NIRS-RSD-33

RADIOACTIVITY SURVEY DATA in Japan

NUMBER 33
NOV. 1971

National Institute of Radiological Sciences
Chiba, Japan

Radioactivity Survey Data in Japan

Number 33

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Contents

External Dose Data

External Exposure due to Natural Radiation
(*National Institute of Radiological Sciences*) 1

Dietaly Data

Strontium-90 and Cesium-137 in Rice
(*National Institute of Agricultural Sciences*) 6

Strontium-90 in Wheat
(*National Institute of Agricultural Sciences*) 10

DATA OF THE TWELFTH NUCLEAR TEST OF PEOPLE'S REPUBLIC OF CHINA

Meteorological Data

Gross Beta-radioactivity in Rain and Dry Fallout
(*Japan Meteorological Agency*) 13

Gross Beta-radioactivity in Upper Air
(*Research and Development H.Q., Japan Defense Agency*) 18

National Institute of Radiological Sciences, Chiba Japan
Science and Technology Agency, Japan

External Dose Data

External Exposure due to Natural Radiation

(*National Institute of Radiological Sciences*)

A field survey of exposure rates due to natural radiation has been conducted throughtout the Hokuriku district of Japan during May 1970 and October 1970.

The situation of the Hokuriku district in Japan is shown in Figure 1. Distribution of observed locations in the districts is indicated in Figure 2. In each location, from one to five sites containing at least 5 stations were made there. A total of 83 site were measured.

Observations were made using a spherical ionization chamber and several scintillation surveymeters. The spherical plastic ionization chamber of which inner diameter and wall thickness are respectively 200 mm and 3 mm (acrylate) has adequate sensitivity for field survey. The chamber was used as a standard of apparatus, but it is difficult to observe all locations only by the apparatus, so that a surveymeter with a NaI (T1) 1"ϕ x 1" scintillator was used for regular measurements. Two types of surveymeters, the one with a 2"ϕ x 2" NaI (T1) scintillator and the other with a 3"ϕ x 3" NaI (T1) scintillator, were used as auxiliary devices. In 13 sites, both the chamber and the surveymeter were used for measurement of given stations and their readings are compared for drawing a relationship between them.

Practically the direct reading of the surveymeter were reduced into the reading of the plastic chamber corresponding to it from the relationship of linear proportion. Systematic error at calibration (^{60}Co) and reading error (random) of the plastic chamber were respectively within ±6 % (maximum overall error) and within ±3.5 % (standard error for 6μR/hr). Reading error of the surveymeter is about ±3 % (standard error for 6 μR/hr).

Measurements in open bare field were made at one meter above the ground and outdoor gamma-rays exposure rates (μR/hr) were due to cosmic rays as well as terrestrial radiation, so that it may be considered that the contribution of fallout due to artificial origin was very slight.

Gamma-ray exposure rates due to natural radiation in each location are shown in table 1, and population exposure due to natural radiation in each prefecture of the Hokuriku district is shown in table 2.

Table 1. Gamma-ray Exposure Rates due to Natural Radiation in each Location of the Hokuriku district – May, 1970 and October, 1970 –
by S. Abe, T. Ido and S. Hongo
(*National Institute of Radiological Sciences*)

Prefecture	Location	Exposure Rate (μR/hr)	Apparatus*	Number of Sites measured in each Location
Niigata	1 Samboku	13.0	D	1
	2 Murakami	14.9	D	1
	3 Shibata	14.2	D	1
	4 Niigata	10.8	A D	5
	5 Maki	10.9	C,D	1

Prefecture	Location	Exposure Rate (μR/hr)	Apparatus	Number of Sites measured in each Location
Niigata	6 Maki beach	7.8	A C,D	3
	7 Shirone	11.1	C,D	1
	8 Niitsu	12.4	C,D	1
	9 Suibara	11.7	C,D	1
	10 Tsugawa	9.9	C,D	1
	11 Kamo	10.7	C,D	1
	12 Tsubame	11.5	C,D	1
	13 Sanjo	11.6	C,D	1
	14 Mitsuke	10.2	C,D	1
	15 Izumozaki	10.7	C,D	1
	16 Tochio	10.7	C,D	1
	17 Nagaoka	10.6	A,C,D	2
	18 Kashiwazaki Arahama	8.5	C,D	1
	19 Kashiwazaki	(11.0)	C	
	20 Ojiya	10.5	C,D	1
	21 Koide	12.7	C,D	1
	22 Shiozawa	7.8	C,D	1
	23 Tokamachi	6.9	C,D	1
	24 Matsudai	6.5	C,D	1
	25 Urakawara	12.5	C,D	1
	26 Naoetsu	8.7	C,D	1
	27 Takada	10.1	A,C,D	2
	28 Arai	8.1	C,D	1
	29 Itoigawa	8.1	C,D	1
	30 Oumi	9.8	C,D	1
Toyama	31 Kurobe	11.7	C,D	1
	32 Uozu	10.3	C,D	1
	33 Namerikawa	10.2	C,D	1
	34 Himi	8.4	C,D	1
	35 Shimminato	7.3	C,D	1
	36 Takaoka	11.1	C,D	2
	37 Oyabe	8.5	C,D	1
	38 Toyama	9.4	A,C,D	4
	39 Johana	8.9	C,D	1
	40 Hosoiri	11.6	C,D	1
Ishikawa	41 Suzu	11.7	C,D	1
	42 Wajima	9.0	C,D	1
	43 Uchiura	9.3	A,C,D	1
	44 Anamizu Tsubakizaki	6.7	C,D	1
	45 Anamizu	6.5	C,D	1
	46 Togi	10.8	C,D	1
	47 Shika	10.6	A,C,D	1
	48 Nanao	8.9	C,D	1
	49 Hakui	11.2	D	1
	50 Kanazawa	11.4	A,C,D	5
	51 Yoshinodani	12.1	C,D	1
	52 Komatsu	9.7	C,D	1
	53 Kaga	9.5	C,D	1

Prefecture	Location	Exposure Rate (μR/hr)	Apparatus	Number of Sites measured in each Location
Fukui	54 Fukui	10.7	A,C,D	3
	55 Katsuyama	12.0	C,D	1
	56 Ono	12.7	D	1
	57 Sabae	11.4	C,D	1
	58 Takefu	8.0	C,D	1
	59 Tsuruga Myojin	19.4	A,C,D	1
	60 Tsuruga	16.9	A,C,D	1
	61 Mihama Okuura	18.9	A,C,D	1
	62 Mihama	12.4	C,D	1
	63 Obama	9.8	C,D	1
	64 Takahama Jinno	14.5	A,C,D	1
	65 Takahama	9.2	C,D	1

