A DEFENCE OF RICE CULTIVATION WITH SOME REFERENCE TO THE CLIMATIC CYCLES

By

TADASHI WATANABE

Prof. of Hokkaidô University

1

Dr. SEIICHI TÔBATA, Prof. of Tôkyo University, wrote "an essay entitled "Talking against rice cultivation and rice eating" in the "Bungei-Shunjû" (most popular Japanese monthly magazine, "Literary Criterion")[1]. This is similar to a paper of the late Dr. KÔKICHI MORIMOTO, former Prof. of Hokkaidô University, who wrote an essay "The pickled radish ruins the nation" in the "Chuô-Kôron" (also a monthly magazine, "Central Review") more than thirty years ago.[2]

As these two authorities in economics argued against the excessiveness, the rice culture and its consumption in Japan has been so firmly established in the main-land.

2

As for Hokkaidô, which is situated in north Japan and has been opened up comparatively lately, the American advisers, invited by the "Kaitakushi" (the Colonization Office which was established in 1869) in the beginning of the Meiji Era for planning Hokkaidô agriculture, emphasized that the farming in such a cold zone should be different from that of Honshû (the main-land of Japan). They believed that production of wheat, barley, clover, potatoes, and the like should be encouraged, while rice-plant, soybean, and sweet potato growing should be discouraged. Accordingly, they adviced the American way of living on bread, butter and meat, and rejected the ordinary Japanese living on boiled-rice and miso-soup (soup of

1) Vol. 28, No. 16, Dec. 1950.

2) See K. MORIMOTO: New Efficiency in Economic Life. (in Japanese) 1920.

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salted soybean paste). It naturally followed that the graduates of Sapporo Agricultural College, taught by American professors, becoming the prefectural leaders, encouraged animal husbandry after the model shown by the American advisers. Despite that, emigrants from Honshû wanted rice-cultivation and rice eating at any cost. In order to break through the stronghold erected by the Sapporo Agricultural College graduates, Dr. TSUNEAKI SAKÔ, an important graduate of the Tôkyô Komaba Agricultural College, moved into the Hokkaidô Prefectural Government. He established experimental fields for rice cultivation in Kami-Shiroishi near Sapporo in 1893, where he made experiment on the selection of rice varieties and the way of rice cultivation. Having proved the possibility of rice cultivation in Hokkaidô, he planned and easily secured the passage of a law authorizing irrigation associations to make establishment of irrigation ditches.

The rice cultivation in Hokkaidô has continued to develop, and almost 200,000 ha. of paddy fields are now cultivated; four million koku (80 mill. bushels) of rice are raised at maximum. Rice is now at the top farm product in Hokkaidô as well as in whole Japan.

3

The development of rice cultivation in Hokkaidô depended upon 1) discovery of fit areas, 2) improvement of the way of cultivation, and 3) the proper time of promotion. The areas along the Pacific coast in Hokkaidô, having a dry warm winter climate and foggy cool summer, are not good for rice cultivation. At present, there are almost no paddy fields in Kushiro and Nemuro districts. Kamikawa county in inland Ishikari district, having the highest atmospheric temperature in summer, is most suitable for the rice cultivation, and next comes Sorachi county in the same district. Those two counties now account for 60% of the total rice production, and are most thoroughly established as rice cultivation areas. Around these centers, minor rice areas are to be found; in the south-western area one may point out Sapporo, Kutchan, Date-Monbetsu, Oshima-Ôno, Esashi and Setana as rice-growing areas; in the eastern part, Tokachi; in the northern part, Kitami and Teshio.

The paddy fields in Teshio are situated at a higher latitude

than those of Kitami, marking the northern-most limit of rice cultivation in Japan. Those districts of later development suffered in early Shôwa years (after 1930) from cool summers, and rice cultivatian was considerably depressed. But recently a farmer near the mouth of the Teshio River (44′ 42″ N. Lat.) made a record rice production of over a hundred two-bushel bags per ha.. Thus rice cultivation in Hokkaidô has developed through the discovery of fit areas.

