter growing period leaves the field free for these crops for a longer period than wheat. If the grain crop does not ripen early, the two crops interfere too much with one another, and there is more

danger of this if the winter grain is wheat than if it is barley.

Wheat grows more rankly and taller than barley, throws more shade, and therefore tends to interfere more with interplanted crops. Also wheat tends to lodge more than barley, because its straw is longer and less stiff. Lodging is particularly liable to occur because it is the practice to fertilize heavily. If it were not for resulting interference with the interplanted crop, lodging would not be as objectionable as it is in western countries, because Japanese farmers do not harvest by machinery but rather by hand with a sickle or similar tool.

On upland it is even more important than on paddy fields that the winter crop should not interfere with the summer crop. To be sure, the ridges on which the winter grain is grown do not always have to be leveled as they do on paddy fields, for the crop following the grain not being rice is often interplanted, i.e. planted in the bottom of the furrow before the grain is harvested. If the winter grain is too tall or is lodged, it shades the furrows between the ridges so that seed (azuki bean, soy bean, etc.) planted in them may not germinate properly. Hence, it is desirable that winter grain have short, stiff straw, and in these respects barley has the advantage over wheat.

If seedlings are planted in the furrows between the ridges of grain, early maturity and short, stiff straw are as much an advantage as when the summer crop is sown. With tobacco, for example, seedlings are raised in a special seed bed, usually close to the farmer's dwelling, and the small plants set between the rows. For tobacco[1] the rows of grain are customarily spaced two feet apart and the tobacco seedlings spaced one foot apart in their row along the furrow between the rows of grain. When gourds are planted, a strip 10 to 20 feet wide is cleared and seedlings planted in a single row down the center of this bare strip spaced 15 to 20 feet apart. By the time the vines have spread over this empty space, the wheat or barley is ready for harvest. Of course, when upland rice follows winter grain, more preparation of the field is necessary. It is obvious that upon uplands, as upon paddy fields, wheat is at the same disadvantage compared with barley, because of its longer growing period, ranker growth, and weaker straw.

On the other hand, there is one important respect in which wheat has the advantage over barley; it is less sensitive to soil acidity.[2] Acid soils are widely distributed over northeastern Japan and the sea coasts. They also occur widely over some of the tablelands in the interior. The area covered with this sort of soil constitutes more than a half of the farm land and land fit for future cultivation in Japan.[3]

Position of Wheat Summarized

We are now in position to state the place of wheat in Japanese agriculture. It is a winter crop, except on Hokkaido, grown exclusively on double-cropped land on which it is subsidiary to the summer or principal crop. Because it is a subsidiary crop grown in winter on double-cropped land it does not compete with the main crop grown in summer. On irrigated land, this is almost exclusively rice; on unirrigated land, the main crops are of many sorts — beans, sweet potatoes, rice, maize, etc. Wheat competes for the land only with other winter crops, the most important of which are naked barley and common barley, though certain minor crops like rape are also competitors. In southern and central Japan, its main competitor is naked barley; in central and northern Japan, common barley. In the south, it competes with naked barley principally upon paddy fields; in the north it competes with common barley mainly upon upland. Wheat is at a disadvantage in its competition with the barleys because it has a longer growing period, makes a ranker growth, and lodges more easily. The longer

[1] Since tobacco is a state monopoly, the area permitted to be planted is limited by the government and the sales price fixed. Of recent years, some American-type tobacco has been planted and this, if more successful in the future than in the past, may lead the government to permit some extension of the area in this type of tobacco in order that importation of tobacco from America may be reduced. In 1931, tobacco was grown on 90,272 acres.

[2] Nasu, *op. cit.*, p. 62.

[3] *Ibid.*, p. 58.

growing period of wheat may bring its harvesting into the rainy season in early summer and injure the quality of the crop. Moreover, the longer growing period, as compared with barley, shortens the interval between the rice harvest in the fall and the sowing of winter grain, and also the interval between the grain harvest in the spring and the rice transplanting in early summer. Even as small a difference as a week or ten days in the growing periods of wheat and barley may give barley a distinct advantage where the summers are rather short for the maturing of rice. Such a difference may also be important where the summer crop is interplanted before the winter grain is harvested and also where some sort of vegetable is grown between the rice harvest and the winter grain sowing. In these cropping systems, rank growth and lodging are disadvantages which barley with its shorter, stiffer straw offers to a lesser degree than wheat. Finally, all over Japan a large area of irrigated land remains uncropped in winter because it cannot be well drained. In addition to such wet land, many fields in the north, irrigated as well as dry, grow no winter grain because of the severity of the climate. On them, green-manure crops, grown to some extent all over Japan, in part replace winter grain.

III. POTENTIALITIES FOR WHEAT EXPANSION

Expansion of wheat production in any country may be brought about by increasing yields, or increasing the area sown to wheat, or both. Yields may be increased by sowing higher-yielding varieties, by better cultural methods, by more effective manuring, or by transferring wheat culture to better land. Acreage may be increased by bringing into cultivation new land not previously cropped or by displacing some other crop from land already cultivated. Expansion of acreage and increase in yield are not unrelated. In Japan, as shown in Table 1, wheat yields less heavily upon upland than upon paddy. Hence the extension of wheat culture on upland would tend to lower the average yield per unit area; conversely, its expansion on paddy fields would tend to raise the average for Japan. In old countries like Japan, new land not previously cultivated is likely to yield less per unit area when brought into cultivation because nearly all the more fertile land has long been under crops and only the poorer land remains out of use. Hence extension to new land, if not greater on new paddy fields than on new upland fields, would also tend to reduce average yields.

Improvement in Yields

Yields in Japan had already risen strikingly before the inauguration of the Five-Year Plan (see Chart 1, p. 68). In 1925–32, wheat averaged close to 28 bushels per acre on paddy fields and around 23 bushels on upland.[1] The average for all sorts of land was 25.1 bushels per acre—a yield exceeded in some of the humid countries. In most of these, the acreage is small, agricultural techniques well developed, and wheat growing not a major agricultural enterprise.[2] In them, wheat tends to be concentrated upon land especially adapted to it; yields are therefore higher than they would be if wheat were cultivated more widely as it is in Japan, France, and Germany. In France and Italy average yields are lower than in Japan, but in Germany they are appreciably higher.[3]

There was therefore room for increase of Japanese yields; but considering the way in which much of the land is used for two or more crops in the same year, the average wheat yields of Japan seemed high. Moreover, as Chart 1 shows, though average yields had risen over a period of decades, for several years following 1925 they had remained astonishingly uniform. Indeed, yields fluctuated much less than in western Europe, the British Isles for example (see p. 88). When the Five-Year Plan was adopted, there were

[1] See data in Swen and Alsberg, *op. cit.*, p. 373 (converted to 60-lb. units), and Table II below, p. 97.

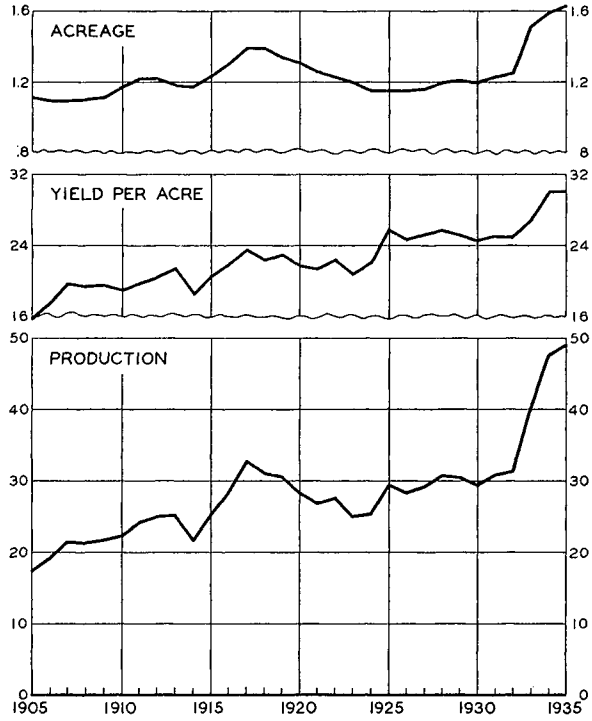
[2] With the general introduction of nationalistic measures in restraint of international trade in the last few years, this is no longer as true as it was formerly.

[3] See Table IV in our annual reviews of the crop year, e.g., Wheat Studies, December 1934, XI, 178.

distinct possibilities of further improvement over a period of years, but these could hardly be expected to be realized quickly.

CHART 1.—WHEAT ACREAGE, YIELD PER ACRE, AND PRODUCTION IN JAPAN, ANNUALLY 1885–1935*

(Million acres; bushels per acre; million bushels)



* Data for 1922–35 in Table VI. Earlier data slightly revised (chiefly for 1905–09) from those given in WHEAT STUDIES, April 1933, IX, 274.

Increased fertilization.—When we turn to the possibilities by the use of more fertilizer, we again find the prospects none too good. According to Nasu,[1] Japan ranks higher in the consumption of chemical fertilizer per unit area than any other Pacific country, and intermediate as compared with the older agricultural countries in Europe. In addition, Japanese farmers use many other kinds of fertilizer, the most important of which are night soil, soy-bean cake,[2] and fish waste. Taking the fertilizer situation as a whole, it is probable that Japan lags little, if at all, behind the agriculturally most advanced countries of Europe. The government had, therefore, not too much to expect in the way of increasing production by the use of fertilizer.

However, little is on record—at least in European languages—regarding the proportion of the fertilizer that goes to winter grain. If most of it is used on rice, then there may still be room for increasing the yields of winter grain by more intensive fertilization, particularly since an irrigated crop like rice leaves less residual fertilizer value in the soil than a dry-land crop. Furthermore, the area of upland fields sown to winter grains is much greater than that of paddy fields.

Improved wheat varieties.—To judge by the comparatively high wheat yields of Japan, low-yielding varieties can hardly be very widely cultivated. Yet, no doubt, there was ample opportunity for improvement when the Five-Year Plan was inaugurated, especially in view of the many diverse soils and climates. It is hardly to be assumed that everywhere the varieties best for local conditions were already grown or that everywhere the best varieties were incapable of improvement. Japanese farmers have not heretofore used pure-bred wheat seed extensively.

As far as the writer could learn through direct personal inquiry among Japanese agronomists, wheat diseases, such as smut and rust, are so rarely a factor in reducing yields that wheat breeders do not take them into consideration. Also shattering does not seem to be a serious problem because of the method of harvesting. The field must be made ready for transplanting rice as soon as possible; the farmer must ordinarily cut the wheat as soon as it is mature. He does so by hand and does not shock it, but ties it in small sheaves which are often carefully hung on racks till dry and ready for threshing. This careful handling further reduces shattering.

The most important defect of Japanese varieties from the standpoint of Japanese uses of wheat seems to be a low milling yield of flour. The average over the country for different varieties is 65 to 69 per cent, as contrasted with about 72 per cent in the United States and Canada. Obviously, if it were possible to increase the milling yield of Japanese wheat

[1] *Op. cit.*, pp. 163–64.

[2] For the year 1922, the consumption of soy-bean cake by Japanese farmers has been calculated at 13.9 kilograms of nitrogen and 2.8 kilograms of phosphoric acid per hectare. *Ibid.*, p. 164.

by 5 or more per cent, this would be an important contribution to making Japan self-sufficient.

The character upon which the breeder focuses his attention as an indicator of milling yield is the weight of 1,000 kernels. The average for Japan lies between 28 and 30 grams. Percival gives the average weight of the wheats most commonly grown in England, a humid country with a mild insular climate producing like Japan only winter wheats, as 45.0 grams, with a maximum over 50.0 grams.[1]

Though subject to exceptions, larger size of individual berry and greater crop yield are usually accompanied by a longer growing period. These biological characteristics of the wheat plant are a serious handicap to the breeding of wheat with both high yield and early maturity.[2] The importance of early maturity in Japan has been pointed out above. The Japanese breeder must, therefore, strike a compromise between high yield and large 1,000-kernel weight on the one hand and early maturity on the other. He must also strike a compromise between high yield and shortness and stiffness of straw, for shortness of straw is also to some degree correlated with early maturity. Shortness and stiffness of straw as already shown are valuable traits in Japan because of the practice of interplanting other crops between the ridges on which wheat is sown.

The lowness of flour yields of Japanese wheats is not due solely to the light weight of the wheat berries, but also to a peculiarity of their outer coating. Cells with tough and exceptionally thick walls[3] are found immediately under the aleurone layer. This layer lies just inside the bran proper. In the milling process, these cells are only imperfectly opened up and therefore do not discharge all their flour content. They adhere to the bran, prevent other cells lying between them from losing their flour content, and reduce flour yields in proportion.

Expansion of Wheat Acreage

Wheat culture in Japan might be extended by making new paddy fields, by the relocation of existing paddies, by improving the supply of water or by winter drainage, by planting wheat on paddies not theretofore sown to it, and finally by displacing other crops with wheat.

[1] J. Percival, *The Wheat Plant, A Monograph* (London, Duckworth, 1921), p. 425.

[2] Cf. C. L. Alsberg and E. P. Griffing, "The Objectives of Wheat Breeding," Wheat Studies, June 1928, IV, 286–87.

[3] M. Yamasaki and S. Hatano, "On the Relation between Flour Yield and Some Other Characters in Wheat Kernels," *Journal of the Imperial Agricultural Experiment Station* (Tokyo), March 1933, II, 129–40; "On the Relation of the Structure of Starch Cells to the Flour Yield in Wheat Kernels," *ibid.*, 141–52. A summary in English is appended to each article.

In the first paper, these investigators report, among other results, "that flour yield is correlated somewhat closely with endosperm percentage, weight and volume per 1000 kernels, and compactness, while the correlation between flour percentage and glassiness as well as specific gravity is much lower. It is, however, pointed out that the relation of the endosperm percentage to flour yield is not so close as may be expected" (p. 140).

In the second paper, the same investigators show:

"(1) In flour milling, the amount of flour adhering to bran scales varies markedly with the samples; the more the quantity of flour adhering to bran scales, the less flour yield of the samples. This disturbs, to some degree, the correlation to be found between flour yield and endosperm percentage . . . .

"(2) The floury portions adhering to bran scales are, as observed microscopically, composed of one or two layers of starch cells of a special type . . . . , and the existence of such starch cells is noticed also in the cross section of kernels. These starch cells are much smaller in size than the ordinary ones, bear thick cell-wall . . . . , and look hard in texture; the starch granules contained are small and the gluten content is high; the cells are stained by iodeosin or haematoxylin solution more deeply than the ordinary starch cells. The starch cell of such type is, for convenience, termed *'hard starch cell.'* Sometimes there occurs *'semi-hard starch cell'* which is an intermediate class between the typical hard starch cell and the ordinary starch cell.

"(3) On milling, hard starch cells are not broken and adhere firmly to bran scales; and moreover, the part of an ordinary starch cell lying between hard starch cells is also lost being accompanied by the latter. Therefore the more the amount of hard starch cells, the less flour yield.

"(4) By the anatomical study of grains at different stages of growth, it was made clear that hard starch cells are the cells which remain at earlier stages of growth and are developed incomletely [*sic*] . . . . This may be affirmed also by the fact that hard starch cells are multiplied especially under such unfavorable conditions of seed riping [*sic*] as shading or excessive application of nitrongenous [*sic*] fertilizer . . . . Moreover it is sometimes observed that even in the same variety the frequency of occurrence of hard starch cells varies considerably with the locality where the variety is grown . . . ." (p. 151).

On irrigated land. — The creation of new paddy fields in Japan is difficult because nearly all land that might readily be converted into paddies has long since been so ameliorated. Indeed, between 1917 and 1931 the area of all sorts of arable land was practically stationary in Japan.[1]

Each year, arable land, including paddy, is withdrawn from cultivation in consequence of the growth of cities, the building of railroads, factories, roads, etc.[2] The area converted to non-agricultural uses in 1931 was: for building sites, 8,845 acres; for roads, rivers, railways, waterways, 9,995 acres. The cities and towns of Japan have been growing rapidly in area; it is even possible that Japanese cities grow faster in area relative to population than many cities in the Occident because not many Japanese dwellings have over two stories and the majority only one. Arable land surrounding cities is bought up by speculators who often leave it uncultivated. Furthermore, since Japan is a mountainous country with heavy rainfall, not infrequent typhoons, and occasional earthquakes, some arable land is destroyed by floods and landslides. In 1923, the earthquake year, such destruction amounted to 79,818 acres.[3] The average for the period 1918–26, inclusive, was 48,192 acres a year out of a total arable area averaging 14.97 million acres.

There is, of course, a certain amount of reclamation of swamp, marsh, tidal, forest, and waste land. Reclamation is encouraged by government subsidy, but in 1923 there was an absolute decrease in arable land which had not been wholly made good by 1928.[4] The greatest opportunities for expanding paddy area are on Hokkaido, where in 1927 it was estimated that 1.1 million acres were fit for conversion into paddy fields.[5] However, this land when brought into cultivation can have but little effect upon the size of the wheat crop because the climate is not suitable for second crops of winter wheat.