*

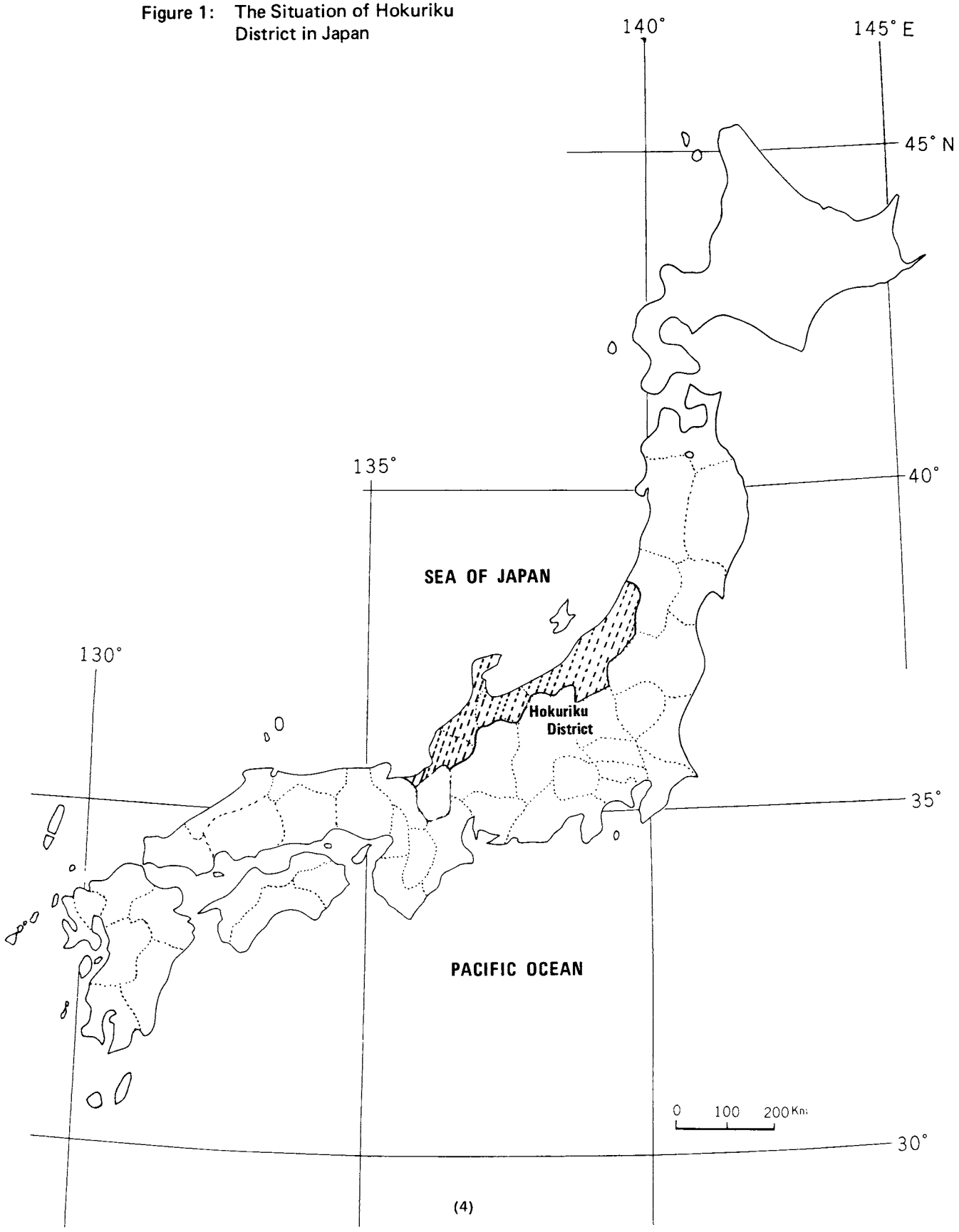
A: Spherical Ionization Chamber
B: Survey meter with a 3"ϕ x 3" NaI (Tl) Scintillator and a recorder
C: Survey meter with 2"ϕ x 2" NaI (Tl) Scintillator and a recorder
D: Survey meter with 1" ϕ x 1" NaI (Tl) Scintillator

Table 2. Population Exposure due to Natural Radiation in each Prefecture of the Hokuriku district by S. Abe, T. Ido and S. Hongo
(National Institute of Radiological Sciences)

Prefecture	Exposure Rate ± Standard Deviation (μR/hr)	Population* (x1000)	Number of Sites
Niigata	10.7 ± 1.7	2,361	38
Toyama	9.7 ± 1.4	1,030	14
Ishikawa	10.6 ± 1.1	1,002	17
Fukui	11.6 ± 2.9	744	14
Hokuriku	10.6 ± 1.9	5,137	83