4

The writer was formerly a student under Prof. Morimoto and is now the Vice-president of the Japanese Society of Farm Economics under the presidency of Dr. TÔBATA. He is sorry to disagree with these two authorities who have depreciated the use of rice. But their cautions against too much should be appreciated. An episode in the development of rice cultivation in Hokkaidô which the writer himself experienced is as follows. In 1917, he graduated from the Dept. of Agricultural Economics of Hokkaidô University and became a member of the Hokkaidô Agricultural Experimental Station. In 1920, appointed as the chief of the Kitami branch of the same station, he moved to Nokkeushi town which is now Kitami city. It is in the north-eastern part of Japan, facing the Okhotsk Sea which sometimes freezes in winter. At that place he dared to encourage and promote the rice cultivation. It was an adventurous trial, but it was temporarily successful. In 1920, in this district only 15 ha. out of about 100,000 ha. of the total area under cultivation, were used as paddy fields practically as a trial planting; by 1927 when he left Kitami, there could be found the paddy fields of almost 10,000 ha. and the rice production amounted to at least 100,000 koku. During these latter years of the Taishô Era, (1920–30) when he stayed in Kitami and encouraged rice cultivation there, we had no bad crop even once, so farmers took the rice cultivation to be easy and enlarged the acreage of the rice fields.

However, after the good crop of 1930, bad crops followed successively in 1931, '32, '34, '35, '40, '41, and the latest one in 1945. These years meant a period of uncertainty for rice cultivation ranging over 10 years or more.

Those who were appointed to the post of the Kitami Experi-

mental Station succeeding the writer, suffered on account of these bad crops and were obliged to give advice to the farmers that they should change the paddy fields into those for upland crops. Subsequently the acreage of paddy field in Kitami, Tokachi and Teshio decreased by one half.

5

Since ten years ago the Japanese government has made a plan of self-sufficiency in wheat, and as Kitami is especially fit for wheat cultivation, it became the main production center of that cerial. Wheat, peas, flax, potatoes, sugar-beets and the like are suitable for production in a cool climate. Those crops showed rather good yields in Kitami district over the past few years. However, strange as it may seem, results of survey of farm economies show that the gross income is almost the same between 15 ha. upland crop farms and 5 ha. of rice farms, even in the bad crop years[4].

Thus, the upland cultivation of peas and beans has been proven to be rather unprofitable. After the beginning of the war, potato cultivation became profitable as an upland crop in Hokkaidô. That is a result of the controlled high price of potatoes throughout Japan as complements of main food, also it became profitable when processed into starches and glucoses. Barley also became important. These crops supplement the shortage of rice. However, nowadays, when food has become more abumdant, farmers begin to detest the idea of growing potatoes and barley as food crops.

Potatoes are now going to be used for making starch, glucose, maltose, and alcohol, not for a staple food.

In Hokkaidô, there is also a tendency to promote the culture of beans for export to Honshû and foreign countries.

Those are not for main items in the diet. Rice always continues as the main food and main crop. During and after the recent war, except one year of failure (1945) rice yields have been abundant thanks to the hot summer temperature.

6

The writer became professor of Farm Management in the

4) See T. WATANABE: Topics on Hokkaidô Farming. (in Japanese) 1948.

Faculty of Agriculture of the Hokkaidô University in 1927, and concurrently adviser for the Farm Management of the Hokkaidô Agricultural Experimental Station.[5]

As a professor of Farm Management and Agricultural Economics, the present writer's interests were directed to the climate fluctuations and business cycles. Studying the history of crop fluctuation, the writer found cyclical movement of rice crop fluctuation which correspond closely to the summer atmospheric temperature in northern Japan. High atmospheric temperature in summer causes a good rice crop and low atmospheric temperature in summer causes a bad rice crop. These relations come out very obviously.[6] But what are the causes of the high and low temperature ?

They come in time series and some series of about 16 years contain summer high temperature and are followed by other about 16 years of low summer temperature. Morover, a 3-year-cycle of low-low-high summer temperature years occurs repeatedly within the low summer temperature year series. The first low summer temperature year has low temperature wet spring and rather clear summer and fall. In these years rice growth is delayed but not damaged very badly They should be called delayed type.

The second low summer temperature year has somewhat hot spring, but much rainfall in summer causes cold temperature so that rice flowering and fructification are much damaged. They should be called damaged type.[7]

The third year is good throughout the growing season. To the happiness of the rice growers it seems that there is no year as has bad (low) temperature throughout the entire growing season. Growers should protect the young rice plant in the low spring temperature year, and make them mature early in the low fall temperature year. But ordinary growers cannot entirely escape bad crops, especially in northern and eastern districts.

Comparing the following tables of climatic data and rice yields

5) See "Comparative Economic Analysis of Experimental Farms in Hokkaidô Agricultural Experimental Station.", the report of that station, No. 41, (in Japanese) 1944.

6) T. Watanabe: On the Growth of Rice plant in Cool Climate. The Journal of Sapporo Agriculture and Forestry Society. No. 24. 1932.

