

11. MAIZE PRODUCTION IN JAPAN

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Introduction

The maize has been introduced into Japan, according to legend, by Portuguese who visited Japan during the period of 1573-'91, which is about 80-100 years after the Columbus's discovery of American continent.

The maize in Japan is called in general as 'Tōmorokoshi' or 'Tōkibi'. 'Tō' is the name of China eons ago and means Chinese. And in some regions it is called 'Nanban-kibi', and 'Nanban' means Portugal and Spain at that time. Accordingly, 'Tomorokoshi', 'Tokibi' and 'Nanban-kibi' mean Chinese sorghum, Chinese millet and Portuguese or Spanish millet respectively.

For about 300 years since its introduction to around 1880s the maize has been cultivated in various regions south of central part, although no production data is available, and formed local varieties adapted to each respective region.

Since then in 1870s American reclamation mission introduced into Hokkaido, the varieties belonging to medium flint and dent strains for table and feed uses, and those varieties have spread to Tohoku and Kanto regions.

The very first national statistics on maize was taken in 1906. The total planted acreage of maize was 49,800 ha. The same acreage has increased to 116,100 ha in 1967. Such an increase in planted acreage is largely due to a great changes in the use of maize.

As of 1966 the total maize consumption as dry grain for feed was 3.241 million tons, against which the domestic production was only 63,300 tons with planted acreage of dry grain corn being 26,100 ha, which constitutes only 1.9% of total consumption, the domestic supply being so small against the demand.

Transition of Maize Production

(1) Planted acreage

The change of planted acreage of maize in Japan is as shown in Table 1 and Fig. 1. From the first statistic in 1906 to 1950 the investigations were made only on dry grain corn and immature corn (including sweet corn). From 1951 the investigation was extended to green fodder and silage corn. Some fluctuations in total planted acreage have been witnessed up to 1946 but the acreage maintained 50,000-60,000 ha level. Since then the acreage has rapidly increased, reaching 116,100 ha in 1967. However, the planted acreage of corn by uses such as dry grain, sweet or fodder shows a great difference.

The planted acreage of dry grain corn was 47,700 ha in 1941 but has decreased during the war due to the necessity of producing staple food grains. In 1956 it has increased to 49,500 ha but it has continuously decreased to 21,200 in 1967, which is only 43% of 1956.

The planted acreage of immature and sweet corn maintained the level of 26,000 ha since 1951. In 1941 it was 35% of dry grain but in 1967 it has increased by 123%.

The planted acreage of green fodder and silage corn at the time of first investigation in 1951 was 10,000 ha which has increased by 6.5 times in 15 years reaching 68,900 ha in 1967 accounting 59% of the total corn planted acreage.

Such a marked difference in planted corn acreage by use is judged to be caused by the changes in the use of maize or in social and economic situations. That is, in spite of such a great demand for dry grain reaching 4 million tons, the planted acreage is saliently decreasing because of such factors as the outflow of rural labor force, low profitability in corn cultivation in comparison to rice, etc., the import of low-priced overseas corn under trade liberalization bringing about the decline of farmers' zeal for corn production. On the other hand, because there is a stabilized demand for immature corn including sweet corn, although small in quantity, the planted acreage of corn for table use and canning remains constant. The planted acreage of green fodder corn tends to increase in recent years due to a rapid growth in livestock industry and a further increase is expected.