To make a new paddy field the basic problem is to provide a water supply. Having accomplished this, the farmer must first remove the top soil, of which there may be from 5 to 10 inches; this is carefully preserved. Then the land is leveled. If it is sloping—and much of the land of Japan still uncultivated is hilly—he must build an embankment, or even a retaining wall, of such height and shape that the area within it can be made quite flat. In consequence, the paddies of Japan are of all shapes and sizes. There is no minimum size; a few are as large as an acre and some are as small as a table cloth or even a couple of napkins. What a Japanese farmer aims at is a size of about one-fourth of an acre if possible. So small a size is necessary in order that when flooded the water may be of uniform depth everywhere. If the paddy is not completely level some of the rice plants in it may barely have their roots wet unless a considerable depth of water is run on. In that event, other rice plants may be wet up to their necks, as it were. The Japanese practice is to aim at a depth of 3 inches of water in the paddy; more is believed to reduce yields. In America, 5 or more inches are usually necessary to flood the whole field.

Having seen to his supply of irrigation water and having terraced the land to the necessary extent after removing the top soil, the Japanese farmer must make his paddy retain the irrigation water. This he does by tamping down the subsoil before replacing the top soil. And this need to make the paddy field reasonably water tight renders paddy building more or less of a gamble. The farmer may strike a spring which may bring his efforts to naught, or gravelly or sandy, permeable subsoil which can be made to hold water only with difficulty or not at all. On paddy fields, water regulates the temperature, supplies nutrients, and brings nutrients up from the soil. Sandy soil is, therefore, unfavorable for paddy fields, because of excessive

[1] *Statistical Abstract of the Ministry of Agriculture and Forestry, 1931–32* (Tokyo, March 1933), p. 2, and earlier issues.

[2] *Ibid.*, p. 4. For table covering 1918–27, see Swen and Alsberg, *op. cit.*, p. 372.

[3] Nasu, *op. cit.*, p. 123.

[4] *Statistical Abstract of the Ministry of Agriculture and Forestry* (Tokyo, March 1933), p. 2. In 1929, an "Arable Land Census" was taken which yielded a somewhat lower figure than the ones previously established. The figures for 1929 and subsequent years are, therefore, not wholly comparable with those for the years before 1929.

[5] Nasu, *op. cit.*, p. 112.

percolation, and clay, because of insufficient percolation; clayey loam is the best for paddy fields.

It is obvious then that the extension of wheat growing by bringing new paddies into cultivation must be a slow, expensive, and not very promising process; and this is true also of the increase of paddy area through relocation or rearrangement. "There is assuredly no way of altering the shape of paddies which are dexterously fitted into hillsides. But large numbers of paddies are on fairly level ground. There is no real need for these being of all sizes and patterns. They are what they are because of the degree to which their construction was conditioned by water-supply problems, the financial resources of those who dug them or the position of neighbours' land. And no doubt in the course of centuries there has been a great deal of swapping, buying and inheriting. So the average farmer's paddies are not only of all shapes and sizes but here, there and everywhere."[1]

To meet this situation the government about 30 years ago undertook to stimulate the "adjustment" of paddy fields. When a sufficient number of the farmers of a village petition the government to adjust the lands of their village, government irrigation engineers study the situation and make a plan for the adjustment of all the irrigated lands of the village. This involves throwing all the land into one pot, reconstructing the irrigation system, relocating roads, footpaths, and sometimes even houses. The land is then subdivided into larger paddies of regular size—usually rectangles of an area of 1 *tan* (fourth of an acre). These are then allocated to each farmer in proportion to what each had contributed. Sometimes a farmer gets a little less land than he had before or of poorer quality; sometimes he gets a little more or of better quality. In the former case he is compensated, in the latter he must pay. The government lends him the money on long-time, easy terms if he is unable to pay without assistance. Indeed, in so far as it may be necessary, the government lends the village on easy terms the funds with which to pay the general costs.

The ultimate results are a better irrigation system; less land occupied by roads, footpaths, etc.; better yields which may amount to an increase of 15 per cent; and saving of time and effort on the part of farmers, because their holdings after adjustment lie in adjacent tracts, so that their time may be spent in working their paddies instead of walking to and from them. The improvement of the irrigation system may lead to the more economical use of water and therefore sometimes renders the opening up of new paddies possible. The relocation of roads, paths, irrigation ditches, etc., may add as much as 3 per cent to the cultivated area of the village. What is of interest in the present connection is that in the course of the last twenty-five years or so somewhat less than a third of the villages of Japan proper have been adjusted in this way. In 1931, 6,165 projects were completed involving 600,000 acres. The cost of adjustment of projects completed, begun, and in progress was 569,361,154 yen.[2] It is obvious, therefore, that no sudden and large expansion of wheat culture was to be expected from this source.

As was pointed out in the preceding section, a quite considerable area of paddy fields might be so improved as to produce winter grain. Adjustment improves the irrigation system so that a larger proportion of the paddies can in many instances be dried off in winter and made available for second crops. The government also encourages drainage projects but the acreage so benefited is not large.[3] Nevertheless, the prospects are not good that large areas will be drained better except incidentally through adjustments; no large, sudden increase in wheat acreage is to be expected from this source.

We see, then, that on paddy fields extension of wheat culture through the opening up of new paddies, through the adjustment of ex-

[1] Scott, *op. cit.*, p. 71.

[2] *Statistical Abstract of the Ministry of Agriculture and Forestry* (Tokyo, March 1933), p. 5. At the then parity with the dollar, this represented about 278 million dollars.

[3] In 1930, 28 projects were authorized, in progress, or completed at a cost of 9,317,106 yen. Twenty were completed benefiting 48,425 acres. In 1931, 14 projects were authorized or in progress; none were completed in that year. *Ibid.*, p. 4.

isting paddies, and through better drainage permitting the planting of wheat on paddies not theretofore sown to it was possible when the Five-Year Plan was inaugurated, and has indeed been going on for decades. These procedures account in part for the gradual, slow increase of Japan's wheat crop during recent decades. They could not, however, make a great contribution to the rapid, large increase of the last three years. No material enlargement of area could be expected from the sowing of fallow, for, as we have seen, the area of paddy that lies fallow in winter from choice is insignificant. The only other possibility for expansion of acreage, so far as paddies were concerned, was through the displacement of other winter crops by wheat.

On upland.—The creation of new upland fields is an easier task, obviously, than the creation of new paddy fields, provided suitable land is available. But such land is not plentiful. Nasu has estimated that 79.7 per cent of all land theoretically arable was already in cultivation at the end of 1926.[1] Much of what remained unameliorated was in Hokkaido, where but 55.7 per cent of the land theoretically arable was in use; or else it was situated in the northern and northeastern prefectures where both soil and climate are unfavorable, or in the more mountainous prefectures where conversion of uncultivated land into fields is difficult, expensive, and not remunerative. Indeed, in many favorably situated prefectures, over 90 per cent of the land theoretically arable was, and is, in cultivation; in one, Osaka, the percentage is 103. In the more isolated mountainous regions, there is still some small, slight survival of "fire farming," a primitive form of cropping by which a little patch of forest or brush is burned off on a hillside and two or three crops raised till the soil is exhausted, when the field is abandoned and again allowed to revert to brush or forest. The first crop on such a clearing is usually buckwheat, sometimes followed by rape or millet.

The brightest prospects for extending spring-wheat acreage were (and are) on Hokkaido upon upland. The production of more spring wheat would be relatively more useful in Japan than an equal increase of winter wheat because spring wheat tends to be strong and is, therefore, needed by Japanese millers to blend with the domestic weak winter wheats in making the bread types of flour. The total area fit for cultivation on Hokkaido is 1,580,000 *cho* (3.9 million acres).[2] Of that not already in cultivation, 571,144 *cho* (1.4 million acres) are fit for upland fields[3] on which alone, as we have seen, wheat is grown on Hokkaido. Some of this upland can, and no doubt ultimately will, be converted into paddy fields. The government is actively stimulating the exploitation of this land by subsidy and otherwise, but a virgin region is involved in which progress is necessarily slow.

In summary, then, it may be said that when the government proposed to expand wheat production, the prospects were not good in the directions thus far discussed. There was no prospect of bringing much uncultivated land into cultivation rapidly. There were some but not large prospects of increasing yields by more intensive fertilization; but the use of fertilizers was already considerable. There were some but not large prospects of increasing yields by introducing improved varieties; yields were already quite good and the introduction of new varieties takes time. This brings us to another possibility that had proved of importance in preceding decades—the displacement of other crops by wheat.

Displacement of Other Crops

Practically nothing was to be expected from the displacement of forage crops or the breaking up of pastures, for there is little animal husbandry in Japan. The number of horses and cattle combined did not quite reach 3 million head in 1927, of which 90 per cent were employed for farm work. There were less than 70,000 milch cows and very few goats or sheep. Consequently, there is very little land in forage crops and improved pastures.[4]

[1] *Op. cit.*, p. 69.

[2] *Ibid.*, p. 111.

[3] *Ibid.*, p. 115.

[4] With the growth of a woolen-textile industry, sheep keeping is being advocated, but it remains to be demonstrated that the climate is suitable. Since a very large proportion of the crops of Japan are eaten di-

While the area under cultivation of most of the miscellaneous crops is not large, some occupy a considerable acreage (e.g., rape with 176,000 acres in 1924–27) and the aggregate acreage is considerable. One might therefore expect that there was considerable opportunity for wheat. However, these crops are for the most part specialties which are demanded to give variety to the diet and fetch a high price. Taken as a whole, the value per unit area of miscellaneous crops was materially greater than that of wheat.[1] Price relationships by themselves were not favorable to wheat. In fact, as we shall see, miscellaneous crops were but little if at all disturbed by the Five-Year Plan.

Fruit trees, and to a lesser degree vines, come into full bearing only after a considerable period of years, and their profitable life, especially that of most kinds of fruit trees, is long. Tea improves the older the bushes; there are instances of 100-year-old plantations bearing well. If such perennials are grubbed up to make room for some annual crop, a heavy investment is sacrificed. Farmers are therefore slow to make such a change even when the perennial crop becomes unprofitable or an alternative crop becomes more profitable. They delay year after year in the hope that price relationships will improve. Therefore, any sudden release of considerable perennial-crop area for wheat was not to be expected.

Mulberry trees were in a somewhat different position. Under the systems of pruning employed, they begin to yield soon, and in Japan it is not regarded as good practice to keep them more than 15 to 20 years. Mulberries would, therefore, be more likely than tea or fruit trees to be grubbed up when it became unprofitable to cultivate them. Since mulberry trees or bushes are all grown for their leaves which are fed to silk worms, the prolonged low world prices for silk have led many Japanese to question whether silk prices will, within any reasonable period, again be high enough to make the production of cocoons as desirable a farm enterprise as formerly. At the initiation of the Five-Year Plan, there was therefore basis for the hope that wheat might to some extent displace mulberry. The present crisis has led to the destruction of some mulberry plantations. It is as yet impossible to say into what crops this land has gone. Upon some of it winter grain crops are probably being grown, but most certainly a considerable portion of it has gone into fruit trees.

Finally, perennial crops on the average yield more per *tan* in value than wheat or barley. The average in 1927 for tree fruits of all kinds was 65.5 yen per *tan;* for osiers, 27.45 yen.[2] The value of mulberries cannot be determined exactly since the leaves are not marketed as such but indirectly as cocoons. In 1927,[3] the value was estimated at about 33 yen per *tan,* which was higher than the ordinary per *tan* value of the product from an upland field at that time. Since then, it has fallen considerably. In short, the prospects for wheat to displace any perennial crop, except possibly mulberries, were not good.

Mention may be made in passing of a small area (66,000 acres in 1927) planted to sugar cane, mostly upon the Loochoo Islands. While cane is harvested annually, it is rarely treated as an annual crop, except in Java and in cli-

rectly and since night soil is extensively used for manure, the farm family, and indeed the town dweller as well, in a way, play the rôle of live stock on Occidental farms. With the more extensive use of artificial fertilizer and the introduction of sewage systems into towns, this situation will ultimately change. Perhaps one of the most promising possibilities of expanding Japanese agriculture in the future is in the direction of using more rough non-arable land for animal husbandry. Such land will become more available if and when the Japanese turn more than at present to the use of coal, gas, oil, and electricity for fuel and employ less charcoal. At present rough land brings a return as a source of charcoal. Indeed on some rough land a species of oak is systematically planted and pollarded furnishing a crop of hard wood for charcoal about once in eight years.

[1] Nasu, *op. cit.,* pp. 146–52, gives the following per *tan* (0.245 acre) value of various crops in 1927:

Crop	Value in yen	Crop	Value in yen
Lotus roots	142.05	Naked barley (upland)	19.00
Shichito-i	104.58	Common barley (upland)	17.00
Cabbages	77.47	*Kibi*	15.88
Rape	27.55	Millet	13.77
Pyrethrum	26.32	*Hie*	11.03
Wheat (upland)	20.00		
Barley (paddy)	20.00		

[2] Nasu, *op. cit.,* pp. 147, 149.

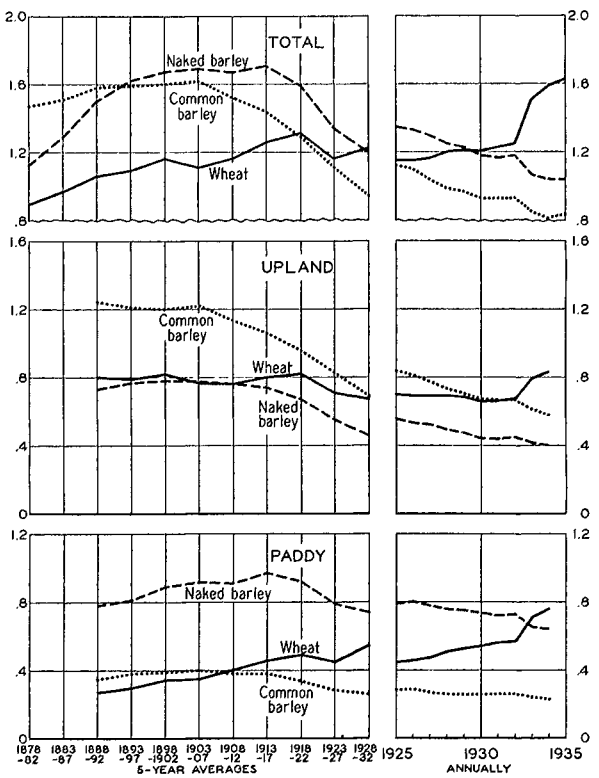
[3] *Ibid.,* pp. 150–51.

mates with killing frosts as in the United States. Crops are harvested yearly for a series of years, the practice being known as rattooning. Cane customarily occupies the land for several years, so that it is not available for grain growing. Since the area in cane is small and the climate presumably too tropical for grain, nothing was to be expected from this source.

There remains then as the most promising possibility for large and rapid increase of wheat acreage at the time of the inauguration of the Five-Year Plan the displacement of the barleys by wheat. Chart 2 shows that

CHART 2.—ACREAGE OF WHEAT AND THE BARLEYS IN JAPAN, FROM 1878–82 TO 1935*

(*Million acres*)



* Data from Table I.

common barley has for two decades lost ground both upon paddy and upland but actually and proportionately more on upland. The total acreage in common barley is now materially less than it was fifty years ago.

Chart 2 also shows that naked barley rose to a peak in the earlier war years, and has since declined. Its decline was greater on upland than upon paddy.

Chart 2 shows that wheat rose to a peak in the later war years and then declined to about its pre-war level. Thereafter, it showed a slight upward trend until it rose sharply with the inauguration of the Five-Year Plan. The rise in 1932–33 was slightly greater on paddy than on upland.

The points of interest in the present connection are:

(*a*) That such a stimulus as was furnished by the war—presumably good prices—pushed up the acreage of wheat and naked barley, but not of common barley. There was therefore the promise that good prices, if obtaining during the operations of the Plan, would favor the success of the Plan whether the good prices were the direct result of the Plan or were due to other causes, for example the world price situation.

(*b*) The fact that wheat on the whole has shown an upward trend of acreage except for a post-war decline and a rather steady state in recent years, whereas the barleys have declined in acreage, was favorable for the success of the Plan. To expand wheat acreage at the expense of the barleys, it was merely necessary to accelerate a process already going on slowly.

(*c*) The fact that naked barley was already declining on upland (Chart 2) was favorable to the expansion of wheat on upland. The fact that wheat was already slowly expanding upon paddy, whereas naked barley was contracting on paddy, was favorable for the expansion of wheat on paddy.

Furthermore, the differences in the money value per *tan* were not great (see above), so that a moderate shift in price relationships would prove a powerful inducement to shift from one crop to another. Moreover, the effect of such a shift might be considerable, since the area sown to winter grain is quite large. In any event, if it was to prove possible to expand wheat production in Japan by enlarging wheat acreage, the most probable direction in which most of such enlargement was likely to take place seems to have been the displacement of the barleys by wheat.