R. Nakayama: Studies on the Annual Variation of Rice yield per Unit Area in Hokkaidô. Hokkaidô Pref. Agri. Exp. St. Report No. 2, 1951.

7) K. Sakai: Cytological Studies on the Sterility of Rice by Cool Climate of 1941 in Hokkaidô. Report of Hokkaidô Agri. Exp. St. No. 40. 1943.

of recent years, one can see the series of cool summer years as 1931–'32, 1934–'35, 1940–'41, in which the August high types and the August low temperature types are perceptible.

The rice yield records of the agricultural experimental stations are sometimes erroneous, but the most reliable data available, for the statistics of whole prefectures were sometimes deliberately falsified especially after war years.

7

In the following Table I, statistics of the recurrence of two low-temperature cycles are cerrelated with figures on the rice crop in certain Hokkaidô zones in northern Japan.

Considering that, after the bumper crop period of rice crop from the middle Taishô to the early Showa, followed by the bad crops beginning in 1931 and ending in 1945, then followed recently by the good crop period again, it is to be noticed from the records that there has occured a 33 year climatic cycle of rice crops. The writer definitely affirms the existance of this cycle. The chronological record is shown in the table.

In Table II the good and bad yields of rice crop in Tôhoku and Hokkaidô are shown. It is very interesting to compare data in this table with data in Diagram I, which graphs the rice production from a certain field near Nasuno in Kantô district. The diagram records annual rice crop yields per "tan" for about 100 years. During this period the rice yields increased from about 1.5 koku to 2.5 koku, because of the improvement of agricultural technique —improvement of varieties, the development of ploughing, manuring and defence from plant diseases and insect damages and so on. It is observed that untill 1907 they had the same bad crop years as in north eastern district, therefore it is seen that the rice cultivation in central parts of Japan had also an unstable period just as in Tôhoku (North Eastern) districts. However, recently, bad crops in central Japan have not been so remarkable and they do not occure in coincidence with those of Tôhoku and Hokkaidô. Presumably this is because of the development of techniques; the rice yield has become stable and abundant.

According to the local histories of Tôhoku districts, the development of farm land was carried out during the good crop period,

while during the bad crop period they suffered from famine and went down into the miserable condition.

Especially the conditions of Kamikita, Shimokita, and Sannoe counties in Aomori prefecture and Iwate prefecture on the Pacific coast, which were formerly territories under the Nambu Clan, were most terrible. On the other hand conditions in the Tsugaru counties under the Tsugaru Clan in Aomori prefecture, and in Akita and Yamagata prefectures on the Japan Sea coast were comparatively better. As in Hokkaidô, so even in Honshû the districts on the Pacific coast are less adapted to the rice cultivation, while the districts on the Japan Sea coast are more suitable. The reason is that on the Pacific coast side the summer winds mostly come from the ocean carrying fog and rain inland.

Of corrse, the present writer lays no claim to bring the first finder of the 33-year-cycles. The point is that an effort has been made to find a close connection of good and bad crop of rice within this cycle.

It is claimed by the writer that he is the first discoverer of 3-year-cycle of rice crop yield. It is to be insisted that even in the period of frequent occurence a succession of bad crops there is a 3-year-cycle of one good crop followed by 2 bad crops. It is true that this may be a special phenemenen in Hokkaidô, but even in Honshû there is a cycle of crop yield of upper, middle and lower rates. In 1932 and 1935 in Tôhoku district the crop yield was rather good. Of course, it must be admitted that bad crop years have sporadically occured, for instance, in 1911 and 1945; but even these two years seem on the 33 year cycle.

8

It is most interesting to find that in the period of bad crops and of cold weather in Japan in the early part of Shôwa, there were damages by drought in the North America and European countries. The case was almost the same in 1945. The writer believes the reason is as follows: in the year when solar activity is poor and the north-eastern part of Japan had a bad crop because of lower atmospheric temperature, the evaporation from ocean surface being slight, the quantity of vapour coming into the inner part of continent is scarce; thus strong tendencies of drought

appear and yields of barley and wheat decrease because of the shortage of humidity. It seems that the good and bad crop years go parallel throughout the world.

In Diagram II annual average mean atmospheric temperature in 3 typical (Pacific, Central, and Atlantic) states in U. S. and in Diagram III annual precipitations of 4 zones (Pacific, two Central, and Atlantic) are compared. In the continent, climates are reversed in east and west side. Japan is situated in the east side of the Eurasian continent and has reversed climate of the western half of the U. S., and probably of Europe.