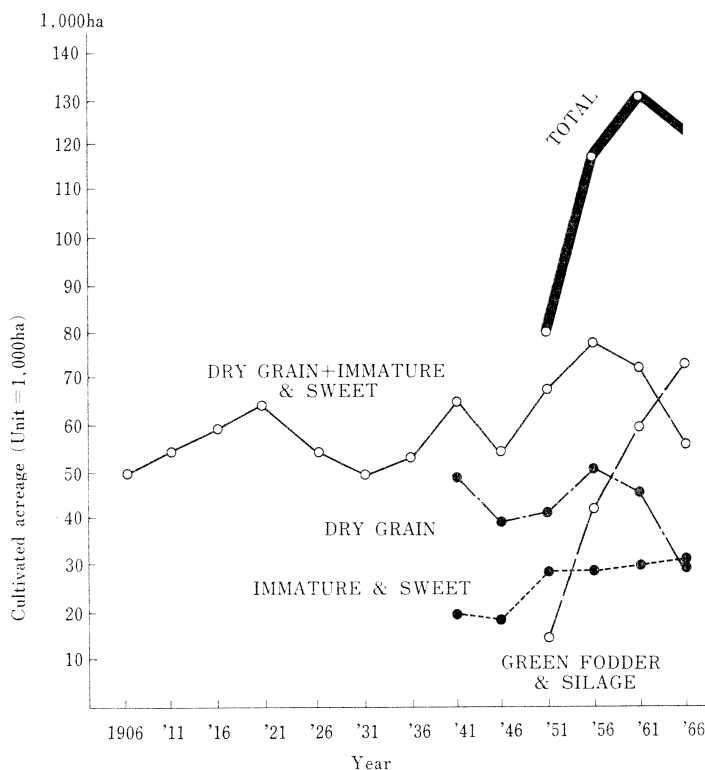


Fig. 1. Transition in maize cultivated acreage.

Table 1. Transition in maize cultivation.

Year	Planted Acreage (1,000 ha)					Yield (MT/ha)			Production (1,000 MT)		
	Dry grain	Immature & sweet	Green fodder & silage	Total		Dry grain	Immature & sweet	Green fodder & silage	Dry grain	Immature & sweet	Green fodder & silage
				Excluding green fodder & silage	Including green fodder & silage						
1906	—	—	—	49.8	—	1.61	—	—	80.2	—	—
1911	—	—	—	53.3	—	1.71	—	—	91.0	—	—
1916	—	—	—	58.4	—	1.72	—	—	100.4	—	—
1921	—	—	—	61.9	—	1.76	—	—	108.7	—	—
1926	—	—	—	52.1	—	1.45	—	—	75.5	—	—
1931	—	—	—	46.0	—	1.23	—	—	56.8	—	—
1936	—	—	—	50.4	—	1.56	—	—	78.7	—	—
1941	47.7	16.1	—	63.8	—	1.53	5.29	—	72.5	84.8	—
1946	36.1	14.7	—	50.8	—	1.15	7.57	—	41.4	111.5	—
1951	39.3	25.6	10.5	64.9	75.5	1.52	7.83	46.5	59.9	200.7	489.2
1956	49.5	25.6	39.7	75.1	114.8	1.65	7.67	27.4	82.5	196.4	1,085.7
1961	43.1	26.5	57.4	69.6	127.0	2.69	10.55	36.7	116.0	279.2	2,107.0
1966	26.1	26.3	69.2	52.4	121.6	2.43	10.14	38.7	63.3	270.5	2,679.0
1967	21.2	26.0	68.9	47.2	116.1	2.85	11.23	44.4	60.5	292.1	3,060.0

Source: Statistics & Survey Division, Ministry of Agr. & Forestry: Statistical Yearbook of Ministry of Agr. & Forestry.

Major producing region is Hokkaido as shown in Fig. 2 followed in the order of Tohoku, Kanto, Tozan, Kyushu and Shikoku regions. In the regions of Kinki, Tokai and Chugoku the share of immature or green fodder corn is higher.

(2) Yield (ton/ha)

Table 1 shows the changes in yield per hectare. The yield of dry grain corn has gradually increased except the duration of war and recently national average yield has nearly reached 3 tons/ha.

Marked yield increase since 1961 is largely due to the advance in breeding-rearing and extension of superior F₁-hybrid suited to Japan and because of intensive planting is concentrated in the district comparatively advanced in cultivation technique.

On the other hand, the Government carried out a program of rationalizing the production of domestic corn in 1963-'64 by encouraging dense planting and intensive fertilizer application for F₁-hybrid using tractor at 58 places throughout the country, and in some places a good yield of 8 tons/ha has been achieved.

The yield of immature corn (including sweet corn) in 1967 was 11.2 tons/ha, showing a gradual increase, and as for green fodder and silage corn, 44.4 tons/ha in same year.

(3) Production

The change in maize production since 1906 is as shown in Table 1. The production of dry grain corn has increased along with the increase in planted acreage up to 1956. However, because of the increase in yield such a trend has disappeared. That is, the planted acreage in 1967 has decreased to 43% of 1956 but the production remained at 73%. The production is decreasing each year, declining recently to less than 2% of total demand.