Taking the situation as a whole, the poten-

tialities for wheat expansion seemed none too good. In 1929, the leading agricultural economist of Japan wrote as follows: "All these unfavorable circumstances being taken into consideration, we must come to the conclusion that Japan can scarcely expect to win in the international competition in the cultivation of wheat. In other words, the increase of demand for wheat at home will not be met sufficiently by the increased production at home."[1] Yet looking at the problem historically, the potentialities seemed better than this analysis indicated. Chart 1 (p. 68) shows that during the war years production rose sharply to a volume in 1917 which since has been exceeded only in 1933–35. This was due, as pointed out above, to a sharp increase in acreage, which was accompanied by a somewhat comparable increase in yields.

It seemed possible, therefore, despite the unfavorable agronomic outlook, that if a stimulus to wheat growing somewhat more intense than that of the war period were to be applied, the goal of the Plan might be approached if not actually reached. Chart 1 shows further that after the war acreage dropped rapidly though not permanently to its pre-war level, yield on the contrary dropped relatively less, and then rose to a new plateau at a higher level than before. This would lead one to infer that the Plan would be likely to influence acreage more than yield. Furthermore, since in a country like Japan which is not predominantly a wheat consumer, the war-time stimulus to increase wheat production had been a favorable price, any element of the Plan which tended to raise relative wheat prices gave promise of being an important factor in stimulating production.

IV. CONSUMPTION OF BARLEY AND WHEAT

The facility with which barley may be replaced by wheat depends to some extent upon the trends of barley and wheat consumption and the uses to which these grains are put. The trends that existed at the time the Five-Year Plan was inaugurated were important because, as a rule, it is easier to accelerate an existing trend than to check or reverse it. If barley consumption is already going down and wheat consumption going up, it would seem that the displacement of barley by wheat on crop land should be easier than if the reverse obtained. The uses made of these grains were also important, because the nature of consumption helps to determine the character of demand. Elasticity of demand for barley relative to wheat should facilitate the displacement of barley by wheat in agriculture. Thus, if the Japanese were great meat eaters and had an important animal husbandry which required feed barley, the demand for barley would be much more inelastic than it is, and the displacement of barley in farming would meet great resistance. Conversely, if bread instead of rice were the staff of life in Japan, the demand for wheat would be much less elastic than it is, and, as the population grows, the pressure of the encroachment of wheat upon other crops would be great. Therefore, the uses to which barley and wheat are put, as well as the trend of consumption, were an important element in the situation confronting the administrators of the Five-Year Plan.

Consumption of Barley

Per capita disappearance of the barleys increased for many years before the war, and since then has dropped.[2] As late as 1921, it was stated officially that the ordinary farm diet consisted of boiled rice and barley (cracked, crushed, or whole) as the principal foods, with vegetables and occasionally fish.[3] Except in northern Japan, two-thirds of the barley eaten is of the naked variety.[4] It is of better food value than common barley.[5] It can

[1] Nasu, *op. cit.*, p. 253.

[2] See Swen and Alsberg, *op. cit.*, p. 377.

[3] Scott, *op. cit.*, p. 389.

[4] *Ibid.*

[5] The average of the analyses (on a moisture-free basis) of seven samples of naked barley gave 2.01 per cent nitrogen, equivalent to 12.56 per cent protein (N × 6.25). The corresponding values for common barley (average of six samples) were 1.64 per cent and 10.25 per cent respectively. Cf. Saiki *et al.*, *op. cit.*, p. 224.

not be grown in Fukushima and the north. There common barley is grown and to some extent eaten, despite the fact that husking it is hard work. Other substitutes for rice in the north are the millets, including *hie*.[1] Few Japanese eat these barleys in preference to rice; hence among those whose standard of living is rising, barley consumption is said to be dropping. However, up to the war, as above stated, per capita disappearance did not diminish significantly, whereas there can be no doubt that the standard of living of the Japanese as a whole was rising. There was no such increase of animal husbandry as might have kept per capita barley disappearance high in the face of declining food consumption. Moreover, in recent years, Japan has been going through a severe agricultural depression (see p. 58), with at times near-famine conditions in some districts. It is possible that among the poorest elements of the rural population the trend to consume less barley, which is claimed for the pre-depression period,[2] has been arrested or even reversed.

Unfortunately, data on the distribution of barley consumption among the several channels exist only for the year 1922–23. At that time, 74 per cent of the naked barley crop and 65 per cent of the common barley crop were used for food (see Table 5, p. 78). The uses of the barleys other than for food, feed, and seed are small (see Table 5). Small amounts of common barley are used in beer, vegetable cheese (*miso*), alimentary pastes, flour, sauce, and sweet goods, and small amounts of naked barley are used for sauce, vegetable cheese, alimentary pastes, flour, and sweet goods. Ten to 11 per cent of the total of common barley and of naked barley are so used. There do not seem to be any non-food industrial uses. Very little barley is ground into flour.

[1] Scott, *op. cit.*, p. 389. *Hie* (or *hiye*) has the following chemical composition expressed in percentages: edible part, 100; water, 12.40; total nitrogen, 1.552; protein (N × 6.25), 9.70; fat, 3.10; carbohydrate, 68.20; fiber, 4.50; inorganic substance, 1.8; water-insoluble inorganic substance, 1.82; phosphoric acid as P_2O_5, 0.856; calcium as CaO, 0.017. One hundred grams furnish 348 calories. See Saiki *et al., op. cit.*, pp. 228–29.

[2] Nasu, *op. cit.*, p. 19.

Trend of Wheat Consumption

While the general trend of per capita barley consumption has been downward, the trend of per capita wheat consumption has, on the whole, been upward. For 1878–82, per capita wheat consumption has been estimated at 0.27 bushels and for 1923–27, at 0.73 bushels.[3] Annual figures fluctuate considerably, as shown in Table 2, no doubt largely because of variability of year-end stocks. To smooth out these fluctuations to some extent, a three-year moving average centered is also given.

Table 2.—Per Capita Disappearance of Wheat in Japan, Annually from 1923–24*

(Bushels of 60 pounds)

Aug.-July	Actual	Average[a]	Aug.-July	Actual	Average[a]
1923–24 ...	.90	.74	1929–30 ...	.65	.69
1924–25 ...	.60	.78	1930–31 ...	.69	.70
1925–26 ...	.84	.71	1931–32 ...	.75	.65
1926–27 ...	.68	.74	1932–33 ...	.50	.62
1927–28 ...	.69	.70	1933–34[b] ..	.62	.61
1928–29 ...	.72	.69	1934–35[b] ..	.70	...

* Computed from official data on crops, imports, exports, and production.

[a] Three-year moving average centered.

[b] Partly estimated.

A downward trend of per capita consumption of wheat in recent years is clearly indicated by this moving average. For the three years ending with 1934–35, this was only about 84 per cent of the average (0.76) for the four years ending with 1925–26 (see Table VI). The explanation, Japanese experts agree, is to be found in rice prices. These are collected in Table 3.

It is obvious that prices have trended downward since 1927 to a low in 1933 and since have risen somewhat. These low prices were due to a combination of causes. Imports from Chosen and Taiwan had been steadily increasing before the depression and increased much more rapidly during the depression. From 1927–29, rice crops were quite good, stocks tended to increase, and there were no short crops to reduce supplies. The 1930 crop was very large and that of 1933 a record. Large stocks accumulated. These, and perhaps the

[3] See Table IV.

depression, were the main causes of low rice prices.

TABLE 3.—AVERAGE PRICES OF RICE IN JAPAN, 1927–35*

Calendar year	Yen per *koku*	U.S. gold dollars per 100 lbs.	Calendar year	Yen per *koku*	U.S. gold dollars per 100 lbs.
1927....	35.33	5.33	1932....	21.20	1.90
1928....	31.00	4.58	1933....	21.62	1.42
1929....	29.06	4.26	1934....	26.09	1.47
1930....	25.42	4.00	1935[a]...	29.42	1.59
1931....	18.40	2.86			

* Computed from data reported by the International Institute of Agriculture, converted at average exchange rates.

[a] Seven months.

Comparison of Table 2 with Table 3 shows clearly that, as rice prices dropped, per capita wheat consumption dropped also. It is tempting to suppose there was a causal relationship between the two phenomena, and such is the belief of Japanese experts. This surmise is strengthened by consideration of the course of wheat prices. In Table VII, series of price indexes for rice, wheat, and flour are presented, together with a series of percentages reflecting the ratio of wheat prices to rice prices in each year. This table shows that wheat prices have been rising in comparison with rice prices until they reached a peak in 1933, when the wheat-price index was actually higher than that of rice. This trend tends to support the view that low rice prices tend to restrict wheat consumption; for in view of the Japanese preference for rice, it is to be expected that, when rice is cheap and wheat dear, more rice and less wheat will be consumed.

It would, however, be wrong to assume that a low price relative to wheat increases rice consumption directly. The relationship is obviously not so simple. In the period covered, so long as the rice-price index stood near 300 there was no marked tendency for wheat consumption to drop, whatever the relative price of wheat. At some point below 300, a tendency for wheat consumption to drop began to manifest itself—perhaps as early as 1928. These relationships are more easily recognized in Table 4, in which some of the above data are arranged in the order of descending rice prices. In the years when rice prices were low, the effect of relatively high wheat prices seems irregular except when wheat prices were relatively very high as in 1933. This probably is due to a time lag. It makes a difference whether prices are rising or falling (compare year 1934 with year 1930), a phenomenon well known to the business world. Very probably a threshold phenomenon is involved. While the data available are insufficient to test this hypothesis, they certainly suggest there is a price for rice above which wheat consumption tends to rise and below which it drops sharply—presumably because more rice is consumed. This phenomenon of the threshold, well known to psychologists, may often be observed in price-demand - supply relationships between two commodities which are more or less perfectly substitutible for one another and the combined demand for which is rather inelastic. Butter and margarine are substitute commodities of this type,[1] and so are lard and compound.[2]

TABLE 4.—RELATIVE PRICES OF RICE AND WHEAT IN RELATION TO WHEAT DISAPPEARANCE*

Year	Price indexes		Wheat disappearance	
	Rice	Percentage wheat to rice	Actual	3-year moving average
1925.....	353	82	.60	.78
1924.....	327	71	.90	.74
1926.....	319	79	.84	.71
1927.....	298	77	.68	.74
1928.....	262	85	.69	.70
1929.....	246	89	.72	.69
1934.....	221	81	.62	.61
1930.....	215	81	.65	.69
1933.....	182	102	.50	.62
1932.....	178	92	.75	.65
1931.....	156	78	.69	.70

* Based on Tables VI and VII.

[1] Cf. K. Snodgrass, *Margarine as a Butter Substitute* (Food Research Institute Fats and Oils Studies 4), December 1930, p. 256.

[2] Cf. G. M. Weber and C. L. Alsberg, *The American Vegetable-Shortening Industry: Its Origin and Development* (Food Research Institute Fats and Oils Studies 5), June 1934, pp. 179–81; also "Jahreszeitliche Schwankungen der Nachfrage bei Butter, Margarine und Schmalz und ihre Ursachen," *Blätter für landwirtschaftliche Marktforschung*, June 1, 1930, I, 20–24.

The way the farmer—and very likely the urban dweller also—reacts would seem to be as follows: When rice is very cheap, more is consumed, irrespective of the price of wheat. If the farmer consumes more, he cannot eat as much wheat or barley. Consumption of both these grains goes down; he has more of them to sell. Also city dwellers perhaps eat more rice and have less need for noodles, bread, and sweet baked goods. Per capita wheat consumption goes down. Apparently, we must not look upon the drop in per capita wheat consumption as a deliberate choice based on weighing the price of rice with respect to wheat. Rather the farmer, and others, eat more rice because they can afford to eat more of it, and the drop in wheat consumption is a physiological consequence.

Uses of Wheat and Flour

The considerations presented in preceding paragraphs indicate that per capita wheat consumption in Japan is small but rather elastic. Probably the elasticity of the demand for wheat is due in some measure to the diversity of uses to which this cereal is put, for, other things being equal, the greater the number of channels of consumption of a raw material, the greater is the variety of substitutes for it that can be found and the more liable is some portion of the demand for it to be elastic. The uses of wheat in Japan are by no means identical with those to which it is put in the Occident, where practically all wheat that is not used for seed and feed is milled into flour. In Japan, a large proportion is used directly for soy sauce and in cakes and sweetened food. Accurate statistics on the disposition of wheat in Japan do not exist. There are approximate data for wheat for 1922–23.[1] These have been combined in Table 5 with recent data, not precisely comparable with earlier ones, based upon official investigations made in 1931. This table gives domestic utilization only; it does not cover the total quantity of domestic and foreign wheat available for manufacturing. Of the total supplies, domestic and foreign, a large volume is milled into flour for export and is not included in the table.

Table 5 shows that the proportion of the crop used for seed is astonishingly small. It has been reported as only 0.89 bushels per acre,[2] the smallest amount on record for any country. Presumably, this is due to the manner in which wheat is grown in Japan. This rate, multiplied by the acreage, gives an even smaller seed use than that recorded in Table 5.

Table 5.—Approximate Utilization of the Barleys and Wheat in Japan, July–June, 1922–23 and 1930–31*

(Percentage of total)

Item	Common barley	Naked barley	Wheat	
	1922–23	1922–23	1922–23	1930–31
Whole grain, cracked grain, coarse meal...	64.9	74.0	1.0	...
Flour and offals.....	0.2	0.3	67.2	71.4
Cakes and sweet goods	1.0	0.2	3.2	...
Sauce	1.2	3.4	21.5	20.6
Pea-cheese, bean paste	3.3	5.6	1.6	1.3
Beer	3.8	.0	.0	...
Seed	2.9	3.6	2.2	1.9
Feed	22.0	11.7	1.5	...
Others	0.7	1.2	1.8	4.8

* Data for 1922–23 from Ministry of Agriculture and Forestry (Tokyo), *Statistical Report on Cereals, 1928;* for 1930–31 from Ministry of Agriculture and Forestry (Tokyo), direct.

This table also shows that a large proportion of the wheat crop not used for seed or feed is used for food unmilled. At least one-fifth (Table 5) of the disappearance is unmilled in soy sauce.[3] Though with increasing technical skill more barley and beans and other substitutes for wheat in sauce, paste, and cheese manufacture will be used, wheat will continue to be an important raw material in their manufacture.

About three-quarters of the wheat disap-

[1] Given in Swen and Alsberg, *op. cit.*, p. 362.

[2] See *World Wheat Prospects*, Oct. 22, 1932, LXXVIII, 13. The figure given is based on pre-war data and derived from estimates originally presented in *International Crop Report and Agricultural Statistics*, Supplement, March 1916. J. A. Langley estimated seed consumption for 1935 as 1,240,000 bushels; see "Wheat and Flour Situation in Japan," *Commercial Intelligence Journal*, March 9, 1935, LII, 377–81.

[3] Langley (*op. cit.*, p. 378) estimated the consumption for 1934 at 7,440,000 bushels.

pearance is in the form of flour and offals. In America, feed amounts to about 18 pounds for each bushel (60 pounds) of wheat ground; in Japan, offals may be somewhat less for there seems to be some food use of low-grade flour and "red dog," which in America to some extent goes into mill feed (see discussion of Table 6 below). There are few data on the trend of flour consumption. Between 1922–23 and 1930–31, according to Table 5, the utilization of wheat as flour increased by more than 6 per cent, but it is possible that strictly comparable data would lead to a different conclusion. At any rate, it is said by the milling and baking trades of Japan that the proportion of wheat milled into flour has been increasing steadily since the turn of the century and that the consumption of leavened baked goods is now growing.

Table 6 gives a little information regarding the uses to which flour is put in Japan, and Langley quotes an official publication of the Ministry of Agriculture and Forestry as follows:[1] ". . . . wheat flour in Japan is used mostly in the noodle manufacturing industry, which takes 49.6 per cent of the total consumption. The baking industry takes 12.3 per cent; 'Fu'[2] manufacturing industry, 3.9 per cent; the industrial starch manufacturing industry, 1.6 per cent; and the other 32.6 per cent is used by household and other foodstuff manufactures." An appreciable household and eating-place use is to dip sea foods in batter and fry in deep fat.