* 1970 National Census

Figure 1: The Situation of Hokuriku District in Japan



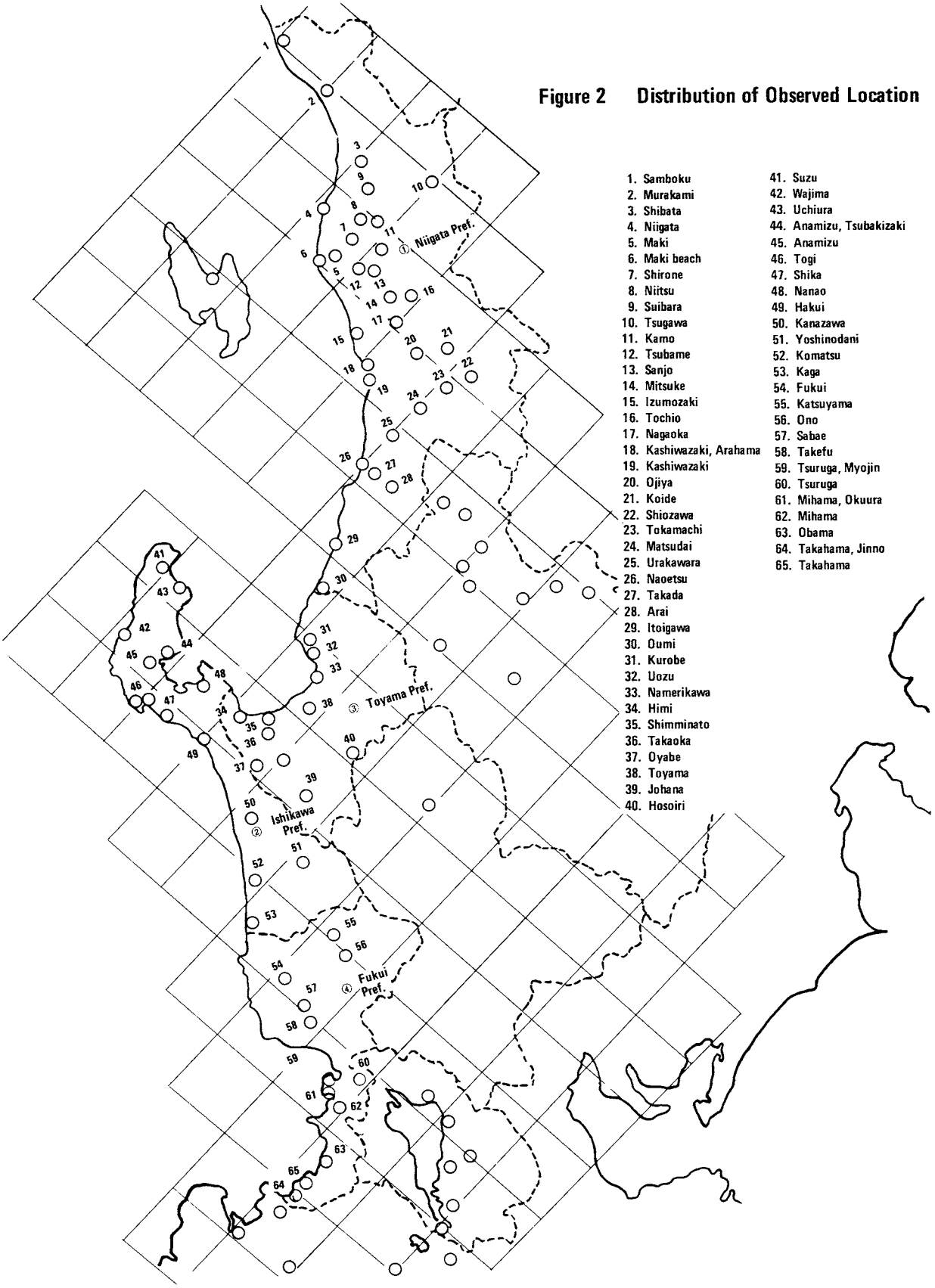


Figure 2 Distribution of Observed Location

1. Samboku
2. Murakami
3. Shibata
4. Niigata
5. Maki
6. Maki beach
7. Shirone
8. Niitsu
9. Suibara
10. Tsugawa
11. Kamo
12. Tsubame
13. Sanjo
14. Mitsuke
15. Izumozaki
16. Tochio
17. Nagaoka
18. Kashiwazaki, Arahama
19. Kashiwazaki
20. Ojiya
21. Koide
22. Shiozawa
23. Tokamachi
24. Matsudai
25. Urakawara
26. Naoetsu
27. Takada
28. Arai
29. Itoigawa
30. Oumi
31. Kurobe
32. Uozu
33. Namerikawa
34. Himi
35. Shimminato
36. Takaoka
37. Oyabe
38. Toyama
39. Johana
40. Hosoiri
41. Suzu
42. Wajima
43. Uchiura
44. Anamizu, Tsubakizaki
45. Anamizu
46. Togi
47. Shika
48. Nanao
49. Hakui
50. Kanazawa
51. Yoshinodani
52. Komatsu
53. Kaga
54. Fukui
55. Katsuyama
56. Ono
57. Sabae
58. Takefu
59. Tsuruga, Myojin
60. Tsuruga
61. Mihama, Okuura
62. Mihama
63. Obama
64. Takahama, Jinno
65. Takahama

Dietary Data

Strontium-90 and Cesium-137 in Rice

(National Institute of Agricultural Sciences)

Strontium-90 content in rice has been determined at the National Institute of Agricultural Sciences since 1957, and cesium-137 content in rice since 1961.

All rice samples are collected at, and sent from national and prefectural agricultural areas throughtout Japan. Sampling locations are shown in figure 4.

The samples are chosen as representative of agricultural conditions, including soil type, crop variety, fertilizer application and harvest time.

The analytical procedure applied is the same as described on page 9, Issue number 22, of this publication.

The results obtained from 1969 to 1970 are shown in table 3 and 4. The annual average of strontium-90 and cesium-137 contents during the period from 1957 to 1969 is shown in figure 3.

Table 3. ^{90}Sr in Rice –1969 to 1970–

by H. Kobayashi and A. Tsumura

(National Institute of Agricultural Sciences)

(Continued from Table 6, Issue No. 22, of this publication)

– 1969 –

Location	Month harvested	Polished Rice		
		g Ca/Kg	pCi/Kg	S.U.
Sapporo, HOKKAIDO	October	0.047	1.2	26
Akita, AKITA	"	0.040	2.3	57
Morioka, IWATE	"	0.053	0.5	9
Sendai, MIYAGI	"	0.078	1.7	22
Mito, IBARAKI	September	0.057	0.7	12
Konosu, SAITAMA	October	0.039	1.1	28
Tachikawa, TOKYO	"	0.063	1.6	25
Kofu, YAMANASHI	September	0.067	0.7	10
Takada, NIIGATA	"	0.072	2.3	30
Kanazawa, ISHIKAWA	"	0.043	1.5	35
Tsu, MIE	October	0.064	1.7	27
Osaka, OSAKA	November	0.064	0.5	7
Okayama, OKAYAMA	"	0.048	0.6	12
Tottori, TOTTORI	October	0.042	1.3	31
Tsukushino, FUKUOKA	November	0.066	0.9	14
Average for year		0.056	1.2	23

– 1970 –

Location	Month harvested	Brown Rice			Polished Rice		
		g Ca/Kg	pCi/Kg	S.U.	g Ca/Kg	pCi/Kg	S.U.
Sapporo, HOKKAIDO	September	0.084	9.7	149	0.047	2.6	55
Akita, AKITA	"	0.135	17.0	126	0.058	2.4	41
Morioka, IWATE	"	0.121	12.4	103	0.047	1.2	26
Sendai, MIYAGI	"	0.109	8.6	79	0.055	1.7	31
Mito, IBARAKI	"	0.100	5.6	56	0.046	1.4	31
Konosu, SAITAMA	October	0.135	8.1	60	0.059	1.2	20
Tachikawa, TOKYO	"	0.096	11.0	114	0.055	1.0	18
Kofu, YAMANASHI	"	0.072	4.7	65	0.048	0.5	10
Takada, NIIGATA	"	0.139	14.5	104	0.056	2.7	48
Kanazawa, ISHIKAWA	August	0.121	9.9	82	0.054	1.7	32
Tsu, MIE	October	0.074	14.3	192	0.048	1.6	33
Osaka, OSAKA	"	0.100	6.1	61	0.050	1.4	28
Okayama, OKAYAMA	November	0.113	4.7	42	0.057	0.9	16
Tottori, TOTTORI	October	0.070	8.3	118	0.057	1.8	38
Tsukushino, FUKUOKA	November	0.111	8.2	74	0.052	2.6	50
Average for year		0.105	9.5	95	0.052	1.6	32