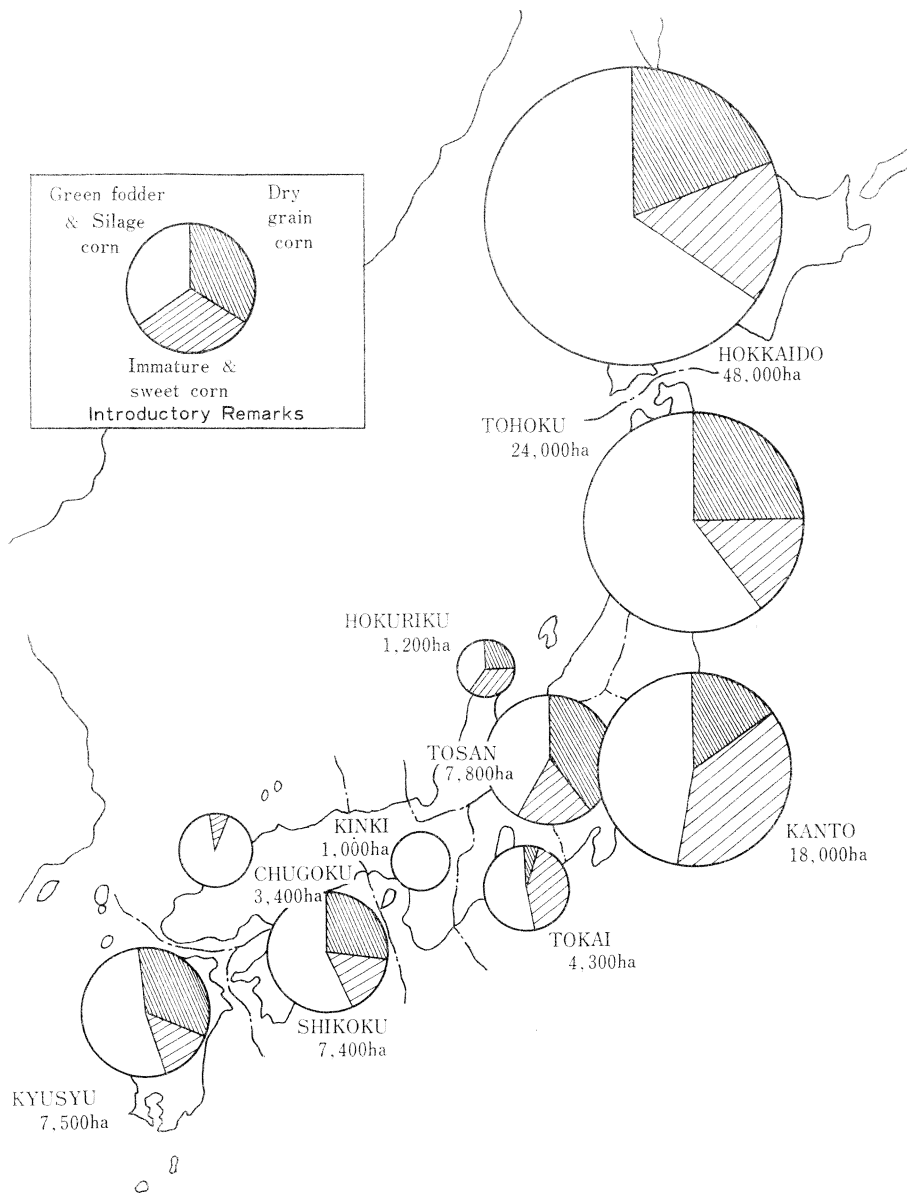


Fig. 2. Maize cultivated acreage by regions and by uses. (1966)

Against this the production of immature corn (including sweet corn) is gradually increasing, repeating the fluctuation; reaching 292,100 tons in 1967. And the production of green fodder and silage corn is showing the tendency of rapid increase reaching 3.06 million tons which is over 6 times of 1951 production.

Production Cost of Maize

The production cost of maize in Japan in 1966 is as shown in Table 2 according to production cost survey of the Ministry of Agriculture and Forestry.