The sole economist who studied such a cycle of good and bad crops in the past was Prof. H. MOORE of the United States. He found out the combination of the two cycles of 8 years and 33 years. The scholar who found out the cycle of 33 years in the relations of weather and other climatic conditions was BRÜCKNER. So this cycle is called BRÜCKNER's cycle. The periodicity of this cycle coincides with the periodicity of solar activity. It is said that the increase and decrease of the sun spots has the periodicity of 2.1, 4.8, 8.3, and 11.1, years, and the least common multiple of those periods is 33 years. It is very natural that the weathers and the farm crops are influenced by this cycle.

Some say that the solar activity, having influence upon human minds, directly causes business cycles and the interchange of war and peace times.

However, not wishing to widen too much the range of the topics, the writer would cut the further discussion, until he completes a critical study of such a treatise as "business cycle" of the late Prof. SCHUMPETER who described 3–4, 10 and 100 year cycles.

9

Only little space for considering the history of agricultural technique remains. The characteristic point of rice cultivation in Hokkaidô until recent time, lay in the direct seeding. Farmers sowed rice-seed with a simple implement directly in the irrigated paddy-field. Though the weeding must be done one time more, the work can be carried out more easily than the common way of transplantation of rice seedlings. On the other hand, in Honshû, rice is generally transplanted, but recently there are not a few

who try to seed directly. But there are some differences between the procedures. In Honshû the seed is sown upon the dried paddy fields and covered with top-soil. In Hokkaidô, if covered with top-soil too early, the rice seed cannot sprout because of the lack of warmth. So Hokkaidô farmers seed rice on watered paddy.

However, recently in Hokkaidô farmers have begun to grow rice-seed sprouts protected from cold, covering the seedbed, sometimes using warming materials under the bed, but usually adopting the method of screening the bed. They nurse the seedling in the frame covered with the oil-paper screen. This is done to hasten sprouting and to make the seedling strong that they may be transplanted as early as possible. If a triple rice cultivation method, that is a combination of 1) direct seeding, 2) transplantation from seedbed, and 3) common rice seedling transplantation method, is adapted, farmers can "spread out" their time and alleviate the intensity of work. Transplantation from seedbed enables not only early reaping but also makes the yield more sure and abundant.

Morover, owing to the improvement of rice varieties, farmers can secure a yield of rice of good quality surely and abundantly.

At present the rice cultivation in Hokkaidô shows its highest success owing to the good time of climatic cycle and the development of technique. Those who try to talk ill of rice cultivation and rice-eating show nothing but a make-shift or ridiculing attitude. If there are defects in rice cultivation and consumption, some improvements should be made. Prof. YAJIMA will offer in the following paper, some comments on the need and measures of improvements.

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TABLE I. A. *Climatic Data in Hokkaidô*

a. Av. Mean Atmospheric Temperature (°C)

Year	Hakodate		Sapporo		Asahikawa		Obihiro		Abashiri, Kitami province	
	July	Aug.	July	Aug.	July	ug.	July	Aug.	July	Aug.
1930	20.0	23.0	20.2	22.2	20.9	21.4	18.7	20.6	18.1	19.9
31	15.9	21.9	16.0	21.3	16.0	21.6	15.1	20.9	12.3	20.2
32	18.1	21.1	18.5	19.8	18.3	18.9	16.2	18.7	13.7	17.5
33	21.8	23.3	22.4	22.8	22.9	22.6	21.0	21.5	19.8	21.3
34	17.5	20.7	17.7	19.6	17.6	19.2	16.5	19.0	14.4	17.7
35	19.5	19.7	19.2	19.3	19.6	18.7	17.6	17.8	16.7	17.1
36	18.6	21.1	19.0	20.5	19.6	20.4	17.6	19.0	16.9	19.5
37	21.4	23.1	22.1	21.7	22.7	21.1	20.6	20.7	20.6	19.7
38	18.9	22.8	19.9	23.6	21.3	23.9	17.4	21.7	17.5	22.8
39	20.7	22.6	21.2	22.1	21.7	21.5	20.1	21.0	18.8	20.4
40	19.7	21.6	20.0	21.0	20.2	20.5	18.4	19.6	17.4	20.2
41	16.9	19.1	17.5	19.7	17.3	19.3	15.7	17.3	12.8	15.8
42	20.5	20.0	20.4	20.0	20.9	19.2	19.2	18.4	17.8	17.7
43	21.3	23.4	22.3	23.6	23.4	22.6	21.7	22.2	20.6	21.7
44	20.8	22.8	21.2	22.7	21.9	22.3	19.9	21.7	19.7	21.4
45	16.0	21.5	16.7	22.1	17.3	21.5	14.6	19.8	13.3	19.1
46	20.7	23.4	21.4	24.2	21.2	23.4	19.6	22.5	18.7	22.4
47	19.7	21.4	20.4	21.1	20.7	20.4	19.3	20.1	18.0	19.2
48	20.2	22.6	21.7	23.5	21.7	22.4	19.5	21.5	17.0	21.4
49	18.8	22.0	20.2	23.3	20.1	23.4	18.7	21.3	17.0	20.7
50	21.4	23.2	22.8	24.0	22.9	23.3	21.4	22.3	20.2	21.9

b. Monthly Precipitation (m. m.)