Obviously the data of Table 6 are not strictly comparable. For each year, the items total 100 per cent, yet those for 1922–23 include "bran," 5.3 per cent, which is certainly not flour. For that year, bran, adhesives, and other industrial uses total 11.8 per cent. For the year 1933–34, no separate figures for industrial uses are given, but these apparently are lumped together as "miscellaneous uses" which amount to 10 per cent. This figure is so nearly like the sum of "bran," "adhesives," and other industrial uses for 1922–23 as to suggest that in 1933–34 the items for adhesives, other industrial uses, and "bran" are lumped together under the caption "miscellaneous." And this raises the suspicion that what is termed "bran" is probably not the article understood in America under this term, but perhaps something of the nature of what is known to American millers as low-grade flour or red dog. Certainly, if the figure given in the table represented all the bran produced in milling wheat, it is far too small. The pericarp, seed coat, micellar layer, and aleurone layer, which, anatomically speaking, constitute the bran, amount to from 7.8 to 8.6 per cent by weight of the grain.[3] However, in milling, it is not practicable to secure complete separation of bran; appreciable amounts of flour and germ remain in the article commercially known as bran. In Japan where, as we have seen, the yield of flour in milling domestic wheat is unusually low, bran yields should be higher than in Europe or America.[4] It follows that the figure of 5.3 per cent cannot represent all the bran produced incidentally in milling; it probably represents the low-grade flour or red dog of

TABLE 6.—APPROXIMATE UTILIZATION OF WHEAT FLOUR IN JAPAN, JULY–JUNE, 1922–23 AND 1933–34*

(Percentage of total)

Item	1922–23	1933–34
Noodles, vermicelli, macaroni, etc...	50.3	50.0
Bread and rolls.....	17.2	14.0
Cakes, dumplings, sweet goods.....	20.7	26.0
Adhesives	2.3	...
Others (industrial manufacture)...	4.2	...
Miscellaneous uses	...	10.0
Bran	5.3	...

* Data for 1922–23 from Ministry of Agriculture and Forestry (Tokyo), *Statistical Report on Cereals, 1928;* for 1933–34 from Ministry of Agriculture and Forestry (Tokyo), direct.

[1] *Ibid.*, p. 379.

[2] A baked product made from freshly washed wheat gluten, wheat flour, and glutinous-rice flour. See C. H. Briggs, "Fu—A Curious Japanese Food," *Northwestern Miller*, May 1, 1935, CLXXXII, 308. According to Saiki *et al.* (*op. cit.*, p. 226) it contains 31.20 per cent of protein.

[3] Percival, *op. cit.*, p. 7.

[4] Langley (*op. cit.*, p. 379) makes the following statement on this point: "The percentage of flour manufactured from 100 kin of wheat (132 pounds) is generally estimated at 73.7, with 25 per cent of bran and 1.3 per cent of waste."

American mills. The discussion of Table 6 presented in the following paragraphs is to be taken as qualified by uncertainty regarding the complete comparability of the data for the two years, 1922–23 and 1933–34.

Since what is to be defined as bread, what cake, and what sweet goods is a matter of opinion and custom, the figures in the table for these two categories are best lumped together. This gives 37.9 per cent of flour consumption in the form of bread, cake, sweet goods, etc., in 1922–23 and 40.0 per cent in 1933–34. Obviously, here there has been a substantial gain for baked goods. The table also indicates that all the gain has come in sweet goods, that, indeed, bread and rolls have lost ground relatively. It must be remembered that the figures of this table are merely estimates. It may be true that bread and rolls have lost ground relative to sweet goods, but it is perhaps equally probable that we have to deal here with differences in classification as between 1922–23 and 1933–34. We must also remember that 1933 was a year of restricted per capita consumption (see p. 76). In the United States under such circumstances, consumption of bread is restricted relatively less than that of sweet goods. In Japan, the opposite may be true, because for many Japanese bread is really cake. Even in ordinary bread, they use as much as 5 per cent of sugar.

While official statistics do not justify definite conclusions regarding the trend of total consumption of flour, what evidence there is indicates that perhaps more wheat is consumed as flour relative to other uses and that relatively more of this flour is going into sweet goods than into bread. This does not necessarily mean that the per capita consumption of baked goods of all sorts is rising. As has been shown, per capita disappearance of wheat has been trending downward in recent years; and it is, therefore, probable, since population is increasing, that per capita consumption of baked goods has not been growing, or has even become less. It is probable that we have here to deal with a contrast between the great cities and the rural districts. Japanese farming is still to a large extent subsistence farming; the farm family produces much of the food consumed. Rice may be prepared for cooking in the home, and everywhere in the country there are small rice mills. Wheat may be cooked with rice without special preliminary treatment, but it is not esteemed in this form as much as rice. Flour cannot be prepared in the home; the wheat must be taken to a mill and there are far fewer flour than rice mills. To prepare baked goods in the home requires experience, good yeast or baking powder, and an oven, all of which are not customarily to be found in most rural districts. The kitchens of the poorer classes are not customarily provided with ovens and this is a handicap on the extension of the use of wheat in Japan. The Japanese *cuisine* of the common people, in the country as well as in the city, runs rather to boiled, steamed, sautéed, and fried foods than to baked ones. There is little prospect that the use of wheat as flour will soon be extended in the household. Enlarged per capita flour consumption, if it comes at all, is more likely to be in the form of commercially baked products.

The situation is different in the great cities, where the Occidental *cuisine* is growing in popularity, especially in hotels and restaurants. The well-to-do city dweller, while continuing to employ the Japanese *cuisine* at home, is very apt to patronize an Occidental eating place when he or his family eat away from home, if only for the sake of novelty and variety. Thus, one can eat after the European fashion in all the best clubs. In small towns and villages, however, there are almost none but Japanese-*cuisine* restaurants and hotels. Bread is not generally obtainable. If it is shipped in, it becomes stale. Sweet baked goods, on the contrary, do not so rapidly deteriorate and lend themselves to a wider distribution than bread.

Furthermore, in cities, economizing labor in the household is often more important than in the country. Rice is laborious to prepare. The washing of rice in a succession of waters, and the cleaning of the sticky pot in which it was cooked and of the equally sticky tub in which it is served take a great deal of time. Then in order to cook rice properly the exact proportion of water must be gauged. There is a great deal of eating between meals, and this is one reason why rice is prepared so

frequently, for cold rice is not palatable.[1] In the individual family, the cooking of its rice is a great part of a woman's housework. This is especially serious for the women of poor farm families, for in many parts of rural Japan their hours of labor during a year exceed those of the men. The supplies of rice to be cooked are so considerable that one name for a servant maid is *meshitaki-onna*—"girl to cook boiled rice."

When bread is used instead of rice, two bakings a week will do; the time saved is considerable.[2] Possibly there is a saving of fuel as well. Bread and other baked goods may be bought, or delivered in the home, ready to eat, and so the burden on the housewife may be lightened. Rice, ready to eat, has not yet been so delivered. In Tokyo, there have been attempts to establish the business of delivering cooked rice in homes, as milk and bread are delivered in America; but they were commercial failures. Keeping the rice hot and palatable presented difficulties. Possibly this might be done more successfully through the use of containers of the vacuum-bottle type, which have now become cheap. However, so long as rice is the staple in the diet, it will prove difficult to lighten the burden of the housewife involved in cooking it in the same way that the burden of housewives in the Occident was lightened when bread-baking was transferred from the home to the commercial bakery.

Demand for baked goods has been encouraged by the government. The army especially has favored bread-eating because bread has obvious advantages over rice as a ration, especially for an army on the move. Moreover, as a source of body energy, wheat is ordinarily cheaper than rice.[3] It is cheaper to feed an army on wheat than on rice. Baked wheaten foods are used in the army; and very probably some soldiers acquire a taste for them which they take back home as ex-service men. However, if they come from the rural districts, they may find difficulty in satisfying the acquired taste for bread. It may not be purchasable in their village. There may be no yeast, no bread ovens, and no one experienced in baking.

The government formerly subsidized yeast manufacture to the modest extent of 40,000 yen a year. It should be noted that the availability of reliable yeast is both cause and effect with reference to bread consumption. Its absence is a potent factor delaying the formation of a bread-eating habit, especially in warm climates. Leavening is then uncertain and bread tends to be of variable and often poor quality. A taste for bread is slow to develop. On the other hand, demand for bread creates demand for yeast. Good yeast improves bread, which in turn stimulates demand.

In Japan, leavening is accomplished by fresh yeast, by dry yeast, and by *koji*, and to some degree by using spontaneous ferment made from potatoes, or dough, sometimes with hops. There are now four concerns in Japan selling bakers' yeast: a baker in Osaka; two other Japanese concerns of which one, the Oriental Yeast Company, is connected with the Nisshin Flour Mills, said to be controlled by the Mitsubishi family; and Standard Brands of Asia, Inc., a subsidiary of the American corporation which controls the Fleischmann Yeast Company.[4]

Dry yeast is used quite extensively, one-third as much as of fresh yeast being employed. The word *koji* is the generic word for ferment or leaven. Bakers, when they use *koji*, usually employ the ferment that is used in *sake* manufacture: the mold, *Aspergillus oryzae*. It is usually added in the form of white, moldy wheat. Often a little yeast is

[1] The writer was told by the European chef of a hotel serving both Occidental- and Japanese-style food that one of the reasons domestic rice is preferred is that it cools off more slowly when cooked because of its glutinous, i.e., sticky texture, and therefore has to be prepared less often in the course of a day. Other types of rice cook up so that the individual grains, not being glutinous or sticky, do not adhere to one another. They therefore do not form coherent masses, and they cool off more readily than Japanese rice, which agglutinates in somewhat larger masses that hold the heat longer.

[2] K. Morimoto, *The Standard of Living in Japan* (Dissertation, Johns Hopkins University, 1916), p. 60.

[3] See Swen and Alsberg, *op. cit.*, p. 369.

[4] There are several other Japanese concerns which sell large amounts of yeast to the general public for medicinal purposes. Much of the advertising is as indefensible as that of many an American patent medicine.

added with the *koji* at the beginning of fermentation.

The customary Japanese bread is a long, three-pound loaf from which the retailer cuts off as much as the customer wants. In Yokohama and Tokyo, there has been some success in introducing the one-pound loaf, sometimes even wrapped. Such a loaf is bought whole for a family. To most Japanese, cake makes a stronger appeal than bread. The word for bread is *pan,* derived long ago from the Portuguese. A popular type of sweet goods is called *kashipan;* the word may be derived from cake, *okashi,* and the word for bread, or it may be a corrupted Portuguese word. The dough is made with sugar, sometimes as much as 35 per cent, and fermented with *koji* or with *koji* combined with a little yeast. Another type of cake very generally found is *kasuteira,* said to be a word derived from the Spanish; it resembles sponge cake. Sweet baked goods of one kind or another, sometimes in large variety, are to be found nearly all over Japan.

Examination of Table 6 shows that while the consumption of flour in the various kinds of baked goods seems to have increased from 1922–23 to 1933–34, consumption in noodles,[1] vermicelli, macaroni, etc., seems to have remained about stationary. The figures do not bear out the view current in some quarters of the trade in Japan that the proportion of flour consumed in noodles and other alimentary pastes is diminishing. We must, however, again keep in mind that the figures of the table are only estimates.

The large direct use of whole unmilled wheat and extensive use of flour in unleavened products such as noodles, vermicelli, and macaroni, and in such leavened products as cakes and other sweet goods, renders domestic wheat less unsatisfactory than it would be if a larger proportion were consumed as bread. Japanese wheat is mostly of the red winter variety. It is weak and of low protein content; satisfactory noodles and sweet goods can be made from the soft flour milled from Japanese wheat, whereas for bread strong flours of high protein content are preferred. The Japanese miller is not as yet much concerned with raising the protein content of the wheat he grinds for home use.

High protein content and high yields per unit of area are not correlated characters.[2] The Japanese wheat breeder is not as yet called upon to make the compromises between yield and quality that are forced upon the wheat breeder in some Occidental countries. Should the Japanese at some future day become bread eaters to an important degree, then the wheat breeder would have to face this dilemma. Even today, some millers are arguing that more attention be paid to protein content in wheat growing; some of the larger mills find it advisable to blend a little high-protein imported wheat with domestic wheat for the best grades of flour. In recent years, about 3 million bushels of imported strong wheat have been used annually for this purpose. Millers have, therefore, urged the government to extend its wheat-breeding program to the improvement of wheat quality and in particular to the development of varieties of higher gluten content. This is not yet included among the official objectives of wheat breeding listed below (p. 85). Perhaps the best prospects for increasing the volume of high-quality domestic wheat are on Hokkaido, where the spring wheat grown ordinarily tends to have a large amount of superior gluten. Perhaps spring wheat might also be grown on upland in the extreme north of Honshu, though it is doubtful that it would give as large a return as some other crops.

An appreciable amount of flour is used in the manufacture of *ajinomoto,* a flavoring material which in the technical terms of chemistry is monosodium glutamate. In its manufacture, the gluten is first separated from the flour and wheat starch is produced as a joint product. A trade estimate puts Japanese wheat-starch production at 65 million pounds per annum. For *ajinomoto,* flours with a high gluten content are preferred and it is desirable that the dry gluten prepared from them have a high protein content. Since domestic wheats do not yield flours of this character, they are imported from Canada

[1] Buckwheat flour is also extensively used in noodles.

[2] Cf. Alsberg and Griffing, *op. cit.,* pp. 286–87.

and sometimes in lesser amounts from the United States. This flour is imported and processed in bond, and is not shown in the trade returns.[1] There are no official figures for the volume of flour used for the manufacture of *ajinomoto* and similar products. An annual production of 65 million pounds of by-product starch would necessitate a consumption of 500,000 barrels of flour. In 1934, about 200,000 barrels of flour were imported in bond from Canada and the United States;[2] this would yield 26 to 27 million pounds of by-product starch. If the trade estimate of wheat-starch production is correct, between 200,000 and 300,000 barrels of flour derived from other sources than Canada or the United States must have been used in wheat-starch production in 1934. Perhaps it was a by-product of *fu* (see p. 79) manufacture.

Finally, wheat flour is much used for industrial purposes for which in America a starch would be used. Fermented or steeped flour is an important textile sizing and the price mills are willing to pay for starches depends in part upon the price of the poorer grade of flour.

V. DEVELOPMENTS UNDER THE FIVE-YEAR PLAN

In April 1932, the Ministry of Agriculture and Forestry took the first official steps to put into effect plans to expand wheat production. A commission to work out a plan was appointed by the government; the guiding spirit was Professor H. Ando, Director of the Imperial Agricultural Experiment Station of the Tokyo Imperial University[3] at Nishigahara, near Tokyo. The government put the plan proposed by this commission into effect at once, and it remained in full effect only until the spring of 1935, when certain features of the Plan were discontinued (see below); its ends seemed to have been accomplished. The 1934 crop was in round numbers 47.7 million bushels, and that of 1935 was even larger (now estimated at 49.1 million bushels).

The Plan and Its Execution

The plan comprised essentially four elements. First, wheat growing was to be made more remunerative to induce farmers to grow more of it. Secondly, steps were to be taken to get better varieties grown. Thirdly, more with a view to long-time effects, the development and testing of new varieties, which had already been going on for many years, was to be speeded up. Finally, through loans and subsidies, the grinding of local wheat for local consumption by small flour mills was to be encouraged. There was to be no direct subsidizing of wheat farmers out of the imperial treasury, except growers of superior seed wheat. It was proposed to expend a total of 10 million yen of which 2.04 million were allotted to the first year.

It was felt in certain quarters that if a large extra supply of wheat were thrown on the market, prices would fall. The government was prevailed upon to set aside 8 million yen to be advanced to farmers on the basis of 70 per cent of the market value of the wheat at the time of storage, such wheat to remain in designated warehouses for a period of three months. It might be held in storage for a longer period, if the owner so desired, thus preventing the glutting of the market immediately the crop is harvested. The period of compulsory storage was to be flexible to the extent that a farmer who took advantage of this credit scheme had the privilege of disposing of his wheat at any time, provided he refunded the amount advanced, plus 5 per cent interest. In 1933, little or no resort was made to this plan, but by August 1934 it was reported that prices were very low due to the large crop. Nevertheless, farmers were obliged to dump much wheat on the market, since all the grain-storage space in

[1] T. J. Monty, "Wheat and Flour Situation in Japan," *Commercial Intelligence Journal*, June 1, 1935, LII, 1008.

[2] Langley, *op. cit.*, p. 380.

[3] The "Imperial" universities are governmental and the members of their faculties are officials of the central government. The relations between government and university are therefore close and the employment of academic experts on government projects is taken as a matter of course.

the country was used for storing government purchases of rice.[1] In July 1935, the Farmers' Co-operative Society began to make wheat purchases with a view to maintaining prices at a fair level.[2]

To make wheat growing more remunerative, four factors were to contribute: the growing of high-yielding varieties already available, the development of high-yielding new varieties, the introduction of better cultural methods, and the raising of the tariff on wheat. This tariff was increased, effective June 16, 1932, on wheat from 1.50 to 2.50 yen per picul (about 132 pounds)[3] and on flour from 2.90 to 4.30 yen. It left the tariff at a much lower level than those of many other importing countries.[4] At the former gold parity, the old tariff rate was equivalent to about 33.5 cents per bushel. With the depreciation of the yen following suspension of gold payments in December 1931, the amount of protection diminished. On June 16, 1932, when the new tariff went into effect, the old tariff was equivalent to 20.9 and the new tariff to 34.7 U.S. gold cents per bushel. During 1933, the new tariff on average amounted to 23.4 U.S. gold cents, and during 1934, to 20.0 U.S. gold cents (old basis). Obviously, in large measure, the increase in nominal rate merely offset the effects of depreciation of the yen.[5]

Since Japan was a net importer of wheat in substantial quantities, the tariff increase could be expected to raise domestic wheat prices, but not necessarily by the full amount of the increase. In view of the very low world prices of wheat, the stimulus to production from the enhanced duty must have been feeble.