Table 4. ^{137}Cs in Rice –1969–

by H. Kobayashi and A. Tsumura
(National Institute of Agricultural Sciences)

(Continued from Table 7, Issue No. 22, of this publication)

Location	Month harvested	Polished Rice		
		g K/Kg	pCi/Kg	C.U.
Sapporo, HOKKAIDO	October	1.106	24.6	23
Akita, AKITA	"	0.993	32.2	34
Morioka, IWATE	"	0.799	33.0	41
Sendai, MIYAGI	"	1.113	22.4	20
Konosu, SAITAMA	"	0.809	8.8	11
Tachikawa, TOKYO	"	1.120	15.8	14
Kofu, YAMANASHI	September	1.146	6.3	5
Takada, NIIGATA	"	0.933	18.3	19
Kanazawa, ISHIKAWA	"	0.826	11.9	15
Tsu, MIE	October	1.253	9.9	8
Osaka, OSAKA	November	1.360	5.1	4
Okayama, OKAYAMA	"	1.253	6.6	5
Tottori, TOTTORI	October	0.826	12.4	15
Tsukushino, FUKUOKA	November	1.240	7.9	6
Average for year		1.051	15.4	16

Figure 3 Temporal Variation of ^{90}Sr and ^{137}Cs in Rice-- 1957 to 1970 –
– All Japan Mean Values –

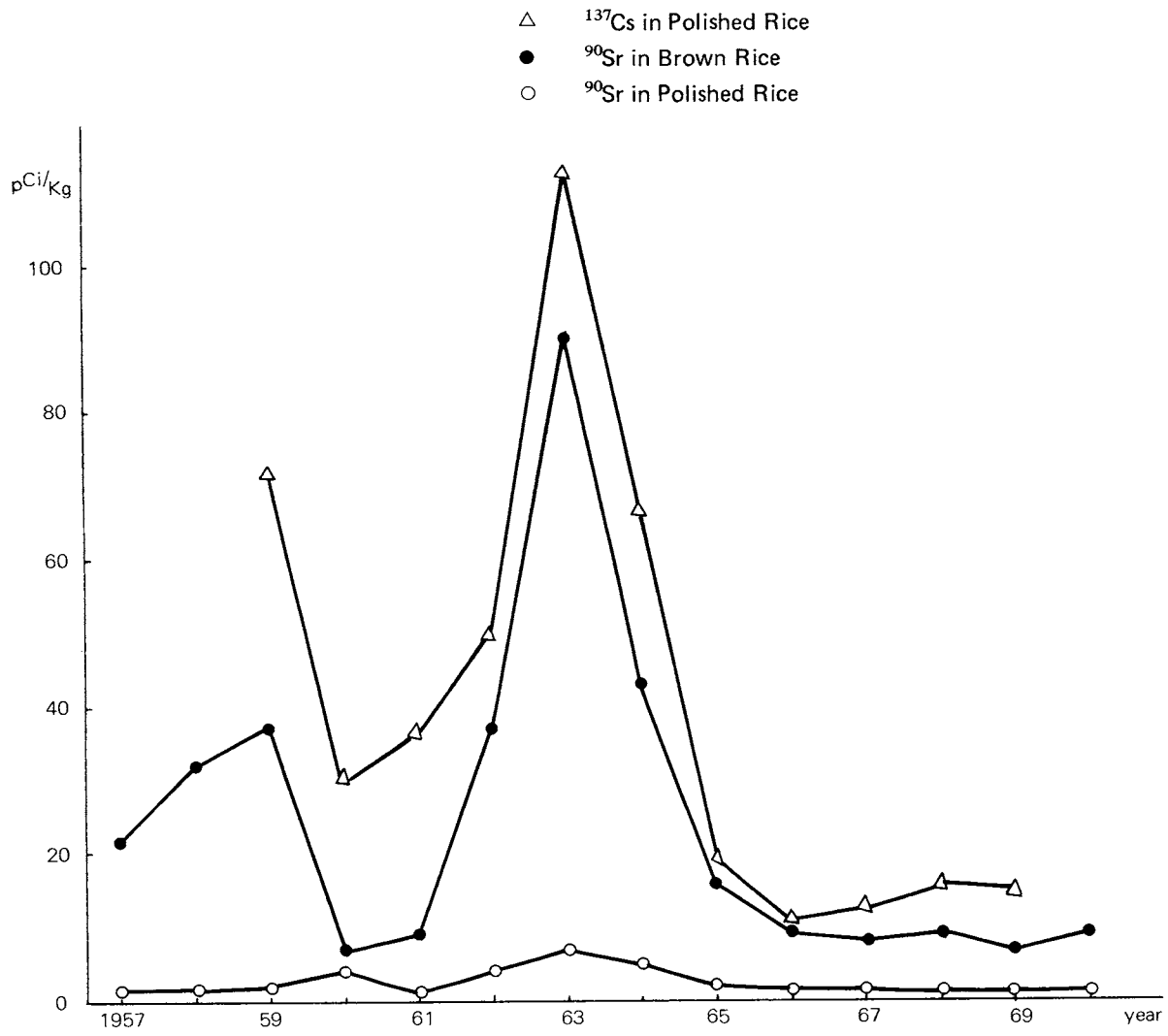
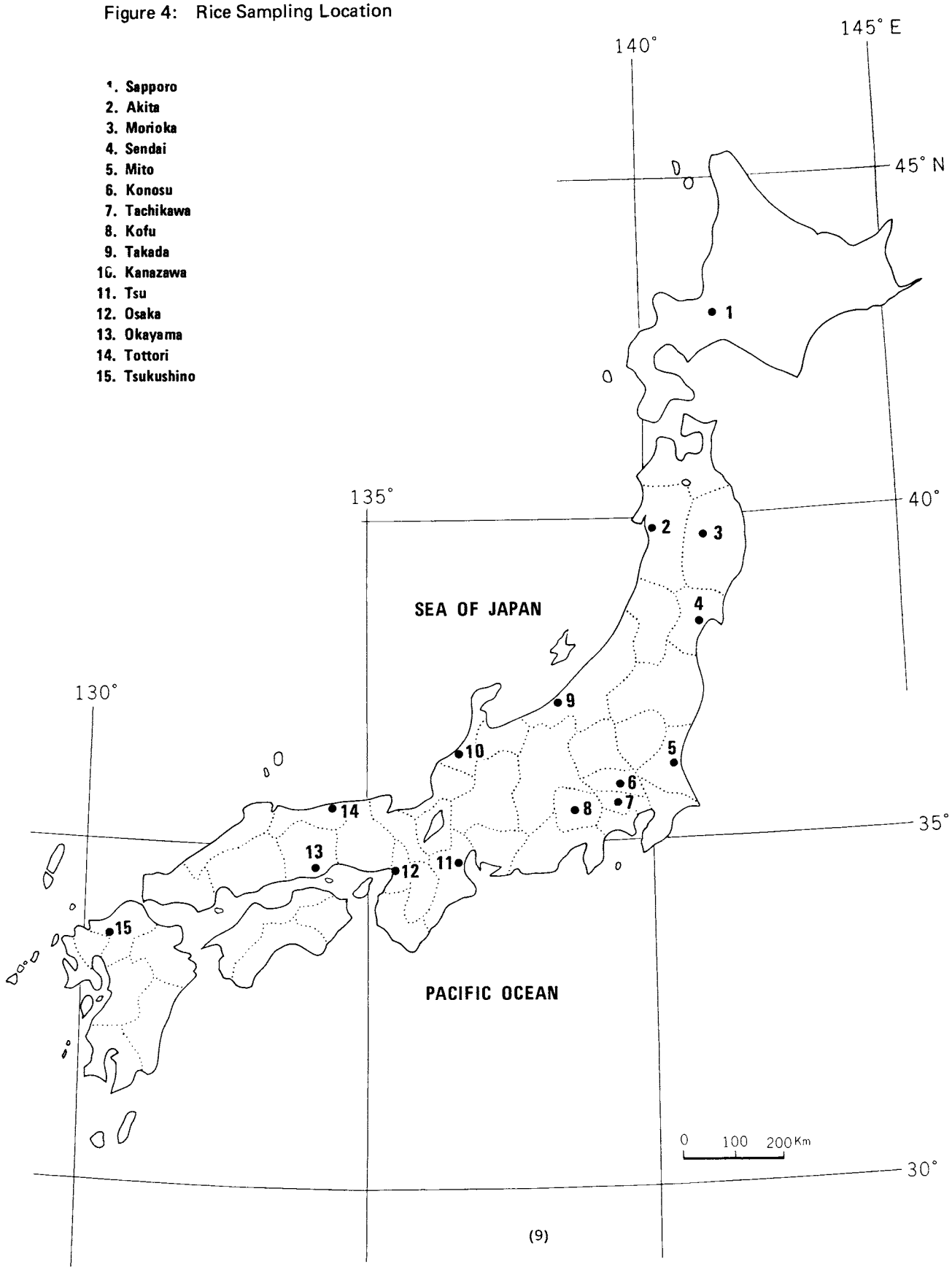