Table 2. Production cost of maize per 0.1 ha. (1966)

Item of cost	Cost		
	Yen	\$	%
Seed	52	0.14	0.4
Fertilizer	2,594	7.21	22.0
Micellaneous materials	310	0.86	2.6
Control of insects & diseases	3	0.01	0.0
Building	481	1.34	4.1
Agricultural implements	1,545	4.29	13.1
Draft animals	611	1.70	5.2
Labour	6,034	16.76	51.1
Charges or fees	185	0.51	1.5
TOTAL	11,815	32.82	100.0

Source: Statistics & Survey Division, Ministry of Agr. & Forestry:
Report of the important agricultural products cost survey, 1966.

Note: \$=¥360.

Table 3. Labour requirement by each farming operation per 0.1 ha. (1966)

Item	Labour hour/0.1 ha	%
Seed selection & sterilization	0	0
Plowing & harrowing	3.2	7.4
Base fertilizer	2.0	4.6
Sowing	3.0	7.0
Thinning	0.1	0.2
Cultivation & weeding	18.9	44.0
After dressing	—	—
Harvesting	10.1	23.5
Threshing & cleaning	5.7	13.3
TOTAL	43.0	100.0

Source: Same as in Table 2.

Total production cost per 0.1 hectare was ¥11,815 (\$32.8*), 51% of which, ¥6,034 (\$16.8) is occupied by labour cost, 22%, ¥2,594 (\$7.2) by fertilizer and 13.1%, ¥1,545 (\$4.3) by agricultural implements and those three account for 86% of the production cost.

* \$=U.S.\$=360 Yen

The comparison of costs in the last several years reveals that no major change can be seen in the cost of fertilizer but the development in mechanization has brought about a large increase in the cost of agricultural implements and the labour cost has also markedly increased due to the outflow of rural labour force and the wage hike resulted from the high growth of national economy. Most important method to ensure the rationalization of maize production from the cost phase is the reduction of labour cost which accounts for major portion of costs, and this can be achieved by mechanization and labour saving of farming operations or by promoting the expansion of management scale.

Labour requirement per 0.1 hectare for maize production in 1966 was as shown in Table 3, a total of 43 hours which is shorter than that of other crops. The said 43 hours which is shorter than that of other crops. The said 43 hours consist of 18.9 hours for cultivation and weeding accounting 44.0% of the total, 10.1 hours for harvesting (23.5%), 5.7 hours for threshing and cleaning (13.3%), and others.

The requirement of so much time for cultivation and weeding is attributable most to the fact that those operations are by hand labour. But advanced farmers use the tractor and weeder. As for the harvesting because of small scaledness of Japanese agriculture, and average maize cultivating acreage per farmer is very small (0.032 ha/farm, 1958) and because the field is irregular, the introduction of efficient and economical machinery such as corn picker is practically impossible. Thus harvesting operation requires so much labour. On the other hand, because the mobility of cultivating land is being inhibited, the expansion of planted acreage and operating scale is not progressing smoothly.

However, 147.1 hours required per 0.1 hectare in 1956 with 41.1 hours for cultivation and weeding have greatly been reduced.

In connection with production cost the production cost exceeds the compensation for family labour which means family compensation per hour is in the deficit of ¥31 (\$0.09), influenced by a very low yield of 1.79 ton/ha attributable in part to unfavorable weather conditions of 1966, which was considerably lower than even those low income crops as ¥524 (\$1.46) for wheat and ¥242 (\$0.67) for maked barley. And this low

Table 4. Compensation for family labour.

Item	Average of ordinary farm*		Best example by subsidized workers**	
	179 kg		800 kg	
	Yen	\$	Yen	\$
Yield kg/0.1 ha				
Price (A)	5,722	15.89	—	—
Price of by-products (B)	232	0.64	—	—
Total (C)=(A)+(B)	5,954	16.54	22,000	61.11
Total production cost per 0.1 ha (D)	12,860	35.72	12,571	34.92
Net income (E)=(C)-(D)	-6,906	-19.18	9,429	26.19
Cost of family labour per 0.1 ha (F)	5,686	15.79	7,210	20.03
Compensation for family labour (G)=(E)+(F)	-1,220	-3.39	16,639	46.22
Family labouring hour per 0.1 ha (H)	39.9 hour		82.6 hour	
Compensation of family labour per hour (G)/(H)	-31	-0.09	20.1	0.56
Year	1966		1965	

SOURCE: * Same as in Table 2, ** Agri. products Section, Ministry of Agric. & Forestry, 1966.

compensation is one major factor which causes the decrease in planted acreage. On the other hand, some good examples of corn cultivation in 1967 under the Government subsidy show 0.8ton/0.1 ha yield, labour requirement of 82.6 hours and labour cost of ¥7,210 (\$20.03) per 0.1 ha with labor compensation of ¥201 (\$0.56) per hour (Table 4).