1930	114.7	46.2	66.9	284.0	182.6	222.6	51.9	143.4	75.7	95.7
31	82.0	126.7	103.7	132.0	54.5	171.1	78.2	66.7	68.6	111.8
32	171.2	325.6	125.4	291.7	91.5	395.8	174.9	165.6	115.3	162.5
33	168.8	159.8	98.6	138.6	167.4	107.7	81.4	101.1	109.2	120.1
34	112.5	78.8	37.5	83.1	44.9	108.8	59.9	69.6	49.2	70.2
35	187.3	127.5	102.0	171.3	191.6	140.4	117.6	219.7	75.0	200.4
36	234.6	139.4	245.2	75.9	157.7	41.4	274.7	127.2	96.8	76.8
37	232.4	120.6	173.4	60.5	184.8	91.0	120.3	50.1	64.8	63.2
38	66.0	19.1	61.0	13.2	91.3	3.8	42.8	39.9	18.3	5.1
39	66.0	232.3	159.6	138.4	239.6	109.0	190.4	156.9	151.8	134.7

40	298.4	90.9	105.4	97.2	122.5	144.6	134.6	129.0	91.4	102.9
41	127.2	75.6	138.5	53.3	109.6	84.4	128.3	75.2	169.2	75.7
42	130.4	284.7	85.0	112.2	70.5	41.8	51.5	167.7	47.0	121.7
43	126.0	9.43	88.9	64.7	93.5	140.7	36.2	170.5	53.8	149.7
44	105.9	111.1	118.8	44.8	69.6	64.8	127.5	48.3	84.4	37.2
45	185.4	107.8	98.1	106.6	69.0	126.1	117.5	132.0	135.3	77.0
46	74.8	8.9	87.5	21.5	149.6	58.1	80.4	99.3	84.9	29.1
47	153.4	100.8	57.9	92.8	130.3	231.9	69.2	119.3	190.4	114.3
48	149.1	133.6	51.0	77.9	121.7	171.4	126.2	282.2	70.7	145.5
49	182.7	103.5	28.0	42.1	32.7	50.3	71.9	32.8	58.8	71.8
50	183.9	51.4	136.8	212.6	104.4	83.4	64.6	59.0	63.7	46.6

B. *Result of Rice Crop at Several Branches of Hokkaidô Agricultural Experimental Station (% of Good Base Year)*

Point / County / Province / Year	Ôno	Kotoni, Sapporo County	Nagayama, Kamikawa County	Ohihiro	Kitami
	Oshima	Ishikari		Tokachi	Kitami
1930	100(1)	100	100(2)	100	100
31	90	83	88	51	45
32	84	86	31	42	17
33	100(1)	92	100(3)	87	101
34	75	89	78	58	24
1935	88	87	85	15	44
36	102	99	100	70	109
37	100	94	92	128	107
38	79	89	85	55	102
39	96	99	86	58	91
1940	80	65	85	61	60
41	5	73	90	35	9
42	80	90	86	53	60
43	102	97	76	57	73
44	—	101	78	43	83
1945	—	81	84	13	0

As the results of one year at one station are sometimes erroneous, bases are sometimes changed.

Common rice variety are chosen; (Bozu 5 Go which is middle maturing, except at Nagayama which Bozu 6 Go is chosen).

(1) are chosen as the base for the following years.

Average of (2) and (3) are chosen as the bese for all at this stdtion.

TABLE II.