Figure 4: Rice Sampling Location



Strontium-90 in Wheat

(*National Institute of Agricultural Sciences*)

Strontium-90 content in wheat has been determined at the National Institute of Agricultural Sciences since 1957. All wheat samples are collected at, and sent from national and prefectural experimental stations, covering all important areas of agriculture throughout Japan.

Sampling locations are shown in figure 6. The samples are chosen as representative of agricultural conditions, including soil type, crop variety, fertilizer application and harvest time.

The analytical method applied is the same one with that shown on page 11, issue No. 22, of this publication.

The analytical results in 1969 and 1970 are shown in table 5. The yearly average of atrontium-90 content during the period from 1957 to 1970 are shown in figure 5.

Table 5. ^{90}Sr in Wheat –1969 to 1970–

by H. Kobayashi and A. Tsumura

(*National Institute of Agricultural Sciences*)

(Continued from Table 8, Issue No. 22, of this Publication)

–1969–

Location	Month harvested	g Ca/Kg	pCi/Kg	S.U.
Sapporo, HOKKAIDO	August	0.315	24.1	77
Akita, AKITA	July	0.372	50.5	136
Morioka, IWATE	"	0.331	33.5	101
Iwamuma, MIYAGI	June	0.331	16.0	48
Nagaoka, NIIGATA	"	0.301	34.4	114
Mito, IBARAKI	July	0.378	25.9	69
Kitamoto, SAITAMA	"	0.325	14.0	43
Tachikawa, TOKYO	June	0.402	14.7	34
Kofu, YAMANASHI	"	0.313	12.7	40
Osaka, OSAKA	"	0.299	25.2	84
Okayama, OKAYAMA	"	0.331	12.8	39
Amagi, FUKUOKA	"	0.385	20.5	53
Average for year		0.340	23.6	70

Table 5. ^{90}Sr in Wheat –1970–

Location	Month harvested	g Ca/Kg	pCi/Kg	S.U.
Sapporo, HOKKAIDO	July	0.410	24.4	60
Morioka, IWATE	"	0.211	18.6	88
Iwanuma, MIYAGI	"	0.211	11.9	54
Nagaoka, NIIGATA	"	0.278	37.2	133
Mito, IBARAKI	June	0.281	22.5	80
Kitamoto, SAITAMA	"	0.261	16.7	64
Tachikawa, TOKYO	"	0.378	39.8	105
Kofu, YAMANASHI	"	0.221	13.5	61
Osaka, OSAKA	"	0.271	31.5	116
Okayama, OKAYAMA	"	0.361	30.3	84
Amagi, FUKUOKA	"	0.325	29.9	92
Average for year		0.292	25.1	85

Figure 5: Temporal Variation of ^{90}Sr in Wheat
– 1957 to 1970 –
– All Japan Mean Values –