To get better varieties grown, the Ministry of Agriculture and Forestry instructed its agricultural experiment stations in the Tohoku (northeast), Chubu (central), and Seibu (west) districts to start wheat-seed farms. A subsidy of about 1,000 yen was given each prefecture to encourage wheat growing. The staffs of experts were increased at a cost of 3,000 yen per station.

The agricultural experiment stations of Japan had been carrying on wheat improvement for many years. However, only some of the improved varieties developed seem to have been thoroughly tested under all local field conditions. Such tests are even more important in Japan than in most other countries because mountains cut up the islands into many climatically different regions, to say nothing of the fact that Japan stretches over nearly 15° of latitude. From the northernmost point of the island of Hokkaido to the southern tip of the island of Kyushu the distance is about the same as that from Jacksonville, Florida, to the international boundary between the State of New York and the Province of Quebec. Moreover, a wheat that is suitable for the paddy fields of a given locality is not necessarily as satisfactory upon upland in the same district.

Improved varieties and new F_1 to F_3 hybrids, i.e., crosses in their first to third generations, were tested at four Imperial agricultural experiment stations, one each in the south, the west, middle Japan, and the northeast. Thence, promising forms were distributed to the special prefectural experiment stations for testing with respect to suitability for local conditions and for fixing of type. The fixed types thus chosen were distributed to local and other prefectural experiment stations where the varieties to be encouraged were finally picked to be propagated on local seed farms from which seed was finally distributed to farmers.

With the future in mind, breeding work was further intensified. Much of the work had previously been concentrated at Nishiga-

[1] J. P. Manion, "Wheat and Flour Trade of Japan, January to June, 1934," *Commercial Intelligence Journal*, Sept. 1, 1934, LI, 356.

[2] T. J. Monty, "Wheat and Flour Trade in Japan," *ibid.*, Aug. 24, 1935, LIII, 307.

[3] Subject to a drawback when the wheat is manufactured into flour for export.

[4] See M. K. Bennett and J. S. Davis, *et al.*, "The World Wheat Situation, 1931–32. A Review of the Crop Year," WHEAT STUDIES, December 1932, IX, 83–84.

[5] On July 20, 1935, an ordinance came into force, except as regards goods in transit on that date, imposing for the duration of one year an import duty of 50 per cent *ad valorem* on certain Canadian goods, including wheat and wheat flour, in addition to the already existing import duties. This, however, was purely retaliatory and not primarily for agricultural relief. See "Japanese Surtax on Some Canadian Goods," *Commercial Intelligence Journal*, July 27, 1935, LIII, 153.

hara. Other stations were led to take up this kind of work and a new station was established at Himeji, about one hour by rail west of Kobe—the Tyûgoku Wheat Breeding Station of the Imperial Agricultural Experiment Station, under the direction of S. Nanikawa. Here all the work is upon winter wheats, since it is very generally held that in Japan proper spring wheats can be grown only on Hokkaido. For reasons set forth on pages 65 to 66, wheat breeding has objectives at this station somewhat different from those of experiment stations in the United States. The most important are:

1. Improvement of yield
2. Improvement of milling yield of flour
3. Earlier maturity
4. Shortness and stiffness of straw.

The reasons why these objectives are so important in Japan, and why high protein content as well as resistance to disease, both so important in the Occident, are not, have been set forth on pages 60 to 67. Also the Japanese climate renders breeding for drought resistance unnecessary. It would seem, however, that for the north and for the Sea of Japan zone more attention might be paid to winter hardiness.

Marked results have already been achieved in developing early-maturing varieties as well as in securing stiffness and shortness of straw. In this experimental work, a large number of varieties drawn from the four quarters of the globe have been employed. With very few exceptions, the best results have been secured with crosses of native sorts. Some notable successes have been obtained with well-known domestic varieties merely by making selections and isolating pure lines.

To facilitate the introduction of better varieties and to promote the employment of the best cultural methods, one hundred and fifty guiding committees were set up at the leading wheat-growing centers. Each of these received 150 yen per annum. "Encouragement funds" of 2 yen per *tan* (0.245 acre) were granted agricultural bodies raising superior seed wheat. Local committees were set up in 10,000 villages to encourage wheat growing; their total membership was intended to be very large—in the neighborhood of 50,000. Each was given a subsidy of 5 yen per annum to stimulate him to activity. Demonstrators were employed to encourage farmers to grow improved varieties and to demonstrate improved cultural methods. Demonstrators were recruited from among persons already in the employ of experiment stations and from among intelligent and progressive country people, often the officers of local co-operatives. Apparently, the Japanese farmer is more teachable and docile than his colleague in the Occident—at least in North America. Perhaps this is because it is not so long since the peasant was practically a serf, perhaps it is because pioneering in the western meaning of the word lies many centuries behind him.[1] Moreover, Japanese farmers have long been used to co-operative, communal, and joint action, and have over long centuries developed a far more respectful attitude to government as government, than the American farmer has. All of this facilitates and makes effective the propaganda by government officials.

Wheat Production and Trade under the Plan

The Five-Year Plan, coming into force in 1932, has influenced the crops of 1933–35. Though the Plan did not influence the size of the 1932 crop, it did affect the prices at which it was sold. These rose rather slowly, for millers anticipating the gold embargo imported large supplies, and later anticipating the tariff change they imported further large amounts. Large stocks had been accumulated when the 1932 crop came on the market, and these served to moderate the upward swing of prices. The two largest milling companies were said to have had a 4 months' supply on hand.[2] Ultimately the price situation began to improve and no doubt had its influence on

[1] It is true, to be sure, that Japanese have opened up new land on the long-settled islands, and that they have suffered hardships in opening up virgin land on the thinly settled island of Hokkaido; but most of this has been done under government supervision and often with government subsidies under a regime of law and order. It has not been, as in North America, individualistic enterprise always pushing in advance of law and order.

[2] "Speculative Gains of Millers Heavy . . . . ," *The Trans-Pacific* (Tokyo), June 2, 1932, XX, 17.

the next crop, that of 1933. Without yet committing ourselves regarding the extent of the influence of the Five-Year Plan, let us summarize what has transpired in respect to wheat acreage, yields, production, and net imports.

In brief, acreage and yields and production all increased markedly in 1933 and still further in 1934 and 1935. The gain in wheat area took place almost wholly at the expense of the barleys (see Chart 2, p. 74). Other crops, including mulberry, were scarcely affected, and little or no new land was brought into wheat cultivation. The average yield in each of the past three years has successively set a new high record—in 1935 exceeding 30 bushels (of 60 pounds) per acre. Chart 2 on page 74, showing the latest available data in the perspective of 50 years, brings out the striking change in the last three years.

The wheat crops of 1934 and 1935 were both approximately equal to Japan's usual consumption. Within two years, therefore, the goal of self-sufficiency in wheat (in a quantitative sense) was reached, and the advance was more than held in the third year. Imports have accordingly declined; in the crop year 1934–35 they were under one million bushels, and in 1935–36 Japan may be a small net exporter as she was in several months of the preceding year.[1]

As shown by Table I, the wheat area increased by 31 per cent between 1929 and 1934 (most of it between 1932 and 1934). Chart 1 (p. 68) and Chart 3 (p. 88), showing the latest available data in longer perspective, bring out the striking changes in the last three years. Chart 2 (p. 74) shows that nearly all of the gain in wheat acreage was at the expense of the barleys. Of this gain, over three-fifths was in paddy land, which ordinarily gives higher wheat yields than upland. The briefer tabulation below is of area sown to the barleys in three of these years, in thousand acres:

Year	Naked barley	Common barley	Total
1929	1,228	967	2,195
1932	1,176	931	2,107
1934	1,040	813	1,853
Change, 1929–34	−188	−154	−343
	−15.3%	−15.9%	−15.6%

Naked barley contributed rather more in absolute area than common barley, but a slightly smaller percentage of its larger area.

Although the upland and paddy fields of Japan proper are very nearly equal in area, paddy fields contributed appreciably more than upland to wheat expansion. This is in harmony with the fact that a greater area of naked than of common barley was displaced, for more naked barley is grown on paddy than on upland, whereas for common barley the opposite practice obtains. The greater contribution made by paddy is contrary to what one would expect.

Less than 35,000 acres of the increase in wheat area could have been contributed by new paddy fields, by paddy fields not previously double-cropped, by new upland fields, by upland fields not previously double-cropped, by the displacement of all annual winter crops other than the barleys, and by the displacement of all perennial crops including mulberries. It is obvious that the contribution from any one of these sources must have been small. When one considers that nearly 1.65 million acres are in mulberry, it is to be inferred that the Five-Year Plan gained very little support from the prevailing low prices of raw silk.

The average yield in each of the past three years has successively set a new high record—in 1935 exceeding 30 bushels (of 60 pounds) per acre. That higher yields should have contributed as much as they did to the success of the Plan (see Chart 1, p. 68) is contrary to the expectations expressed on pages 67 and 68. In percentage increase, acreage made a somewhat better showing than yield; but the contributions made to the enlargement of the crop by each seem to have been different in the several years involved.

From 1932 to 1933, as Chart 1 shows, acreage increased more sharply than yield though yield was greater than in any previous year. This is what one would expect. Acreage can be increased at once by sowing wheat in place of the barleys. Yield could not as easily be increased immediately—at least so far as increase depended upon the sowing of seed of new and tested varieties, because ample

[1] See Table VI.

stocks of such seed were not available; they had first to be grown. This was not possible during the summer that intervened between the inauguration of the Plan in the spring and sowing time in the fall. Dependence for superior seed had to be placed upon careful selection of seed wheat from the commercial crop of such better varieties as were already in commercial cultivation. In addition, no doubt under the government's educational campaign and encouragement, better techniques and perhaps more intensive fertilization were employed. But all this takes time, whereas expansion of acreage requires only the will to sow more wheat and the land on which to plant it, in this case readily available at the expense of the barleys.

As above pointed out, of the enlarged acreage sown to wheat for the 1933 crop, a somewhat greater proportion than in former years consisted of paddy land (see Table I) on which wheat yields are normally heavier than on upland. One would, therefore, suppose that this shift in the nature of the land sown to wheat would be an important factor of itself in raising yield. As a matter of fact, in this year it played no rôle at all, though it did in subsequent years, because the average yield on paddy was only 26.4 bushels per acre, the lowest for any year since 1924. This was more than compensated, however, by the record upland yield of 27.0 bushels per acre. For the first time since modern crop estimating was begun in Japan, upland wheat yields surpassed those on paddy fields. Either the paddy fields newly sown to wheat yielded very poorly because new, or it happened to be a year so unfavorable for wheat on paddy that the efforts under the Plan were unavailing to increase yields on paddy. Whatever the cause, upland behaved differently; yields were very high. The extent to which increased acreage and improvement in yields contributed to the increase in crop may be deduced from the following tabulation by comparing (*a*) the actual crop with crop that would have been harvested (*b*) on the actual acreage at the average yield of 1925–32, and (*c*) on the average acreage for 1925–32 at the actual yields subsequently obtained. The figures in million bushels are as follows:

Crop	1932	1933	1934	1935
(*a*) Actual	31.3	40.4	47.7	49.1
(*b*) Constant yield	31.5	38.1	40.1	41.1
(*c*) Constant acreage ..	29.8	31.9	35.7	35.8

It is obvious that expansion of acreage was responsible to a greater degree for the increase in crop than improvement in yield.

From 1933 to 1934, on the contrary, as Chart 1 shows, yield rose decidedly more sharply than acreage. The measures initiated in 1932–33 that could not show their effects until 1933–34 would seem to have begun to show results. There had been time to produce superior seed of established varieties and of new varieties already developed at experiment stations, but not yet generally grown. Propaganda for better techniques and more intensive fertilization was continued. As in the preceding year, expansion of acreage again made greater contribution in increasing the crop than improvement of yield.

From 1934 to 1935, as Chart 1 based on the latest available data indicates, acreage and yield increased slightly. Expansion of acreage was again the more important. In the striking expansion of wheat production over the whole period from 1931 to 1935, acreage increases figured somewhat more heavily than increased yield per acre.

The chances seem small that in three successive years the weather should be so favorable as to produce three bumper crops in a row. Still smaller would the chances seem to be that each year the weather should be more favorable than in the preceding year so that each of three consecutive bumper crops would be larger than the one that immediately preceded it. Moreover, it would seem that if the weather had been an important factor in producing these bumper crops, yields would not infrequently have risen above the average in earlier years by as much as the crops of 1933–35 did. As a matter of fact, although crop statistics show that wheat yields had been increasing steadily for a long time, in recent years they had not often deviated by as much as one bushel from the five-year average. The war years were exceptions. During this period, yields rose sharply to a new level which was maintained until exceeded in

1933–35 (Chart 1). Japanese wheat yields have long been more constant than those of most other countries with an insular climate, the British Isles for example. Thus for the years 1925–32, the largest yield was 0.5 bushels per acre above the average for that period and the smallest yield 0.6 bushels below this average. In the British Isles, the corresponding oscillations were +3.4 and −2.4 bushels.

The uniformity of Japanese yields is not due to the fact that part of the crop is grown under irrigation. If it were, paddy-field yields should oscillate less around the average than upland yields; they do not. For the period 1925–32, the maximum above the average on paddy fields was 1.0 bushels per acre and the maximum below, 1.4 bushels; the corresponding figures for upland were +1.0 bushels and −0.7 bushels.

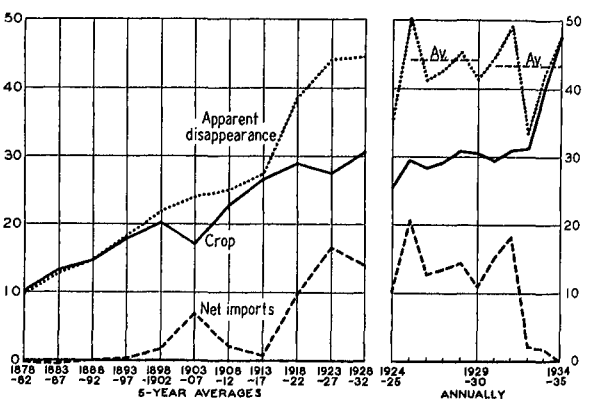
In short, the probability would seem great that weather was not an important factor in determining the high yields of 1933 to 1935. And yet, one is not justified in regarding this as any more than a probability. It is by no means certain that weather was not responsible for the high yields — at least in part. There are instances in different areas in which yields were well above trend for several years in a row; yet there was no wheat-stimulating plan nor any other discernible cause for high yields, unless it be the weather. One must therefore withhold final judgment regarding the effectiveness of the Plan in raising yields until a series of years will have passed.

Moreover, there has resulted a substantial enlargement of the total food supply of Japan proper. It is true that practically no new land was placed under cultivation; barley was merely displaced by wheat. However, at the same time, wheat yields were greatly increased and food production per acre raised. This represents a real addition to the food supply. Moreover, the substitution of wheat for common barley in the north may add something further to the food supply, since much of the common barley crop is used as feed; but in that event some other source of feed must be found.[1]

Chart 3, presenting production, imports, and total supplies over a long period, shows that in the two five-year periods ending with 1932, wheat disappearance in Japan averaged slightly under 45 million bushels. Even the 1934 crop was approximately equal to this figure; at the reduced rate of per capita consumption that has prevailed in recent years, it was ample for uses to which domestic wheat is adapted (see p. 59); and the 1935 crop is somewhat larger. This present trend of wheat disappearance is in striking contrast with the expansion in earlier decades, particularly 1913–22.

CHART 3.—WHEAT PRODUCTION, NET IMPORTS, AND APPARENT DISAPPEARANCE IN JAPAN, FROM 1878–82 TO 1934–35*

(*Million bushels*)



* Data in Tables IV and VI. In the dotted line, changes in carryovers are ignored; the horizontal dashed lines in the upper right-hand corner are 5-year averages ending with 1929–30 and 1934–35.

Perhaps the most striking development following the inauguration of the Five-Year Plan is the sharp drop in net wheat imports. This is shown graphically in Chart 3. It appears from this chart that in the crop year 1931–32 net imports of wheat and flour totaled 18.3 million bushels, which sank to 2.2 million in 1932–33, to 1.7 million in 1933–34, and to practically nil in 1934–35.[2] The figures for 1933–34 and 1934–35 are esti-

[1] Japan has at times imported low-grade wheat for feed. See R. M. Grew, "Import Trade of Japan in 1934," *Commercial Intelligence Journal*, July 27, 1935, LIII, 138.

[2] As stated elsewhere, a small amount of high-gluten flour is imported for the manufacture of *ajinomoto* under bond and is not here included. It is not known to the writer whether all of such flour is imported under bond or only that part which is equivalent to the export of *ajinomoto*.

mates based in part on figures for Chosen and Taiwan for the calendar years 1933 and 1934. In 1934–35, Japan proper (i.e., Japan exclusive of Chosen and Taiwan) imported just about as much grain as it exported flour in terms of grain. For the year 1935–36, it is likely to be to a small degree a net exporter.