Table 5 indicates the price comparison of domestic corn and imported corn, which shows that domestic corn is 20-40% higher than imported corn. Yet, when it is compared with domestic rice which is also a summer crop, the producer's price is only one fourth of rice in 1966, and such low compensation inhibits the increase in planting the corn.

Table 5. Price.

(Unit: Yen & \$/60 kg)

Item	1963		1964		1965		1966	
	Yen	\$	Yen	\$	Yen	\$	Yen	\$
Maize Domestic products	1,741	4.84	1,616	4.49	1,809	5.02	1,902	5.28
Imports (CIF)	1,294	3.59	1,396	3.88	1,456	4.04	1,461	4.06
Cf. Rice (Producer's price)	5,030	13.97	5,772	16.03	6,228	17.30	6,936	19.27

SOURCE: Agri. Products Section, Ministry of Agri. & Forestry, 1968.

Production and Distribution of Superior Seeds

In view of the importance of seed in agricultural production Japan carries out a special encouragement measure by national subsidy for seed growing of major agricultural commodities such as rice, wheat and barley, etc. under the law.

The State subsidizes each prefecture for the production of superior corn seed same as in the case of rice, wheat and barley to ensure the production increase through the extension of superior recommended seed. From 1954 prefectures received 50% State's subsidy to carry out the investigation to determine the recommended varieties of maize, and as for hybrid the projects of selecting recommended varieties have been subsidized in 1966—subsidy of ¥90,000/ha (\$250) for 23 places for basic survey and ¥34,000/ha (\$94.4) for field survey at 38 places in 28 prefectures, and as for the varieties for green fodder corn the investigation to determine the recommended varieties has been carried out as a part of production increase program for feed crop in 15 prefectures.

Based upon the study of such survey results the seeds of selected superior recommended varieties are produced in following respective methods. Breeder's seed farms (1953) and foundation seed farm (1950) have been established in major corn producing prefectures under 50% subsidy from the State for the production of hybrid seed. Superior recommended seeds came to be produced at foundation seed farm by prefecture or by seed growers cooperative under the commission from prefecture. In 1967 the subsidy has been granted to breeder's seed farms for variety growing at ¥73,700/ha (\$205) and for line growing ¥88,500/ha (\$246) and to foundation seed farm for varietal cross at ¥32,000/ha (\$89) and for top and selfed line cross, ¥38,970/ha (\$108). The seeds thus produced are marketed by the Corn Extension Association of each prefecture. As for the seed production of green fodder corn national livestock breeding stations grow the breeder's seed and foundation seed by themselves and commission the seed growers to establish seed farms and the production and supply are carried out under the contract between producers and consumers through seed growers cooperative. Field inspection is made on seed farms growing hybrid and green fodder corn during growing period by experts of prefecture or seed growers cooperative.

The production of breeder's seed and foundation seed in 1966 was 17,516 kg and

663,041 kg respectively, and seed for green fodder corn other than F₁ hybrid was 1,546 tons.

The seed thus produced or general dry grains are subject to national government inspection to insure smooth marketing and quality improvement in accordance with inspection standard as shown in Table 6. Furthermore, only the seeds produced at seed farms designated by prefectural governor are qualified for the inspection.

Table 6. Standard of maize inspection.