A. Climatic Records in Northern Japan

July Average Mean Temperature (°C)

Year	IIII	VI	V	VI	Year	I	II	III	IV	V	VI*
1900	19.6	18.4	19.6	17.2	1929	23.3	23.8	22.8	22.7	23.1	21.7
01	20.0	19.3	19.4	—	30	22.3	21.7	22.3	31.0	21.2	20.2
02	18.9	16.9	17.6	16.4	31	19.0	18.4	18.8	16.9	17.4	16.0
03	20.2	18.9	19.5	17.9	32	22.2	21.3	21.9	19.4	20.0	18.5
04	20.9	20.6	21.4	19.4	33	24.2	24.3	23.9	23.2	23.1	22.6
05	19.9	19.0	20.3	18.6	34	20.0	19.6	19.7	18.1	19.0	16.7
06	—	19.7	20.0	20.0	35	21.3	20.7	20.8	20.0	20.7	14.8
07	19.9	18.2	19.0	18.1	36	22.4	20.8	21.8	20.5	20.0	16.2

Aug. Average Mean Temperature (°C)

1900	23.3	23.5	23.9	20.9	1929	24.9	23.6	24.9	23.7	23.1	21.3
01	23.2	22.8	22.9	20.8	30	24.5	23.9	24.7	24.0	23.7	22.0
02	20.0	18.4	19.6	17.9	31	23.8	23.3	23.3	23.0	22.8	21.3
03	22.2	20.6	22.0	19.2	32	25.0	22.5	23 3	22.0	21.9	19.8
04	22.8	22.2	23.9	22.0	33	24.8	24.1	25.1	23.8	23.9	22.8
05	19.2	18.2	19.8	18.7	34	22.1	20.8	22.0	20.9	21.1	19.6
06	21.6	19.6	21.0	19.8	35	21.9	20.8	21.7	20.3	20.6	19.3
07	24.2	24.2	24.7	23.3	36	23.3	22.1	23.0	21.7	21.7	20.5

July Precipitations (m. m.)

1900	96.6	72.3	36.4	45.0	1929	26.2	14.3	18.8	22.1	15.4	30.9
01	152.1	53.5	189.1	84.6	30	281.6	170.7	170.7	131.3	112.5	66.9
02	143.3	189.3	137.2	124.4	31	113.2	79.1	53.1	133.2	34.4	103.7
03	133.7	129.4	267.2	59.7	32	206.8	232.5	218.9	126.4	142.3	125.4
04	278.9	225.9	309.3	228.0	33	98.1	81.6	79.8	55.8	73.0	98.6
05	81.4	181.3	212.8	50.6	34	246.4	237.0	215.4	180.6	147.0	37.5
06	229.1	220.5	55.0	30.5	35	120.6	136.4	123.9	142.9	112.0	102.0
07	27.1	24.7	111.4	96.9	36	129.0	154.2	143.5	157.6	166.9	245.0

Aug. Precipitations (m. m.)

Year	III	IV	V	VI	Year	I	II	III	IV	V	VI*
1900	26.8	87.5	83.5	149.9	1929	55.0	111.1	41.8	22.0	160.3	233.6
01	100.8	135.1	49.9	92.8	30	112.3	81.7	74.7	88.9	99.1	284.0
02	137.9	71.2	110.9	40.1	31	64.3	223.3	45.7	100.0	157.1	132.0
03	108.8	129.5	92.5	35.1	32	70.7	213.3	125.2	97.8	275.2	291.7
04	53.2	95.8	63.7	64.5	33	131.8	196.8	59.0	182.3	107.2	138.8
05	323.4	334.5	210.4	49.1	34	179.2	212.2	202.8	202.0	76.8	83.1
06	101.4	62.3	107.9	81.8	35	176.8	255.7	130.2	214.1	349.4	171.3
07	88.1	119.4	253.8	114.3	36	159.3	217.0	105.0	147.8	128.6	75.9

* Places of Observetion :

I Sendai, Miyagi pref.
II Morioka, Iwate pref.
III Ishinomaki, Miyagi pref.
IV Miyako, Iwate pref.
V Aomori, Aomori pref.
VI Sapporo, Hokkaido pref.

B. *Crop Records* (*Rice koku per tan*)

Year	0	I	II	III	IV	Year	0	I	II	III	IV**
1900	1.497	1.610	1.148	1.231	1.313	1929	1.920	1.971	1.851	1.734	1.360
01	1.686	1.687	1.395	1.448	1.398	30	2.115	2.030	2.035	1.913	1.532
02	1.328	0.732	0.454	0.622	0.148	31	1.743	1.851	1.671	0.974	0.560
03	1.665	1.441	1.187	1.372	1.121	32	1.901	1.963	1.857	1.514	0.441
04	1.834	1.421	1.334	1.756	1.611	33	2.300	2.310	2.247	2.096	1.671
05	1.353	0.174	0.381	0.955	0.835	34	1.683	1.201	0.738	0.887	0.915
06	1.632	0.994	1.188	0.798	1.190	35	1.482	1.442	1.324	0.786	0.783
07	1.722	1.221	1.517	1.509	1.649	36	2.154	2.094	1.911	2.051	1.593

** Areas :

0 Whole Japan
I Miyagi pref.
II Iwate pref.
III Aomori pref.
IV Hokkaido pref.

TABLE III.