The Leased Territory, Kwantung, is treated as a foreign country in Japanese statistical reports. Exports to it have been on a much higher level in the last few years, as is shown in Table X. There is more reason than formerly to regard the Kwantung Leased Territory as a dependency of Japan, for there is now a disposition to regard the lease from China as void, because sovereign rights now reside in Manchukuo. If the Kwantung Leased Territory be regarded, with Chosen and Taiwan, as a dependency of Japan, then it appears that a large part of her flour exports go to her dependencies.

After 1907, the Chinese Maritime Customs applied the Chinese tariff rates to foreign goods entering at Dairen destined for Manchuria and Chinese points in general. Effective September 25, 1932, Manchukuo took over the administration of the customs at Dairen[1] and customs receipts no longer went to China. Before that time, goods shipped from other points of China to Manchukuo, of course, paid no duty, this not being regarded as foreign commerce. Shanghai was an important transshipment port for Manchuria and the north.

This is now changed, and Chinese goods have become foreign goods with respect to Manchukuo; they pay the same duty as Japanese goods. Shanghai has lost an important element of its transshipment business. Goods manufactured in China for export to Manchukuo no longer enjoy the protection of the Chinese tariff. They must compete on even terms so far as the customs are involved with those from Japan. Flour was this sort of merchandise and Chinese flour mills lost the tariff protection they formerly enjoyed in their Manchurian business. Very probably this was one of the reasons why China lost some of its flour trade in Manchukuo and Japan's exports increased[2] very greatly as Table X shows. This may be due in part also to the fact that trade in general between Manchukuo and China has been greatly disrupted.

But the increase of Japan's flour exports to former Chinese territory is not due solely to changes in the customs system. It is due in part, according to Langley, to the influence of Japanese firms over the trade with Manchukuo, and to the flow of immigrants from flour-eating areas in China into Manchukuo. Japanese millers place per capita consumption of wheat as flour in North China at 8 sacks (of 49 pounds) per annum and in Manchukuo at 0.8 sack.[3] Moreover, in this region, including Kwantung Leased Territory, there has been great economic activity and many sorts of imports from many countries have increased as well as from Japan. For example, those of the United States have increased 96 per cent; those of British India, 178 per cent; of Germany, 95 per cent; of Great Britain, 48 per cent; and of the Netherlands Indies, 253 per cent. On the other hand, imports from China decreased 39 per cent; from Russia, 76 per cent; from Belgium, 77 per cent.[4] However, Japan's greater flour export to Kwantung Leased Territory and Manchukuo has not been all gain; it is in part nullified by loss of exports to China. These dropped steadily from 925,000 barrels in 1931 to 12,000 barrels in 1934. In how far this may be due to the changed customs situation, and in how far to other factors such as the boycott, is a question outside the province of this study.

Changes in the sources whence Japan has drawn her imports of wheat since the Plan was inaugurated are far less striking than those to which net imports were subject.

[1] See H. G. W. Woodhead, "Dairen Customs Regime Strict under New Manchukuo Control . . . . ," *The Trans-Pacific* (Tokyo), Nov. 17, 1932, XX, 5. "China Losing Trade with Manchurians . . . . ," *ibid.*, Nov. 24, 1932, XX, 21.

[2] Some of this increase may have been to make good shortages of Manchukuo crops due to the disastrous floods of 1932 and 1934 in the rich agricultural regions of the Nonni and Sungari valleys.

[3] J. A. Langley, "Japanese Flour Exports," *Commercial Intelligence Journal*, Mar. 10, 1934, L, 375. Per capita consumption as high as 392 pounds per annum in North China looks high.

[4] See "Manchoukuo Shows Large Unfavorable Trade Balance for 1934," *Far Eastern Survey*, April 24, 1935, IV, 61–62.

Gross imports have fluctuated considerably ever since Japan developed a modern milling industry exporting a large part of its product. Imports have varied not merely with the size of the domestic crop and the domestic demand, but also with the success in foreign markets of Japanese millers in competition with foreign millers, especially those of Australia. The data on the sources of Japan's wheat imports are given in Table IX. The causes of the shifts shown in this table are so complex that they cannot be discussed here.

Since, as shown in preceding paragraphs, the net import of wheat for the crop year 1934–35 was practically nil, the government announced on May 1, 1935, it would no longer go on with the Plan.[1] This did not mean complete abrogation, for the tariff remains unchanged and the breeding and testing work of the agricultural experiment stations continues. It meant merely that various subsidies such as those to supervising committees, to seed farms, to individuals, and for the encouragement of small-scale rural milling were discontinued. Naturally, there was a great deal of protest, but the government adhered to its decision.

In the press, it was charged that the Ministry of Agriculture and Forestry was playing up to the interests of the large millers, such as the Nisshin, the Nihon, and the Nitto flour mills.[2] Unfortunately data adequate for an account of what transpired in milling while the Five-Year Plan was in full force are not available to the writer. A trade estimate made in 1935 places the "normal" consumption of small mills at 6.6 million bushels and of large commercial mills at 31.8 million bushels. The years for which this is "normal" is not stated, nor is it stated whether foreign wheat is included in these figures. In 1934, the government appropriation for subsidizing small-scale milling was 300,000 yen. What, if anything, was appropriated for this purpose in earlier years, the writer has not been able to learn. Some of these funds were devoted to the purchase of small motors to replace antiquated water wheels driving small plants operated by farmers as a side line to their regular occupation. It is estimated that up to the beginning of 1934 more than 2,000 of these motors were purchased with the assistance of the Farmers' Co-operative Associations.[3] Official data on the number of small-scale mills are not published; flour milling is not separated from starch making. In 1933, there were in these two industries combined 300 "factories where more than five persons are employed."[4] Of these, only 9 are "not worked by motors." There are no official statistics on mills employing less than five persons, or owned and operated by village co-operatives if, as is the fact, they do not employ this number. Trade estimates place the number of small milling machines at about 7,000 in 1933 and at about 9,000 in the spring of 1935. If we take the trade estimate of 6.6 million bushels as the total grind of small mills and the estimate of 7,000 small milling machines in 1933, then the grind per mill was about 943 bushels, equivalent to about 210 barrels per annum or less than a barrel a day for a 300-day year—a very small amount indeed.

If, in consequence of subsidies under the Five-Year Plan, there was in fact an increase in small milling machines, there may have resulted some modification of the geography of wheat milling. Flour milled in part from imported wheat at seaboard by large commercial mills was presumably shipped in lesser volume to country points. Furthermore, the price situation, discussed above, undoubtedly stimulated farmers to sell wheat rather than to consume it themselves and this perhaps favored small-scale rural milling because supplies of wheat were available locally. On the other hand, the price situation probably tended to reduce rural consumption relatively more than urban consumption.

Whatever may have been the course of small-scale milling, on June 21, 1935, the wheat-flour cartel was dissolved, allegedly because too much competition had been develop-

[1] "Ministry to Cease Subsidy for Flour . . . ," *Japan Advertiser* (Tokyo), May 3, 1935.

[2] *Ibid.*

[3] J. A. Langley, "Flour and Wheat Situation in Japan," *Commercial Intelligence Journal*, Jan. 6, 1934, L, 13.

[4] Department of Finance, *The Thirty-third Financial and Economic Annual of Japan, 1933* (Tokyo), pp. 90–91.

ing from outside mills large and small, long-established and new.[1] Also it would seem that disagreements arose within the cartel itself. At least one of the member mills was no longer satisfied with the share of the business originally allotted to it.

VI. FACTORS CONTRIBUTING TO THE SUCCESS OF THE FIVE-YEAR PLAN

In the preceding section, developments were discussed in relation to the Plan. This discussion dealt principally with the mechanisms by which the desired goal was attained, namely better cultural methods, better seed, better varieties, more intensive fertilization, and increase of acreage. We have next to consider what led farmers to apply such mechanisms. To meet economic emergencies in Japan, the government relies far more than in America upon appeals to patriotism and to national pride. For example, the government began in 1932 to meet the desperate agricultural situation in large measure by a "self-help" campaign, which was virtually an appeal to farmers to work themselves out of debt and into prosperity by reducing their standard of living voluntarily. But there is a limit to the response of even Japanese farmers to such a policy; and it is to be doubted that in peace times mere appeals to patriotism would have secured the response necessary to render Japan self-sufficient with respect to wheat. There must have been other stimuli, presumably economic, as there were during the war years, to turn the attention of farmers to wheat-growing. Once their eyes had been turned in this direction, they naturally would take advantage of the help the government offered in the form of better seed, instruction, and the like. Let us now inquire what these economic considerations were.

The most important, perhaps the predominant one, was probably price. World wheat prices were low during the period of operation of the Five-Year Plan—indeed, they were relatively lower in 1933–34 than in 1932–33; and this, taken alone, would tend to discourage wheat planting. In terms of gold, however, world wheat prices dropped relatively less in this period than those of the two principal competing grains, rice and barley. The change in the gold price index of British import wheat in 1933–34 as compared with 1932–33 was −16 per cent; that of barley, −22; and that of rice, −24.[2] On the assumption that British import prices fairly represent the world wheat price level, it is seen that the world price situation favored the success of the Five-Year Plan. Furthermore, the depreciation of the yen made world prices high in terms of Japanese currency and so, no doubt, reinforced the effects of the tariff in shutting out foreign wheat from domestic consumption and delivering the domestic market without serious competition to the domestic wheat grower.

The domestic price of wheat was high relative to barley, not merely in the world generally, but also in Japan. Perhaps this favorable position of wheat was due in part to the increase of the tariff on wheat without compensating action with respect to barley. At any rate, whatever the cause, the high wheat price relative to barley helped the Five-Year Plan. This is clear since, as we have seen, expansion of wheat acreage took place mainly through the displacement of both kinds of barley upon paddy as well as upon upland fields.

A high price of wheat relative to barley is very effective because the tenant farmer does not have to share with the landlord a second crop raised in winter when rice cannot be grown; the whole of the second crop is the tenant's. Therefore a good price for it means much to him. Undoubtedly, the feeling of the tenant that he has the land rent-free in winter is a strong incentive to make the most of second crops. It is the opinion of Japanese agricultural economists that this was a major

[1] T. J. Monty, "Dissolution of Wheat Flour Cartel in Japan," *Commercial Intelligence Journal*, July 27, 1935, LIII, 146–48. "Wheat Flour Gains Manchurian Buyers . . . . ," *The Trans-Pacific* (Tokyo), Oct. 6, 1932, XX, 22; "Speculative Gains of Millers Heavy . . . . ," *ibid.*, June 2, 1932, XX, 17.

[2] See M. K. Bennett and H. C. Farnsworth with A. E. Taylor, "The World Wheat Situation, 1933–34. A Review of the Crop Year," WHEAT STUDIES, December 1934, XI, 148.

factor in extending the area under wheat, for about half the farming land of Japan is cultivated by tenants who rent their fields. Moreover, while it is true that about one-fourth of the total arable land of Japan is owned by less than one per cent of the landholders,[1] there are also a great many landlords whose holdings are so small that in America they would themselves cultivate all of them. Many landowners with as little as 10 *cho* (24.5 acres) rent out a part and cultivate only a part themselves. To this class of landlords, high relative wheat prices would be as strong a stimulus to put in wheat instead of barley as it is to their tenants.

Very low rice prices, as pointed out above, tend to induce farmers to sell a larger proportion of the wheat crop, perhaps make more wheat available to the industrial and urban classes, and so tend to reduce imports of foreign wheat, since it is these classes that are supplied by the large modern port mills which customarily grind foreign wheat for export. Very low rice prices may, therefore, greatly reduce farmer consumption and so contribute materially to self-sufficiency. This probably happened in 1931–33 and in 1934 until it became apparent that the rice crop was bound to be very short. Moreover, under such circumstances, the government tends to stabilize prices through operations under the rice-control law.

The port milling trade very generally recognizes that high rice prices are a favorable factor, and low prices an unfavorable factor, for the large-scale milling industry. This industry looks with satisfaction upon the results of the Five-Year Plan as a stabilizing influence. No longer to be heavily dependent upon the importation of foreign wheat for the domestic market would tend to stabilize their operations. Apparently, the stimulation of wheat production has proceeded to a point at which large supplies of home-grown wheat tend at times to keep domestic prices down temporarily (see pp. 83, 84). Even though the average price for the year may not be unduly low, millers regard such a situation as favorable, since it tends to widen the spread between wheat and flour.

Some experts believe that this price relationship was a major factor in determining the success of the Five-Year Plan, and they anticipate that with the return of a normal relationship between barley and wheat prices more or less of the land now devoted to wheat will go back to barley. Some of the gains wheat has made—perhaps a large proportion —will be retained, especially if the duty is not lowered and the yen does not greatly appreciate. It is not impossible that if the price relationships between wheat and the barleys return to their former level, wheat acreage will tend to drop. This is what happened after the war. In that event, whether acreage drops to its old level of 1928–32 or drops less far will depend upon the success that is achieved in introducing new varieties that possess to a greater degree than those now grown the advantages of barley: early maturity; short, stiff straw; and good yield. In the post-war period, yields, unlike acreage, did not drop to their pre-war level. Whether the high yields of 1933–35 will also be maintained, it is quite impossible to say so long as the rôle of the weather in producing them is uncertain. If yields again tend to become lower, this trend may be checked to some extent by the introduction of high-yielding new varieties. At what level yields will ultimately tend to become stabilized will therefore depend upon two as yet quite uncertain factors: (*a*) the rôle the weather played in 1933–35, and (*b*) the character of the new varieties yet to be developed or introduced.

In summary, it may be said that the most important single factor in bringing Japan to the point of practical self-sufficiency with respect to wheat was the high price of wheat relative to the barleys. Had there been no Five-Year Plan, it is highly probable that the wheat crop would nevertheless have been greater than it had been, much as it became greater during the war period than it had been before the war. It is, however, equally improbable that the volume of the crop would have increased as much as it did if there had been no efforts on the part of the government. The depreciation of the yen tended to restrict

[1] M. Royama, *Problems of Contemporary Japan* (University of Hawaii Occasional Papers 24), January 1935, p. 34.

imports for domestic use. The new tariff, though not much higher in terms of gold than the one it superseded, strengthened this tendency. Thus domestic wheat had little competition to meet from foreign imported wheat. The governmental measures tended to reinforce the world price relationships which favored wheat with respect to barley. Relatively good wheat prices set the scene for the government. The farmer would probably in any event have planted more wheat; he was, therefore, eager to accept the government's aid and plant superior seed or seed of superior varieties. He was in a favorable frame of mind to heed advice regarding better methods of wheat growing. Thus the great crops of 1934 and 1935 were achieved. The share of the weather in producing them it is as yet quite impossible to appraise.

In short, wheat crops would have been large because of the price situation without governmental interference. They would probably not have been large enough for self-sufficiency, or they would not have been large enough so soon without the Five-Year Plan. Had the old price relationships obtained, it may be doubted whether the Five-Year Plan would have accomplished much except perhaps some long-time effect upon the trend of yield.

VII. ELEMENTS IN THE OUTLOOK

As one attempts to look ahead, the most important element is the future of consumption. This will be determined primarily by two factors, population growth and per capita disappearance. The first of these can be appraised with considerable probability for the immediate future and with a fair degree of probability for the more distant future. The second cannot be forecast with any useful degree of accuracy, except perhaps for a few years; for the more distant future, a forecast is quite out of the question. No more can be done than to place before the reader the factors that are most liable to control per capita disappearance in the more distant future.

Uyeda, as the result of a careful analysis, concludes: "The population of Japan can never reach 100,000,000 which is imagined as the possible future population and it will stop probably at about 80,000,000."[1] He forecasts the population in 1950 at 78,364,000.[2] At the last census in 1930, the population was reported as 64,450,000. If we take the ultimate maximum population at 80,000,000, a point perhaps reached some time after 1950, then at the maximum there will be about 15,550,000 more people in Japan than there were in 1930. If per capita wheat disappearance in future should be as high as the average for three years ending with 1925–26 (see pp. 76, 77), then Japan at maximum population will require about 63 million bushels a year.

This calculation is based upon the assumption that per capita wheat disappearance will be at about the highest level it has hitherto attained. Of this, there can be no certainty for the future. If per capita disappearance in the future is only as high as the average of 1929–33, the total use of wheat would only be about 53 million bushels in 1950. Over the fifty-year period 1878–1927, per capita disappearance increased at the rate of 0.0092 bushels per annum.[3] From 1908 to 1918, disappearance remained practically constant. In the last few years, it appears to have declined.

It must be remembered that wheat eating is not an index of rising standard of living. Rice eating, not wheat eating, is the symbol of social status. Therefore rising living standards are most likely to lead to greater rice consumption by the poorer people. Diversification of the diet will take different paths from those it has taken in the Occident. It will probably take the form of greater consumption of sea foods, of vegetables, of fruits, and of sugar, and not of greater consumption of wheat, meat, and dairy products. Greater consumption of wheat and animal foodstuffs is likely to come very slowly in the future, as it has in the past. These foods may be con-

[1] T. Uyeda, *Future of the Japanese Population* (Japanese Council, Institute of Pacific Relations, 1933), p. 12.