1. Maize for general use

Grade	1st grade	2nd grade	3rd grade
Min. requirement			
Perfect grain (%)	85	75	60
Shape & character	Standard 1st grade	Standard 2nd grade	Standard 3rd grade
Max. limit			
Moistures content (%)	16	16	16
Injured, immature, foreign variety kernel & foreign materials			
Total (%)	15	25	40
Foreign var. kernel (%)	1	2	3
Foreign materials (%)	0	0	1

2. Seed use

Grade	Passed
Min. Requirement	
Perfect grain (%)	85
Shape & character	Standard passed grade
Germination percentage (%)	80
Max. Limit	
Moisture content (%)	16
Injured & immature kernel (%)	15
Foreign materials (%)	0

SOURCE: Regulation of Agr. Products Standard (1967).

In order to ensure the increased hybrid seed production by promoting the extension of cultivation and seed marketing, "the Hybrid Maize Extension Association" has been instituted in 1953 by the representatives of seed growers associations and hybrid seed growers of each prefecture and related officials of prefectural and national governments. The Association has changed its name to "The National Maize Extension Association" in 1955. The Association is contributing to the extension of hybrid by adjusting the demand and supply as well as marketing of seed by devoting its effort to promote the extension of hybrid and to improve seed marketing.

Demand and Supply

Table 7 indicates recent demand and supply of maize grain in Japan. As the figures in the Table are self-explanatory the domestic production is decreasing annually and the import far exceeds the decrease in domestic production which was only 3.5% of total supply in 1963 and since then it is witnessing an annual decrease.

The demand for feed has rapidly been increasing because of the growth in livestock industry that it accounts for 87% of the total demand. And the demand for processing is rapidly increasing although in volume it is only one fifth of the feed.

In 1967 Japan imported 3.960 million tons of maize from 23 countries as shown

Table 7. Demand and Supply of Maize in Japan.

(Unit: 1,000 MT)

Year	Available supply				Disposal of available supply				
	Domestic supply	Change during storage	Gross imports	Total	Animal feed	Seed	Processing	Waste	Food
1955	100	- 10	272	382	293	2	27	2	58
'63	104	+146	2,894	2,852	2,632	2	218	0	0
'64	84	- 12	3,139	3,235	2,903	1	331	0	0
'65	75	+258	3,375	3,375	2,892	1	482	0	0
'66	63	-102	3,696	3,861	3,241	1	613	0	0

SOURCE: Agricultural products section, Ministry of Agr. & Forestry.

Table 8. Imports by country. (Jan.—Dec., 1967)

Country	For feed use	Uses other than feed	TOTAL
Korea Rep.	559	—	559
Korea North	3,775	2,479	6,254
China Mainland	72,832	274	73,103
China Taiwan	689	—	689
Thailand	691,199	8,196	699,395
Singapore	871	946	1,817
Indonesia	100,978	10,901	111,879
Cambodia	17,273	2,273	19,546
Denmark	30	—	30
Ireland	640	—	640
Rumania	74,683	—	74,638
U.S.A.	1,511,495	71,988	1,583,483
Mexico	26,708	343,263	369,971
Brazil	57,829	50	57,879
Argentina	59,040	—	59,040
Uganda	310	5,603	5,913
Mozambique	3,690	141,213	144,903
S. W. Africa	34	—	34
S. Africa	562,206	144,299	706,505
Australia	100	108	208
Peru	—	44	44
Kenya	—	14,453	14,453
Zambia	—	29,243	29,243
TOTAL	3,184,896	775,333	3,960,229

SOURCE: Ministry of Finance: Japan Exports & Imports Commodity by Country, Dec., 1967.

in Table 8. The United States accounts for about half of the import, 1,583 million tons followed by 706,505 tons of South Africa, 699,395 tons of Thailand and 369,971 tons of Mexico.

It is safe to assume that the demand for feed and processing will further increase. Thus, the import of maize grain will increase further because of very small domestic production which is decreasing annually.

Discussion

V. R. Carangal, Philippines: In Table 4, how do you account on the same total cost of production per 0.1 ha for the yield 179 kg and 800 kg?

Answer: As the cultivation method and management are practically the same in both cases of 1966 and 1965, there is not a large difference between the cost per 0.1 ha in these years. In 1966, however, the yield was as low as 179 kg due to serious cold damage.

A. Anés, Spain: What do you call "immature corn", and is it different from green fodder?

Answer: Immature corn is consumed as human food (either cooked or canned food); while green fodder is harvested when a plant is still green and immature, and used only as feedstuff. The yield of immature corn is high because immature ear with green husk is weighed.