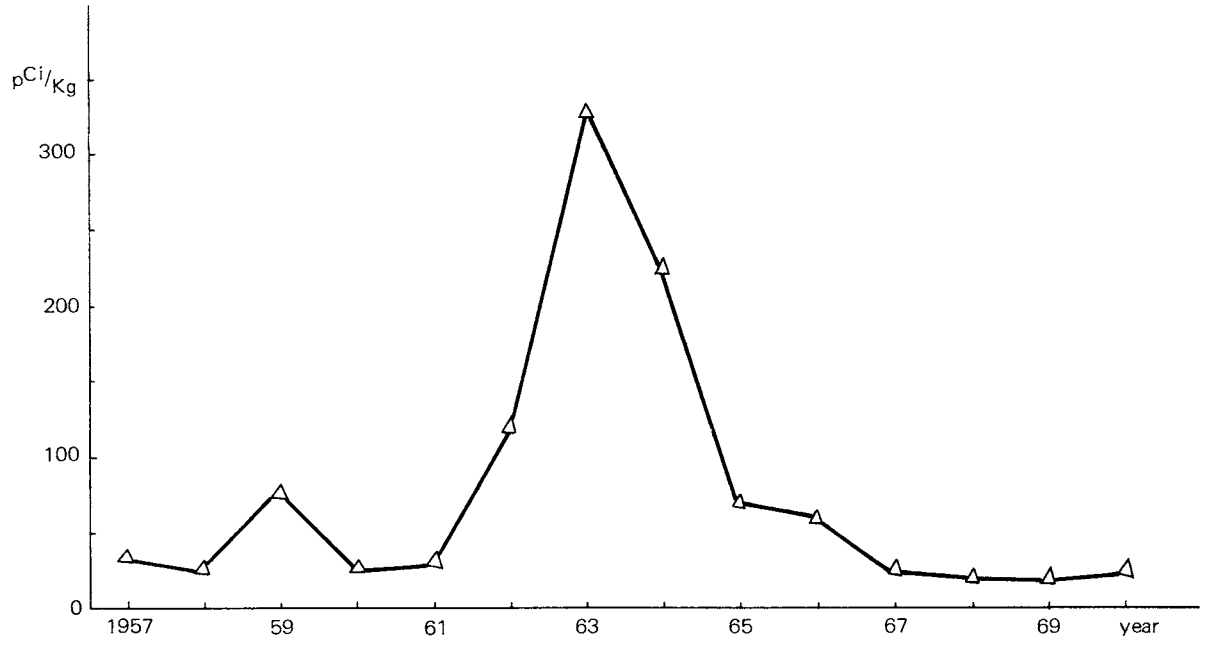
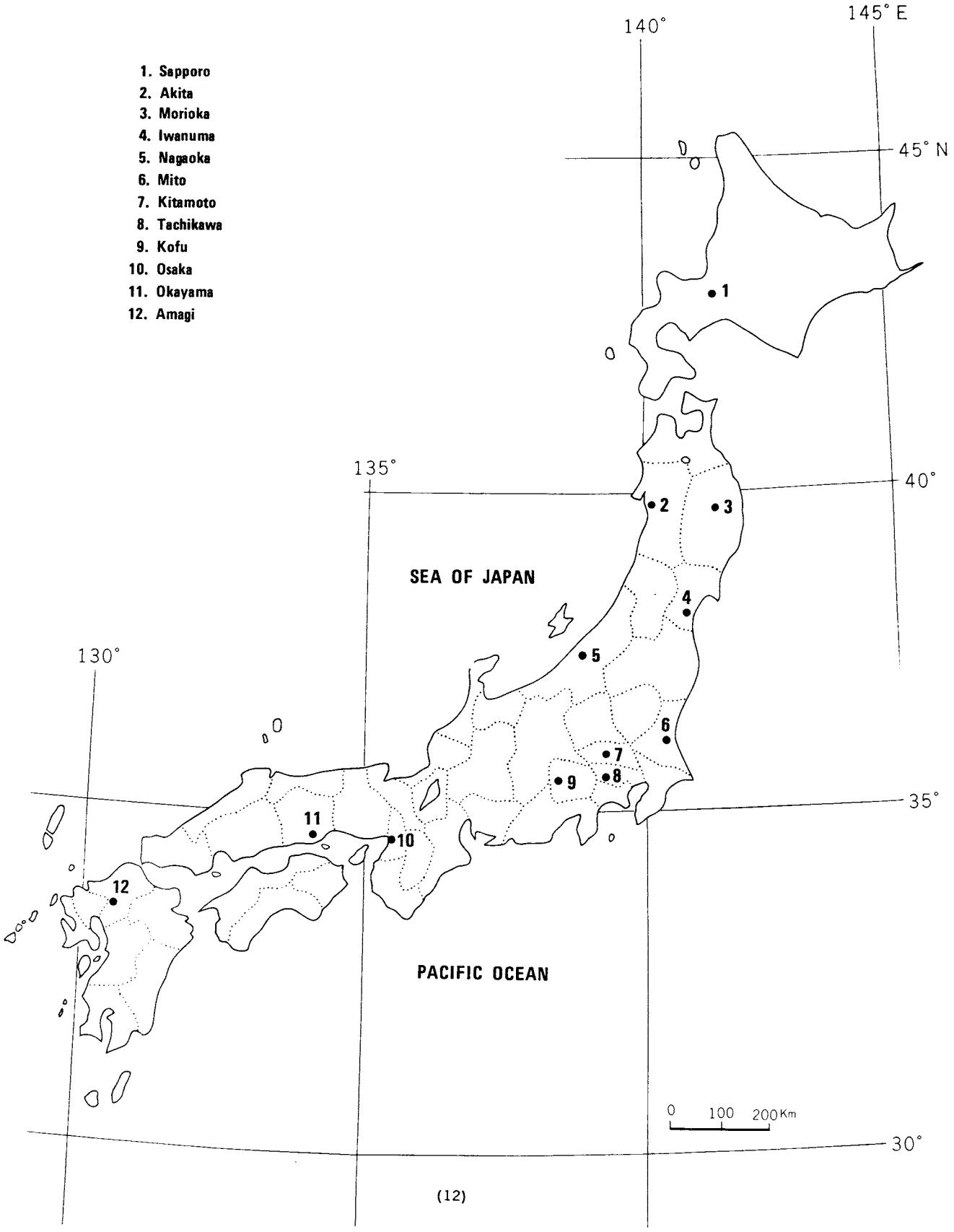


Fig. 6: Wheat Sampling Location



DATA OF THE TWELFTH NUCLEAR TEST OF THE PEOPLE'S REPUBLIC OF CHINA

Meteorological Data

Gross Beta-radioactivity in Rain and Dry Fallout

(*Japan Meteorological Agency*)

Survey of gross beta-activity in rain and dry fallout has been conducted using the data from 13 stations of Japan Meteorological Agency shown in Figure 7.

The procedures of sampling and counting are same as those discribed on page 2 of the report No. 5 of this publication series.

The 12th nuclear test of the People's Republic of China was carried out on 18 November, 1971. It is believed that the test area is the neighborhood of Lake Lop Nor (40°N, 90°E), about 4000 km west-northwest of Tokyo. The date of gross beta-radioactivity for 19-30 November, 1971 is shown in table 6 and 7.

Abnormal microbarographic disturbance was faintly observed at Akita Local Meteorological Observatory. At another stations records were obscure. The data and the result are shown in table 8.

It is estimated from the air mass trajectory shown in Figure 8 that the radioactive debris emitted into the troposphere first passed in an altitude of about 10 km (300 mb level) over the middle part of Japan about 40 hours after the explosion.

The radioactivity in rain and fallout (collected near the ground) during 19–30 November, sometimes showed significant departure from those normal conditions.