[2] *Ibid.*, p. 9.

[3] See Table IV.

sumed in larger quantities by the sophisticated in the great cities, but not soon by the great masses. Per capita wheat disappearance is not likely to rise as fast in the future as it has in the past, and it may remain stationary.

Even without a rise in the standard of living, rice consumption might rise and per capita wheat disappearance remain stationary or decline, so that by 1950 total annual requirements would be not much, if at all, in excess of 50 million bushels. This would probably occur if rice became very cheap, either because the government gave up its rice-control policy or entered upon a policy of freer trade. Neither seems likely in the near future. The population of Japan is still over half agricultural and depends for its livelihood primarily upon rice. The government will hardly deliberately let rice prices find their own level as a matter of national policy. What seems possible is that financial difficulties may render continuation of rice-control operations on their recent scale impracticable.

In short, we cannot expect in the next decade or two that population growth and increase in per capita disappearance combined will raise the demand for wheat at a rapid rate and make Japan an important wheat-consuming country dependent for large supplies upon imports. A total annual disappearance of 60 million bushels or more might be supplied by domestic production if it were thought wise national policy to take the necessary steps. Experience under the Plan has shown that appreciable further increase of yield is well within the range of possibilities and there still remains much land devoted to the barleys upon which wheat might expand, given sufficient inducement.

There is, however, another side to the picture. Japan is suffering from agricultural overpopulation.[1] Her present policy of industrialization, if persisted in as it must be of necessity, will gradually redress this maldistribution of her population. If in time a material reduction in her rural population takes place, reorganization of her agriculture must follow. Whether such a reorganization would render it easier or more difficult to maintain the high level of wheat production necessary for self-sufficiency, it is impossible to forecast.

While Japan may remain self-sufficient in wheat at least in the nearer future, she will probably need to import for a long time to come small amounts of strong wheat to blend with domestic wheats for certain grades of flour.[2] If her people eat more bread of Western type than in the past, the volume of such wheat may become appreciably greater than corresponds to population growth. However, spring wheat is grown in Hokkaido and if attention is there directed to quality, Hokkaido may yet become the granary from which Japan draws the modest volume of strong wheat that may be needed to blend with her weak domestic wheat. Furthermore, there is no doubt that with proper attention to breeding for quality, it would be possible to raise the gluten content of other domestic wheat somewhat and thus reduce the volume of strong wheat needed for blending purposes.

Manchukuo wheat is of the spring variety and better adapted to bread making than the soft red winter wheat of Japan. Wheat together with millet (kaoliang, *Andropogon*) are the staple foods of the mass of Manchukuoans rather than rice. In the Japanese press, the opinion has been expressed that Manchukuo will become the source from which Japanese mills will draw the small volume of strong wheat required. Until 1932, Manchukuo was to a small extent a wheat-surplus region. From 1927 to 1931, the crop averaged 52.5 million bushels per annum, but it has been much smaller since then, as shown by Table 7. Adverse weather has helped to reduce acreage and production, and the very poor crop of 1934 was due in part to floods. Plans have been made to expand wheat growing, especially in the territory served by the Chinese Eastern Railway. It is proposed to double the crop. If wheat acreage is enlarged, the crop is likely to become even more variable than it has been in the past, for wheat growing

[1] Penrose, *loc. cit.*

[2] Langley states that "Owing to the nature of the manufacturing process used in Japanese roller mills, it is absolutely necessary to use at least 10 per cent of foreign wheat." (See "Wheat and Flour Situation in Japan," *Commercial Intelligence Journal*, Mar. 9, 1935, LII, 378.) This is perhaps a large overestimate.

will have to be extended to less favorable sections. Yields already compare favorably with other spring-wheat regions. Nevertheless, some improvement of yields can no doubt be achieved by the introduction of new varieties.

TABLE 7.—AREA, PRODUCTION, AND YIELD OF WHEAT IN MANCHURIA/MANCHUKUO, 1924–35*

(Area, thousand acres; production, thousand bushels; yield, bushels per acre)

Year	Area	Production	Yield	Year	Area	Production	Yield
1924.....	1,840	29,570	16.1	1930.....	3,413	49,848	14.6
1925.....	2,172	35,316	16.3	1931.....	3,919	58,066	14.8
1926.....	2,209	35,564	16.1	1932.....	3,447	41,634	12.1
1927.....	2,810	53,104	18.9	1933.....	3,395[a]	31,709	9.3
1928.....	3,251	54,006	16.6	1934.....	2,041	23,479	11.5
1929.....	3,205	47,848	14.9	1935.....	2,367	30,355	12.8

* Data from U.S. Department of Agriculture and International Institute of Agriculture *Yearbooks*. A slightly different series of production figures for 1925–35 may be found in *Foreign Crops and Markets*, Sept. 9, 1935, p. 343; the estimates for 1925–32 are said to be made by the South Manchuria Railway.

[a] Unrevised, and possibly too high.

Manchukuo may again become a surplus region and be in position to supply some hard wheat to Japanese millers. How soon this may come is quite unpredictable, because of uncertainties of weather, of population growth, and of transportation. Indeed, Japanese millers may, as in the past, import wheat from whatever region has the lowest prices for comparable wheats; and Manchukuo wheat will have to compete for its share of the trade.

If wheat culture is enlarged in Manchukuo, Japanese mills may have to face sharper competition. On November 22, 1934, the new Manchukuo tariff decrees raised the duty on flour to 40 sen a bag of 49 pounds (30 sen exclusive of 10 sen *to* duty). The flour market in Manchukuo fluctuates from 20 to 40 sen per bag. It is claimed that since flour is a necessity, the new rate will not harm Japanese flour exports. However, the new duty is plainly a protectionist measure. There is already a milling industry in northern Manchukuo; it is plainly to develop this industry that the rate on flour was raised. There are said to be 90 flour mills, large and small combined, with a capacity of about 30 million bags. However, some mills are old, others not operating; effective capacity is possibly 14 to 15 million bags. The Japan-Manchuria Flour Mill, organized in 1934 with Japanese capital, operates 4 comparatively modern mills with a capacity of 25 million barrels.

The product of the north Manchukuo mills has supplied the territory as far south as Shinkyo; the territory farther south has been supplied with imported flour. It is likely that the duty will permit northern Manchukuo mills to come farther south and capture a part of the market hitherto dominated by Japan and Australia. These developments are perhaps not very important at present, but they may be significant for the trend in that part of Asia in the future. They are indicative of one of the consequences of an imperialist policy seeking to develop economically backward regions.

Recent developments in the wheat position of Japan may now be summarized as follows:

In the spring of 1932, the government announced a Five-Year Wheat Plan designed to make Japan self-sufficient with respect to wheat. It consisted of the following elements: an increase of the tariff to a level in terms of gold slightly above that before the devaluation of the yen; an educational campaign to encourage use of superior seed wheat and of improved varieties, and the improvement of cultural methods; intensification of research long in progress to develop new varieties without the defects found in varieties commercially grown; subsidization to a very modest extent of many local committees formed *ad hoc;* subsidization of seed-wheat farms; and subsidization of small-scale rural milling. Wheat growers were not directly subsidized.

With the crop of 1934, Japan became practically self-sufficient in wheat in a quantitative sense and by 1935 imports dropped to an almost negligible volume. In the spring of 1935, the subsidizing features of the Plan were dropped. Small amounts of strong wheat for blending with domestic wheat to produce the best grades of bread flour will probably continue to be imported. In 1935–36, Japan may be a slight net exporter as it was for a few months in 1934–35.

The enlargement of the wheat crop by about 60 per cent was due to increase of acreage and of yield. Expansion of acreage contributed rather more to the result than improvement of yield. Practically no land not already in cultivation was newly sown to wheat. Expansion took place almost entirely through the displacement of naked and common barley both upon irrigated land (paddy fields) and upon unirrigated fields (upland). Expansion of acreage was in large part the consequence of a high price for wheat relative to barley. This favorable price situation was the result partly of world conditions, partly of the tariff. How far the record yields of 1933–35 were due to the Five-Year Plan and how far to favorable weather, it will be possible to appraise only after the lapse of a series of years. The probabilities point strongly to the Five-Year Plan as the more important factor.

In recent years, per capita wheat disappearance has been stationary or declining slightly. There is little prospect that it will rise greatly in the near future. Under this assumption, when Japan's population becomes stationary, probably some time not long after 1950, the total domestic requirements of Japan are not likely to exceed 63 million bushels. This is a volume within the capacity of the country to produce. If, however, per capita disappearance continues to decline as it has in the last few years, requirements may be as low as 53 million bushels. The trend of disappearance is likely to be influenced by prices: high rice prices relative to wheat tend to increase wheat consumption and vice versa. The relation of barley to wheat prices will influence the size of the wheat crop. If barley prices become relatively good as compared with wheat, some of the land that has gone into wheat in the last three years may go back into barley. Wheat yields, however, are not likely to return to their former level. Under the most unfavorable circumstances that can now be envisaged, Japan is unlikely to import as much wheat for domestic consumption as in former times—barring of course an occasional failure of the wheat crop or large upward trend of per capita consumption such as is not now in sight.

This study is by Carl L. Alsberg; the Appendix Tables were made by Rosamond Peirce under the direction of Joseph S. Davis

APPENDIX

TABLE I.—ACREAGE OF WHEAT AND THE BARLEYS IN JAPAN, 1878–1935*

(Thousand acres)

Period or year	Total area				Upland				Paddy			
	Three grains	Wheat	Naked barley	Common barley	Three grains	Wheat	Naked barley	Common barley	Three grains	Wheat	Naked barley	Common barley
Average												
1878–82..	3,483	887	1,121	1,475	.....	...	...	...	.....	...	...	...
1883–87..	3,769	966	1,289	1,514	.....	...	...	...	.....	...	...	...
1888–92..	4,135	1,060	1,498	1,577	2,780[a]	802[a]	735[a]	1,243[a]	1,395[a]	272[a]	777[a]	346[a]
1893–97..	4,254	1,086	1,579	1,589	2,765	789	769	1,207	1,489	297	810	382
1898–1902	4,431	1,161	1,675	1,595	2,806	821	782	1,203	1,625	340	893	392
1903–07..	4,420	1,112	1,687	1,621	2,762	765	773	1,224	1,658	347	914	397
1908–12..	4,345	1,163	1,667	1,515	2,654	763	759	1,132	1,691	400	908	383
1913–17..	4,410	1,257	1,711	1,442	2,607	802	743	1,062	1,803	455	968	380
1918–22..	4,190	1,307	1,589	1,294	2,443	818	670	955	1,747	489	919	339
1923–27..	3,610	1,160	1,339	1,111	2,089	708	553	828	1,521	452	786	283
1928–32..	3,369	1,218	1,201	950	1,826	674	461	691	1,543	544	740	259
Annual												
1922.....	3,974	1,229	1,506	1,239	2,336	778	636	922	1,638	451	870	317
1923.....	3,745	1,196	1,378	1,171	2,209	746	586	877	1,536	450	792	294
1924.....	3,609	1,150	1,334	1,125	2,125	716	565	844	1,484	434	769	281
1925.....	3,615	1,149	1,347	1,119	2,096	704	557	835	1,519	445	790	284
1926.....	3,581	1,146	1,335	1,100	2,037	690	533	814	1,544	456	802	286
1927.....	3,504	1,161	1,301	1,042	1,987	688	525	774	1,517	473	776	268
1928.....	3,442	1,201	1,252	989	1,914	688	495	731	1,528	513	757	258
1929.....	3,408	1,213	1,228	967	1,869	684	475	710	1,539	529	753	257
1930.....	3,319	1,204	1,183	932	1,779	660	445	674	1,540	544	738	258
1931.....	3,325	1,228	1,165	932	1,777	665	441	671	1,548	563	724	261
1932.....	3,354	1,247	1,176	931	1,792	674	449	669	1,562	573	727	262
1933.....	3,435	1,511	1,073	851	1,824	797	417	610	1,611	714	656	241
1934.....	3,442	1,589	1,040	813	1,812	831	399	582	1,630	758	641	231
1935.....	3,496	1,626	1,039	831	.....	...	...	...	.....	...	...	...

* Based on Japanese official data given in *cho*, in publications of the Ministry of Agriculture and Forestry (Tokyo), *Statistical Report on Cereals, 1928*, and issues of the *Statistical Abstract*. . . . . Dots (....) indicate that data are not available.

[a] Averages for four years, 1889–92.

TABLE II.—YIELD PER ACRE OF WHEAT AND THE BARLEYS IN JAPAN ON UPLAND AND PADDY, 1889–1934*

(Units of 60 pounds)

Period or year	Wheat		Naked barley		Common barley	
	Upland	Paddy	Upland	Paddy	Upland	Paddy
Average						
1889–92..	13.3	15.4	14.7	17.2	17.2	15.0
1893–97..	15.7	18.4	19.7	21.8	20.0	17.7
1898–1902	16.5	19.4	20.7	21.5	21.3	19.7
1903–07..	14.8	16.7	18.7	18.5	21.8	19.4
1908–12..	19.8	21.8	21.8	23.3	24.6	22.5
1913–17..	19.9	23.5	22.6	25.0	27.2	23.7
1918–22..	21.2	23.8	22.6	25.0	27.3	23.9
1923–27..	22.4	25.8	23.8	27.0	29.1	25.7
1928–32..	23.2	27.6	25.6	29.7	30.8	27.5
Annual						
1932.....	23.4	27.2	24.7	30.1	32.7	28.1
1933.....	27.0	26.4	24.3	25.6	33.1	26.9
1934.....	28.6	31.6	27.8	31.0	33.7	28.6

* Computed from data in Tables I and III.

TABLE III.—PRODUCTION OF WHEAT AND THE BARLEYS IN JAPAN ON UPLAND AND PADDY, 1889–1934*

(Thousand units of 60 pounds)

Period or year	Wheat		Naked barley		Common barley	
	Upland	Paddy	Upland	Paddy	Upland	Paddy
Average						
1889–92..	10,630	4,182	10,811	13,334	21,336	5,200
1893–97..	12,419	5,455	15,166	17,659	24,185	6,771
1898–1902	13,547	6,601	16,152	19,217	25,599	7,737
1903–07..	11,336	5,785	14,475	16,866	26,646	7,696
1908–12..	15,098	8,716	16,521	21,159	27,800	8,610
1913–17..	15,963	10,678	16,813	24,227	28,928	8,994
1918–22..	17,308	11,619	15,155	22,947	26,081	8,096
1923–27..	15,841	11,683	13,135	21,193	24,092	7,265
1928–32..	15,624	14,991	11,805	21,996	21,249	7,119
Annual						
1932.....	15,765	15,571	11,108	21,864	21,852	7,369
1933.....	21,537	18,873	10,121	16,778	20,208	6,477
1934.....	23,734	23,926	11,085	19,898	19,625	6,596

* Basic data from sources noted under Table I. Conversion rates per *koku:* wheat, 289.4 lbs.; naked barley, 301.8 lbs.; common barley, 231.5 lbs.

TABLE IV.—WHEAT SUPPLIES OF JAPAN, FIVE-YEAR AVERAGES, 1878–1935*

(Million bushels, except as noted)

Period	Crop	Net imports[a]			Crop plus net imports	Average population (millions)	Per capita supply (bushels)
		Wheat	Flour	Total			
1878–82..	10.08	(.24)	...	(.24)	9.84	35.93	.27
1883–87..	13.32	(.42)	...	(.42)	12.90	38.09	.34
1888–92..	14.77	(.12)	.12	.00	14.77	40.14	.37
1893–97..	17.95[b]	.00	.36	.36	18.31	42.09	.44
1898–1902	20.17[b]	.21	1.61	1.82	21.99	44.63	.49
1903–07..	17.12	1.71	5.46	7.17	24.29	47.57	.51
1908–12..	22.85[b]	1.64	.56	2.20	25.05	50.36	.50
1913–17..	26.64	2.78	(1.97)	.81	27.45	53.02	.52
1918–22..	28.93	10.23	(.15)	10.08	39.01	55.84	.70
1923–27..	27.52	20.27	(4.10)	16.17	43.69	59.56	.73
1928–32..	30.62	24.42	(10.31)	14.11	44.73	64.21	.70
1925–30[c].	29.70	22.34	(7.87)	14.47	44.17	61.82	.71
1930–35[c].	35.96	21.68	(14.20)	7.48	43.44	66.53	.65

* Basic data from sources noted under Table I, and International Institute of Agriculture *Yearbooks*.

[a] Figures in parentheses indicate *net exports*.

[b] Revision of some estimates of total crop make this differ from the sum of upland and paddy crops in Table III.

[c] Crop years. Second period partly estimated.