The Continuing Period and the Interval of Bad Crop of Rice-Cultivation in Nor'h-Eastern Districts of Japan

The Christian Era	Japanese Calendar Year	Climate	The Crop Situation	The name of bad crop period continued	Interval
1755	Horeki 4	(dry)	—	The Horeki	
56	5	(wet)	bad crop		
1781	Temmei 1	(dry)	—		33 Years
82	2	(wet)	bad		
83	3	(wet)	bad	The Temmei	11 Years
84	4	(dry)	—		
85	5	(wet)	bad		
86	6	(wet)	bad		
1797	Kansei 9	—	bad ?		
98	10	—	bad ?	The Kansei and Kyôwa	33 Years
99	11	—	—		22 Years
1800	12	—	bad ?		
01	Kyowa 1	—	bad ?		
1817	Bunsei 14	(dry)	—		
18	Bunka 1	—	—		
19	2	—	—	The Bunsei and Bunka	
20	3	—	bad		
21	4	—	bad		
1832	Tempô 3	—	—		
33	4	(dry)	bad		33 Years
34	5	(wet)	bad		
35	6	(wet)	—		
36	7	—	bad	The Tempô	
37	8	—	bad		
38	9	(wet)	—		
39	10	(wet)	—		
40	11	—	—		33 Years
41	12	(wet)	—		
1866	Keiô 2	—	bad		
67	3	—	bad ?	Keiô and the early part of Meiji	
68	Meiji 1	—	—		
69	2	—	—		33 Years
1902	Meiji 35	—	bad		
03	36	—	bad ?	The middle part of Meiji	
04	37	—	—		
05	38	—	bad		

The following data are especially in Hokkaidô.

The Christian Era	Japanese Calendar Year	Climate	The Crop Situation	The name of bad crop period continued	Interval
1930	Showa 5	—	bumper		33 Years
31	6	—	bad		
32	7	—	bad	The early part of	
33	8	—	bumper	Shôwa	
34	9	—	bad		
35	10	—	bad		
36	11	—	—		
37	12	—	—		11 Years
38	13	—	—		
39	14	—	bumper		
40	15	—	bad		
41	16	—	bad		
42	17	—	bumper		
43	18	—	bumper		
44	19	—	bumper		
45	20	—	bad		
46	21	—	bumper		
47	22	—	bumper		

DIAGRAM I

Annual rice yeild of a paddy-field at Nasuno, Kanto district.
A study of SEKINE's rice note. Report of Gov. Agr. Econ. Research Inst, No. 1, 1948.