Table 6. Gross beta-activity in Rain, Nov. 20–30, 1971

Compiled by N. Banno, T. Honda, H. Ueno
(*Japan Meteorological Agency*)

Upper row: Concentration (pCi/cc)
Lower row: Deposition (mCi/km^2)

Satation \ Date	Nov. 1971 20	21	22	23	24	25	26	27	28	29	30
Wakkanai	—	—	0.1	0.1	—	0.0	—	—	0.0	0.0	0.1
"			0.8	0.1		0.0			0.0	0.0	0.3
Sappro	—	—	0.1	—	—	0.1	0.1	—	0.0	—	0.0
"			0.3			0.4	0.1		0.0		0.0
Kushiro	—	—	—	—	—	0.0	—	—	0.0	—	—
"						0.0			0.0		
Sendai	—	—	—	—	—	0.0	—	—	—	0.0	—
"						0.0				0.0	
Akita	—	—	—	—	0.2	0.3	0.1	—	0.5	0.1	0.0
"					1.0	4.0	0.5		3.0	0.9	0.0
Tokyo	—	—	—	—	—	—	—	—	—	—	—
"											
Wajima	0.1	0.0	0.2	—	1.0	0.2	0.2	1.2	1.1	0.2	0.0
"	2.0	0.0	5.0		4.5	3.0	2.0	6.6	13.0	5.0	0.0
Hachijojima	—	—	—	—	2.0	0.5	—	0.2	—	—	—
"					2.0	2.0		0.6			
Osaka	—	—	—	—	15.0	—	—	—	—	—	—
"					15.0						
Yonago	—	—	2.9	3.9	2.6	—	—	—	—	—	0.4
"			15.0	39.0	39.0						1.0
Murotomisaki	—	—	—	—	—	—	—	—	—	—	—
"											
Fukuoka	—	—	—	17.0	—	0.6	—	0.7	—	—	—
"				94.0		6.0		7.0			
Kagoshima	—	—	—	—	—	—	—	0.0	—	—	—
"								0.0			

Table 7. Gross beta-activity in Dust, Nov. 19–30, 1971

Compiled by N. Banno, T. Honda, H. Ueno
(*Japan Meteorological Agency*)

(pCi/m^3)

Station \ Date	Nov. 1971 19	20	21	22	23	24	25	26	27	28	29	30
Sapporo	0.2	0.5	0.3	0.2	0.3	0.2	0.1	0.1	0.2	0.1	0.1	0.1
Sendai	0.2	0.6	0.6	0.3	0.3	0.9	0.1	0.3	0.4	0.9	0.1	0.1
Tokyo	0.3	1.0	0.6	1.2	0.3	2.8	0.7	0.9	0.7	2.2	0.4	0.3
Osaka	1.9	1.5	1.9	0 0.4	4.8	1.2	0.5	1.4	3.4	8.0	0.6	0.6
Fukuoka	0.5	0.7	1.2	0.0	1.2	1.0	0.2	0.7	12.0	1.4	0.0	0.0

Table 8 The Microbarographic Disturbance due to the 12th Nuclear Test of The People's Republic of China, Nov. 18, 1971.
Compiled by N. Banno, T. Honda, H. Ueno
(Japan Meteorological Agency)

Station		Time (G.M.T.)	Amplitude (mb)	Period (min)	Duration (min)
Wakkanai	(45° 25′ N 141° 41′ E)	—	—	—	—
Kushiro	(42° 59′ N 144° 24′ E)	—	—	—	—
Akita	(39° 43′ N 140° 06′ E)	09:46	?	?	13
Wajima	(37° 23′ N 136° 54′ E)	—	—	—	—
Tokyo	(35° 41′ N 139° 46′ E)	—	—	—	—
Yonago	(35° 26′ N 133° 21′ E)	—	—	—	—
Murotomisaki	(33° 15′ N 134° 11′ E)	—	—	—	—
Kagoshima	(31° 34′ N 130° 33′ E)	—	—	—	—

— : Records were obscure.

? : Not determined because the change was too small.