TABLE V.—WHEAT SUPPLIES OF CHOSEN (KOREA), 1922–34*

(Thousand bushels, except as noted)

Calendar year	Crop	Net imports[a]			Crop plus net imports	Population July 1 (millions)	Per capita supply[b] (bushels)
		Wheat	Flour	Total			
1922....	10,532	175	683	858	11,390	17.87	.64
1923....	8,599	144	887	1,031	9,630	18.23	.53
1924....	10,289	615	1,360	1,975	12,264	18.60	.66
1925....	10,509	(509)	1,432	923	11,432	18.97	.60
1926....	10,241	101	1,493	1,594	11,835	19.36	.61
1927....	9,043	165	1,553	1,718	10,761	19.75	.54
1928....	8,595	567	1,800	2,367	10,962	20.14	.54
1929....	8,320	(80)	1,932	1,852	10,172	20.55	.49
1930....	8,985	207	1,842	2,049	11,034	20.95	.53
1931....	8,341	126	1,475	1,601	9,942	21.30	.47
1932....	8,576	(208)	1,169	961	9,537	21.60	.44
1933....	8,887	(351)	982	631	9,518	21.88	.44
1934....	9,268	...	...	...	.....	....	...

* Official data as reported by U.S. Department of Agriculture, and International Institute of Agriculture.

[a] Figures in parentheses represent *net exports*.

[b] Carryovers disregarded.

TABLE VI.—WHEAT ACREAGE AND PRODUCTION IN JAPAN, NET IMPORTS, AND TOTAL SUPPLIES, ANNUALLY, FROM 1922–23*

(Thousand bushels, except as noted)

Aug.–July	Area (thousand acres)	Yield per acre (bushels)	Crop	Net imports[a]			Crop plus net imports	Population Jan. 1 (millions)	Per capita supply[c] (bushels)
				Wheat	Flour[b]	Total			
1922–23.....	1,229	22.5	27,617	13,758	(321)	13,437	41,054	57.63	.71
1923–24.....	1,196	20.9	25,032	28,670	(1,326)	27,344	52,376	58.39	.90
1924–25.....	1,149	22.1	25,406	14,529	(4,455)	10,074	35,480	59.16	.60
1925–26.....	1,149	25.7	29,521	27,546	(6,943)	20,603	50,124	59.97	.84
1926–27.....	1,146	24.8	28,440	17,848	(5,035)	12,813	41,253	60.89	.68
1927–28.....	1,161	25.2	29,208	20,530	(7,012)	13,518	42,726	61.82	.69
1928–29.....	1,201	25.7	30,812	27,695	(13,158)	14,537	45,349	62.76	.72
1929–30.....	1,213	25.1	30,496	18,079	(7,189)	10,890	41,385	63.72	.65
1930–31.....	1,204	24.5	29,537	25,280	(10,080)	15,200	44,737	64.68	.69
1931–32.....	1,228	25.2	30,892	28,424	(10,148)	18,276	49,168	65.60	.75
1932–33.....	1,247	25.1	31,336	19,595	(17,390)	2,205	33,541	66.53	.50
1933–34.....	1,511	26.7	40,376	16,551[d]	(14,833)[d]	1,718[d]	42,094[d]	67.47	.62[d]
1934–35.....	1,589	30.0	47,660	18,528[d]	(18,528)[d]	0[d]	47,660[d]	68.44	.70[d]
1935–36.....	1,626	30.2	49,087	.....	.....	.....	.....	.....	...

* Official data: on crops from U.S. Department of Agriculture; on trade from International Institute of Agriculture, and Department of Finance (Tokyo), *Monthly Return of the Foreign Trade of Japan*.

[a] Taking 1 *kin* = 132.276 lbs., and converting flour to wheat equivalent at 4.5 bu. per bbl. Figures here include trade of Japan with Chosen (Korea) and Taiwan (Formosa), taking means of two successive calendar-year figures given in Table VIII (see also note *d*).

[b] Figures in parentheses represent *net exports*.

[c] Carryovers disregarded.

[d] Using rough approximations for trade with Chosen and Taiwan, in the absence of data for 1934 and 1935.

TABLE VII.—INDEX NUMBERS OF PRICES OF RICE, WHEAT, AND FLOUR IN JAPAN, ANNUALLY 1923–34, AND MONTHLY, FROM JULY 1933*

(Base: October 1900 = 100)

Calendar year	Index numbers			Percentage wheat to rice	Month	Index numbers			Percentage wheat to rice	Month	Index numbers			Percentage wheat to rice
	Rice	Wheat	Flour			Rice	Wheat	Flour			Rice	Wheat	Flour	
Average					1933–34					1934–35				
1923....	277	205	...	74	July	174	186	212	107	July	219	159	184	73
1924....	327	233	...	71	Aug.	175	181	175	103	Aug.	233	167	190	72
1925....	353	289	...	82	Sept.	175	180	...	103	Sept.	242	174	196	72
1926....	319	252	262	79	Oct.	176	181	...	103	Oct.	257	178	200	69
1927....	298	228	247	77	Nov.	185	183	...	99	Nov.	253	178	196	70
1928....	262	223	231	85	Dec.	185	180	...	97	Dec.	246	176	195	72
1929....	246	219	227	89	Jan.	190	181	209	95	Jan.	244	183	199	75
1930....	215	175	186	81	Feb.	193	186	213	96	Feb.	251	201	215	80
1931....	156	122	140	78	Mar.	193	186	207	96	Mar.	250	206	218	82
1932....	178	164	188	92	Apr.	200	185	204	92	Apr.	245	203	212	83
1933....	182	185	212	102	May	208	184	204	88	May	245	193	208	79
1934....	221	178	200	81	June	213	180	198	84	June	245	172	185	70

* Bank of Japan indexes from The Institute for Commercial Research, Kobe, *The Bulletin of the Financial and Economic Statistics of Nippon;* and through the Yokohama Specie Bank, San Francisco.

TABLE VIII.—TRADE OF JAPAN IN WHEAT AND FLOUR, 1922–34*

(Thousand bushels, for total and wheat grain; thousand barrels, for flour)

Calendar year	Net imports of wheat and flour[a]				Net imports of wheat grain				Net exports of flour			
	Total	Foreign trade[b]	Chosen trade[c]	Taiwan trade[c]	Total	Foreign trade[b]	Chosen trade[c]	Taiwan trade[c]	Total	Foreign trade[b]	Chosen trade[c]	Taiwan trade[c]
1922.....	20,336	21,347	(144)	(867)	19,642	19,763	148	(269)	(154)	(352)	65	133
1923.....	15,682	16,779	(555)	(542)	16,250	16,275	53	(78)	126	(112)	135	103
1924.....	23,166	25,623	(1,686)	(771)	25,214	25,758	(453)	(91)	455	30	274	151
1925.....	11,822	13,777	(938)	(1,017)	17,416	17,035	480	(99)	1,243	724	315	204
1926.....	18,529	21,060	(1,457)	(1,074)	25,702	25,830	82	(210)	1,594	1,060	342	192
1927.....	11,666	14,349	(1,608)	(1,075)	16,800	17,139	(60)	(279)	1,141	620	344	177
1928.....	14,190	17,371	(2,099)	(1,082)	23,653	24,157	(277)	(227)	2,103	1,508	405	190
1929.....	15,154	18,016	(1,778)	(1,084)	26,952	26,966	166	(180)	2,622	1,989	432	201
1930.....	9,761	12,691	(1,960)	(970)	17,546	17,776	(88)	(142)	1,730	1,130	416	184
1931.....	17,259	19,994	(1,620)	(1,115)	26,296	26,542	(94)	(152)	2,008	1,455	339	214
1932.....	14,166	16,336	(858)	(1,312)	27,626	27,433	483	(290)	2,991	2,466	298	227
1933.....	719	2,719	(649)	(1,351)	18,890	18,784	602	(496)	4,038	3,570	278	190
1934.....	.....	4,583	...	.....	.....	17,979	...	...	.....	2,977	...	...

* Data from International Institute of Agriculture *Yearbooks*. Figures in parentheses indicate the opposite of that shown in the headings—in the first eight columns *net exports*, in the last four columns *net imports*.

[a] Including flour converted to wheat grain at 4.5 bushels per barrel, implying an extraction rate of 72.6 per cent.

[b] Including trade with Kwantung Leased Territory and, latterly, Manchukuo, but excluding trade with Chosen (Korea) and Taiwan (Formosa). See Tables IX and X.

[c] What Chosen and Taiwan statistics report as imports from Japan are here taken as Japan's exports to these possessions, and what those statistics report as exports to Japan are treated as Japan's imports.

TABLE IX.—IMPORTS OF WHEAT GRAIN INTO JAPAN, BY SOURCES OF EXPORT, 1922–34*

(*Thousand bushels*)

Calendar year	Total[a]	United States	Canada	Australia	China[b]	Other foreign	Kwantung	Chosen	Total ex-Chosen
1922.....	20,006	4,424	723	2,715	313	11,595[c]	88	148	19,858
1923.....	16,392	7,994	2,173	5,687	167	224	30	117	16,275
1924.....	26,104	10,068	4,837	10,804	48	0	14	333	25,771
1925.....	17,517	6,260	3,338	7,394	19	5	19	482	17,035
1926.....	25,916	7,182	9,210	9,412	...	26	...	86	25,830
1927.....	17,177	.....	.....	.....	...	...	...	38	17,139
1928.....	24,160	5,416	12,328	3,026	1,756	23	1,607	4	24,156
1929.....	27,186	5,378	14,660	5,297	496	164	971	220	26,966
1930.....	17,796	7,494	6,520	3,762	...[d]	...[d]	...[d]	20	17,776
1931.....	26,554	1,949	5,727	18,859	...[d]	7	0	12	26,542
1932.....	28,013	431	4,372	22,630	0	...[d]	0	580	27,433
1933.....	19,465	109	4,133	14,535	0	7	0	681	18,784
1934.....	.....	4,896	2,922	9,822	39	300[e]	0	...	17,979
1935[f].....	.....	13	1,944	9,526	7	945[e]	0	...	12,435

* Data from Ministry of Agriculture and Forestry (Tokyo), *Statistical Report on Cereals, 1928,* and direct; and Department of Finance (Tokyo), *Monthly Return of the Foreign Trade of Japan.*

[a] Including not only trade with Kwantung Leased Territory, which is officially included in the foreign trade statistics of Japan, but also that with Chosen (Taiwan exports no wheat to Japan), which is excluded from those statistics.

[b] Including Manchuria up to 1931, but presumably not Manchukuo thereafter.

[c] Includes imports of 11,588,000 bu. of uncertain origin.

[d] Less than 500 bu.

[e] Including imports from Argentina not separately distinguished till 1935, when they amounted to 872,000 bu. in January–September.

[f] Nine months, January–September.

TABLE X.—EXPORTS OF WHEAT FLOUR FROM JAPAN, BY AREAS OF DESTINATION, 1929–34*

(*Thousand barrels*)

Calendar year	Total[a]	China	Manchukuo	Netherlands Indies[b]	Other foreign	Kwantung	Chosen	Taiwan	Total ex-Chosen, ex-Taiwan
1929.....	2,700	1,206[c]	...	11	115	735	432	201	2,067
1930.....	1,951	767	136	18	174	255	417	184	1,350
1931.....	2,074	925	212	10	41	331	341	214	1,519
1932.....	3,023	708	579	4	18	1,184	303	227	2,493
1933.....	4,055	326	963	9	42	2,240	285	190	3,580
1934.....	.....	12	946	7	66	1,957	...	...	2,988
1935[d].....	.....	19	1,070	5	188[e]	1,313	...	...	2,595

* Data for foreign countries and Kwantung from Department of Finance (Tokyo), *Monthly Return of the Foreign Trade of Japan;* for Chosen and Taiwan from International Institute of Agriculture *Yearbooks* (see note under Table VIII).

[a] Including exports to Chosen and Taiwan, which are not included in Japanese export statistics.

[b] Including small amounts to Straits Settlements in some years.

[c] Including Manchuria, later separated as Manchukuo.

[d] Nine months, January–September.

[e] Includes 66,000 bbls. to the Philippine Islands.

WHEAT STUDIES *of the* FOOD RESEARCH INSTITUTE

VOLUME X

No. 1. *British Preference for Empire Wheat.* October 1933. $.50
No. 2. *Price Leadership and Interaction among Major Wheat Futures Markets.* November 1933. $.75
No. 3. *The World Wheat Situation, 1932–33: A Review of the Crop Year.* December 1933. $1.00
No. 4. *World Wheat Survey and Outlook, January 1934.* January 1934. $.50
No. 5. *Price Relations between May and New-Crop Wheat Futures at Chicago since 1885.* February 1934. $.75
No. 6. *Environment, Heredity, and Wheat Quality.* March 1934. $.50
No. 7. *World Wheat Survey and Outlook, May 1934.* May 1934. $.50
Nos. 8 and 9. *Decline and Recovery of Wheat Prices in the 'Nineties.* June and July 1934. $1.00
No. 10. *Pacific Northwest Wheat Problems and the Export Subsidy.* August 1934. $.75

VOLUME XI

No. 1. *World Wheat Survey and Outlook, September 1934.* September 1934. $.50
No. 2. *Decline in Wheat-Flour Export during the Depression.* October 1934. $.75
No. 3. *Prices of Cash Wheat and Futures at Chicago since 1883.* November 1934. $1.00
No. 4. *The World Wheat Situation, 1933–34: A Review of the Crop Year.* December 1934. $1.00
No. 5. *World Wheat Survey and Outlook, January 1935.* January 1935. $.50
No. 6. *Starch and Flour Quality.* February 1935. $.50
No. 7. *Per Capita Wheat Consumption in Western Europe* (I). March 1935. $1.00
No. 8. *Spreads between Wheat Prices in England.* April 1935. $.50
No. 9. *World Wheat Survey and Outlook, May 1935.* May 1935. $.50
No. 10. *International Wheat Policy and Planning.* June 1935. $.75

VOLUME XII

No. 1. *World Wheat Survey and Outlook, September 1935.* September 1935. $.50
No. 2. *World Wheat Prices, Canadian–Argentine Spreads, and the Ottawa Agreement.* October 1935. $.50
No. 3. *Japanese Self-Sufficiency in Wheat.* November 1935. $.75

RECENT CONTRIBUTIONS FROM THE FOOD RESEARCH INSTITUTE

(Numbered reprints available free on request)

E 45. "The Bitter Glucoside of the Olive," W. V. Cruess and C. L. Alsberg. *Journal of the American Chemical Society,* October 1934

G 65. "Wheat, Wheat Policies, and the Depression," Joseph S. Davis. *Review of Economic Statistics,* April 1934
G 66. "New Chinese Agricultural Statistics," M. K. Bennett. *Journal of Farm Economics,* April 1934
G 67. "A Random-Difference Series for Use in the Analysis of Time Series," Holbrook Working. *Journal of the American Statistical Association,* March 1934
G 68. "Wheat Consumption during the Depression," Carl L. Alsberg. *Proceedings of the World's Grain Exhibition and Conference,* Regina, Canada, 1933
G 69. "Observations on Wheat Consumption," Carl L. Alsberg. *Proceedings of the Fifth Pacific Science Congress,* Victoria and Vancouver, Canada, June–July, 1933
G 70. "What about Wheat Prices?" Holbrook Working. *Proceedings of the Fifth Pacific Science Congress,* Victoria and Vancouver, Canada, June–July, 1933
G 71. "British Wheat Yield per Acre for Seven Centuries," M. K. Bennett. *Economic History (Supplement),* February 1935
G 72. "AAA as a Force in Recovery," Joseph S. Davis. *Journal of Farm Economics,* February 1935
G 73. "Planned Agricultural Adjustment in the United States, 1933–34," Joseph S. Davis. Chapter i in *Commodity Control in the Pacific Area,* edited by W. L. Holland (London, Allen and Unwin, 1935)
G 74. "Differential Price Behavior as a Subject for Commodity Price Analysis," Holbrook Working. *Econometrica,* October 1935

FOOD RESEARCH INSTITUTE

STANFORD UNIVERSITY, CALIFORNIA

A research department of Stanford University, established in 1921 jointly by Carnegie Corporation of New York and the Board of Trustees of the Leland Stanford Junior University, for research in the production, distribution, and consumption of food.

PUBLICATIONS

WHEAT STUDIES

Ten issues yearly, published at approximately monthly intervals; $6.00 per volume. Each volume includes a comprehensive annual review of the world wheat situation, a survey and outlook at four-month intervals, and usually six special studies. For partial list, see inside back cover.

FATS AND OILS STUDIES

A series (books, issued irregularly) of studies in fats and oils of animal and vegetable origin, dealing primarily with economic aspects—production, trade, prices, and utilization—but with due reference to technical knowledge.

GRAIN ECONOMICS SERIES

A series (books, issued irregularly) covering topics in grain economics not suited to full discussion in *Wheat Studies.*

MISCELLANEOUS PUBLICATIONS

A series (books, issued irregularly) embodying the results of research in fields other than those covered by the series listed above.

CONTRIBUTIONS

Reprints from periodicals of articles written by members of the Food Research Institute.

List of publications available free on request. Address all communications to

FOOD RESEARCH INSTITUTE

STANFORD UNIVERSITY, CALIFORNIA

European Sales Agents:

Great Britain: P. S. KING & SON, LTD., 14, Great Smith Street, Westminster, S. W. 1, London
Continental Europe: MARTINUS NIJHOFF, 9 Lange Voorhout, The Hague, Holland