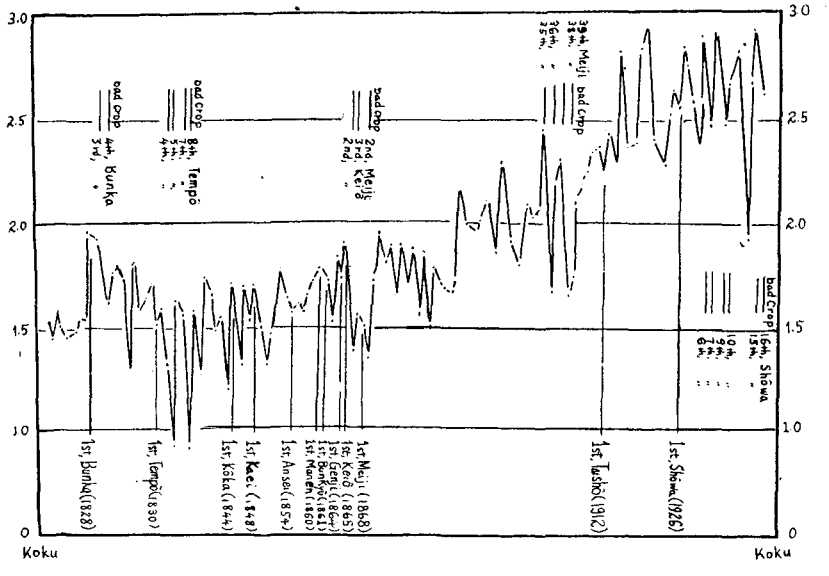
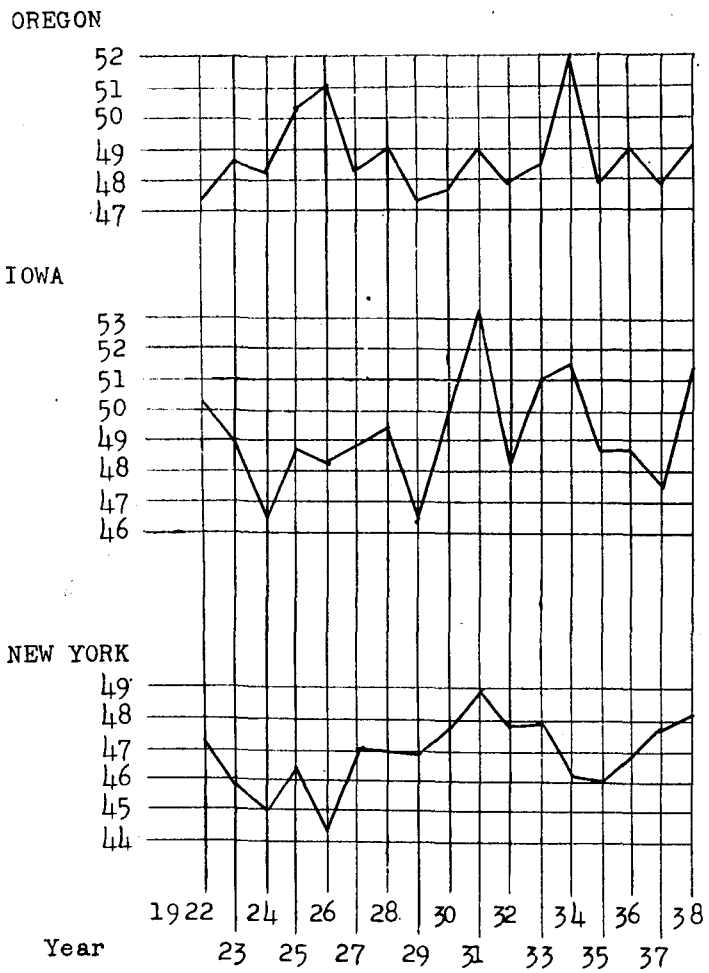


DIAGRAM II

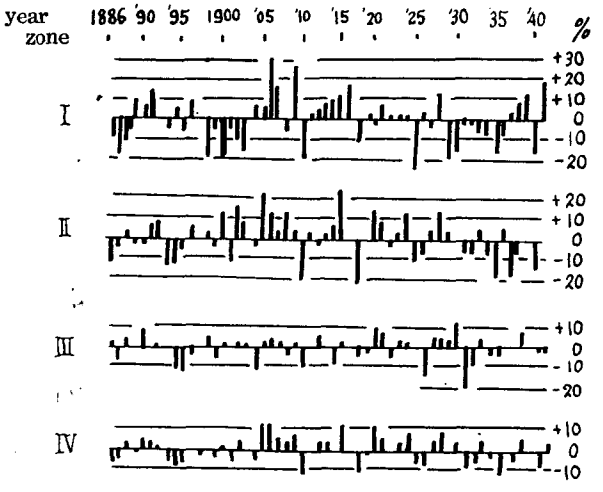
The Annual Average Mean Atmospheric Temperature (°F) in 3 Typical States in U. S.



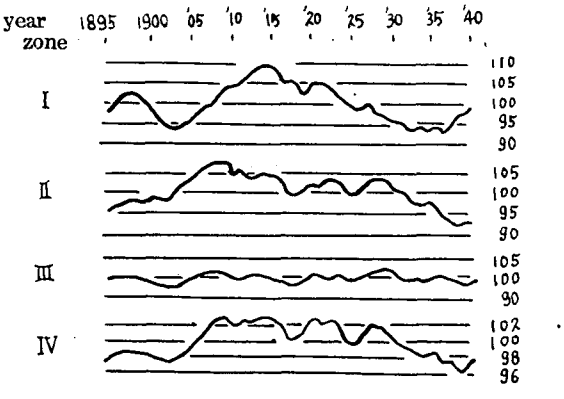
(Prepared by the data in the yarbook of U. S. D. A. 1941)

DIAGRAM III

The Annual precipitations—indicated by the percentage compared with the average year



Trend of precipitation—The moving average for ten years



(The Yearbook of the U. S. Department of Agriculture, 1941. p. 692)

The I. zone means west of the Rocky mountains, namely the Pacific coast; the II. zone, from the Rocky mountains to the Mississippi River (contains the State of Montana); the III. zone, east of the Mississippi River; the IV. zone, Atlantic coast. (The year book of U.S.D.A. 1941)