Fig. 7: Fallout Observation Network of Japan Meteorological Agency

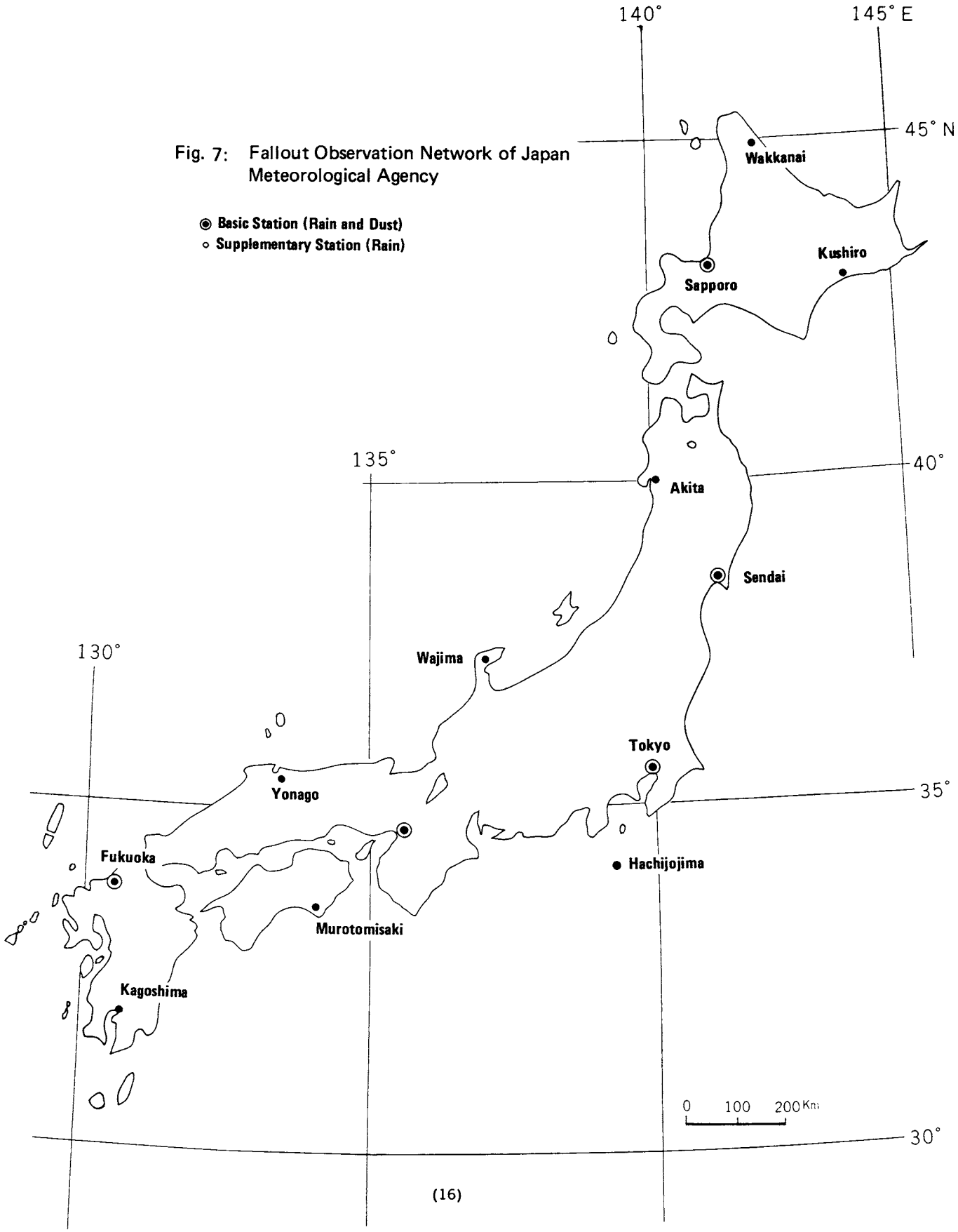
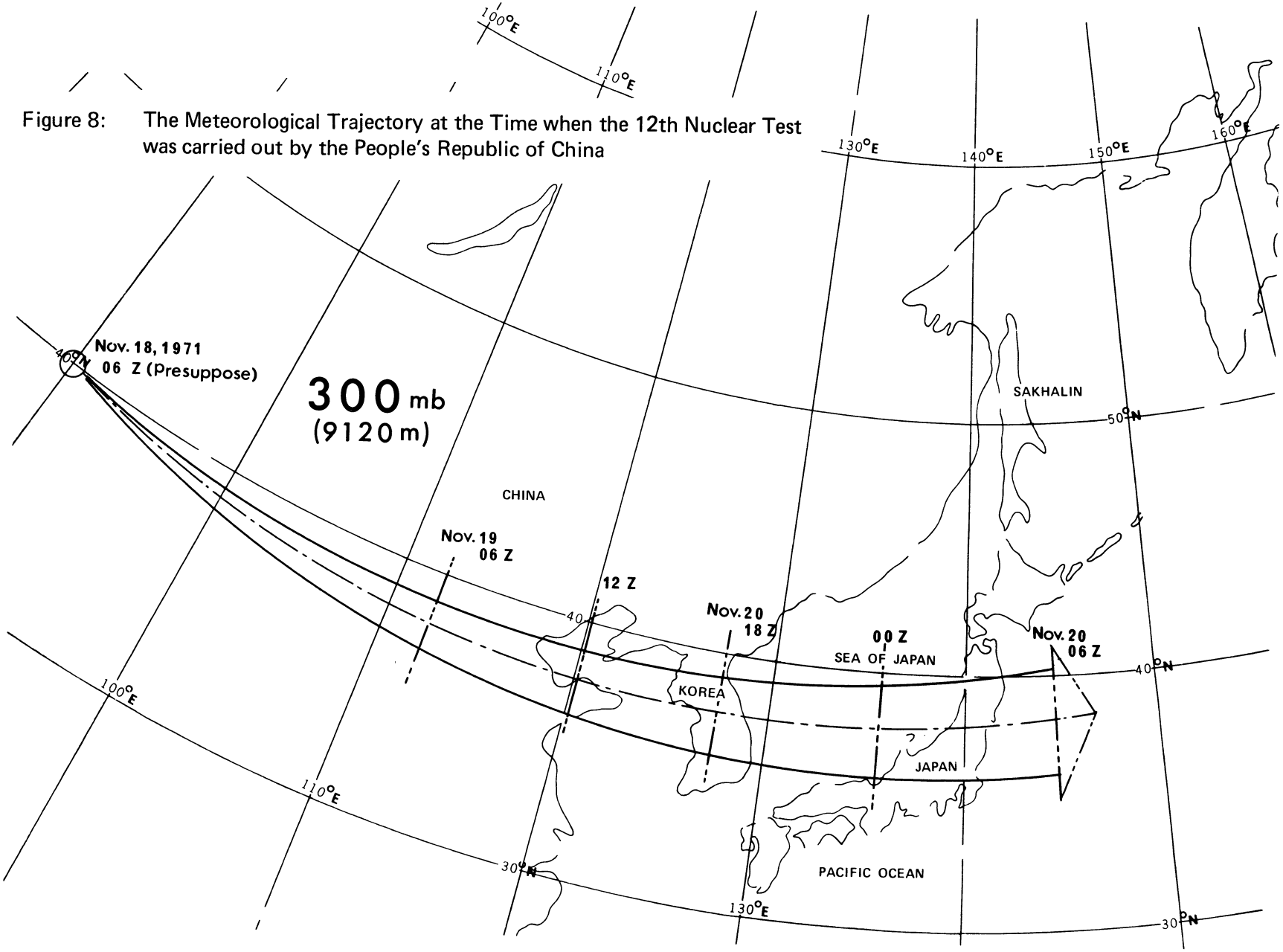


Figure 8: The Meteorological Trajectory at the Time when the 12th Nuclear Test was carried out by the People's Republic of China



Gross Bata-rad ioactivity in Upper Air

(*Research and Development H.Q., Japan Defense Agency*)

Since 1960, Research and Development H.Q., Japan Defense Agency has measured the beta-activity of dust in the lower laver of the stratosphere and tropopause using aircraft as collectors.

The samples were taken over three areas of Japan using both dust samples attached under the aircraft wings and gummed papers attached in front of them.

The sampling flight with gummed papers were made using two aircraft at the same time, one of which made a normal sampling flight and the other only upward and downward flight. The difference between the amounts of radioactivity of samples collected by the two aircraft is taken as the value at the flight altitude.

Figure 9 shows three sampling areas of Japan.

Results obtained is shown in Table 9.

Table 9. Gross β-actibity in Upper Air
– Nov. 19th to 25th, 1971 –
by K. Kenmochi, T. Akimoto, T. Matsumura and K. Kitazawa
(*Research and Development H. Q., Japan Defense Agency*)

(unit = pCi/^{3})

investigation contents / time and day	Northern Area			Central Area			Western Area		
	Fright Area	Altitude (ft)	Intensity	Fright Area	Altitude (ft)	Intensity	Fright Area	Altitude (ft)	Intensity
Nov. 19th 18:00				Iruma	37,000	3.2			
				Sado			Chikujyo		
21:00	Hachinohe			Wajima			Mishima	30,000	3.7
22:00						3.3			
23:00	Niigata	37,000	1.8	Iruma			Chikujyo		
	Hachinohe								
20th 00:00				〃	37,000	1.2			
01:00	〃	〃	1.8						
02:00				〃	30,000	0.4			
03:00	〃	30,000	0.6						
04:00				〃	〃	0.4			
05:00	〃	〃	1.0						
							Chikujyo		
09:00							Tanegashima	18,000	0.15
12:00							Chikujyo		0.17
25th 08:42	Hachinohe			Iruma			Chikujyo		
08:53		16,000	0.14						
	Miyako			Maebashi	16,000	0.1	Mishima		
09:30									
	Tomakomai			Niigata			Nakatsu	16,000	0.08
							Aso		

Figure 9: Three Sampling Areas of Japan