3. Concerning the Environmental Survey (Air, Indoor Air, Soil, Ground Surface Sampling, Etc.)

(1) The Air Survey

The air survey was carried out using low-volume air samplers that captured air samples for the period of one week.

The results of the air survey aggregated by area and region are shown in Table 3-1.

Table 3-1. Concentrations of PCDD+PCDF+Co-PCB in Air (Unit: pg-TEQ/m^3)

	Osaka Prefecture Nose Town Regions		Saitama Prefecture Regions			Hiroshima Prefecture Fuchu City Regions	
	A region (n=6)	B region (n=7)	A1 region (n=8)	A2 region (n=6)	B region (n=5)	A region (n=5)	B region (n=5)
PCDD+PCDF							
Mean	0.075	0.074	0.41	0.29	0.74	0.10	0.040
Standard deviation	0.0094	0.013	0.36	0.065	0.032	0.046	0.0027
Median	0.073	0.079	0.32	0.28	0.74	0.10	0.040
Range	0.066 – 0.092	0.049 – 0.088	0.15 – 1.2	0.23 –0.39	0.69 – 0.78	0.054 – 0.18	0.037 – 0.044
Co-PCB							
Mean	0.0018	0.0015	0.015	0.0093	0.020	0.0056	0.0029
Standard deviation	0.00072	0.00054	0.015	0.0055	0.0016	0.0014	0.00054
Median	0.0015	0.0013	0.010	0.0087	0.020	0.0059	0.0027
Range	0.0012 – 0.0027	0.0012 –0.0027	0.0043 –0.046	0.0030 – 0.019	0.018 – 0.022	0.0038 – 0.0069	0.0027 – 0.0039
PCDD+PCDF +Co-PCB							
Mean	0.077	0.076	0.42	0.30	0.76	0.11	0.044
Standard deviation	0.0094	0.013	0.36	0.067	0.032	0.047	0.0034
Median	0.075	0.082	0.33	0.29	0.76	0.11	0.043
Range	0.070 – 0.094	0.051 – 0.090	0.15 –1.3	0.23 –0.40	0.71 –0.80	0.058 – 0.18	0.040 – 0.049

Notes:

1 When the actual measurement of an isomer was below the lower limit of determination (ND), its actual concentration was calculated by applying one-half the value of the detection limit (according to the survey manual, only the calculated results of ND×1/2 are shown).

2 The lower limits of determination were as follows:

T_4CDD, T_4CDF: 0.01 (pg/ m^3), P_5CDD, P_5CDF: 0.01 (pg/ m^3)

H_6CDD, H_6CDF: 0.01 (pg/ m^3), H_7CDD, H_7CDF: 0.01 (pg/ m^3)

O_8CDD, O_8CDF: 0.01 (pg/ m^3), Co-planar PCB: 0.01 (pg/ m^3)

Analysis and Evaluation

(a) Comparison of Regions

No distinct difference was observed between the regions in the Nose Town area of Osaka Prefecture regarding concentrations of PCDD+PCDF and concentrations of Co-PCB in the air during the survey period. In the Saitama areas, concentrations in the B regions were higher than concentrations in the A1 and A2 regions. In the Hiroshima Prefecture Fuchu City area, concentrations in the A regions were higher than those in the B regions.

In the Saitama Prefecture areas, concentrations in some locations exceeded environmental standards. However, concentrations in the air environment during this survey are from once-yearly measurements, so those values cannot simply be compared with air environment standard values, of which evaluations are based on evaluation of annual mean values (see Figure 3-1).

(b) Comparison with Long-Term Air Measurements

With the objective of determining concentration levels outside the one-week period when air environment concentrations were measured, long-term air measurements (sampling for about one month carried out 3 to 4 times) were carried out at one location in each region (see Figure 3-2).

Sampling was carried out in every region from mid-January to the end of March (except the Nose Town area of Osaka Prefecture, where sampling began in early December). Some fluctuation in concentration levels was

observed, but no major difference was found between the concentration levels during the one-week survey period and the concentration levels during the long-term air measurement. The sole exception to this, however, was in the Saitama Prefecture B regions, where the concentration levels during the one-week survey period were distinctly higher. It will be necessary to consult with relevant local governments concerning the causes for this and address it.

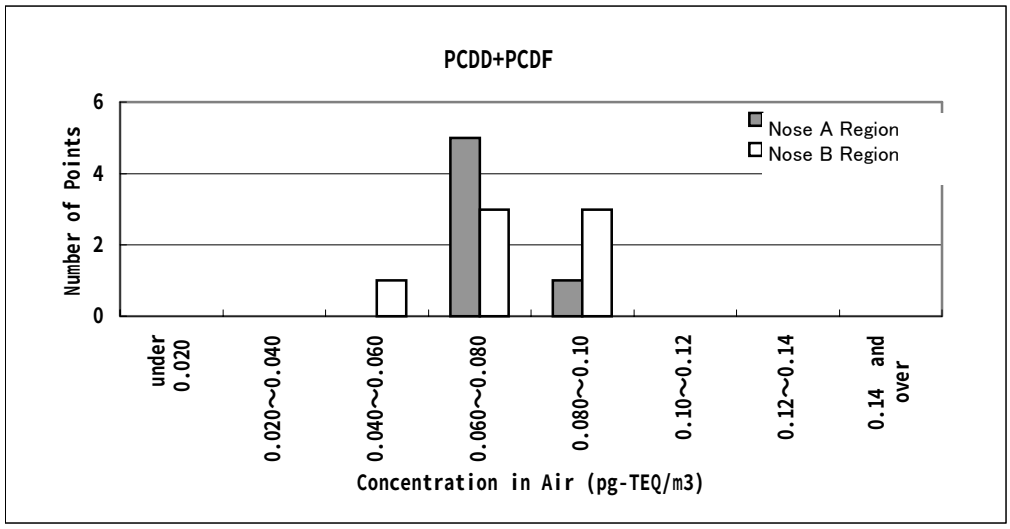

Figure 3-1-1A. Frequency Distribution of Concentrations in Air (Nose Area PCDD+PCDF)

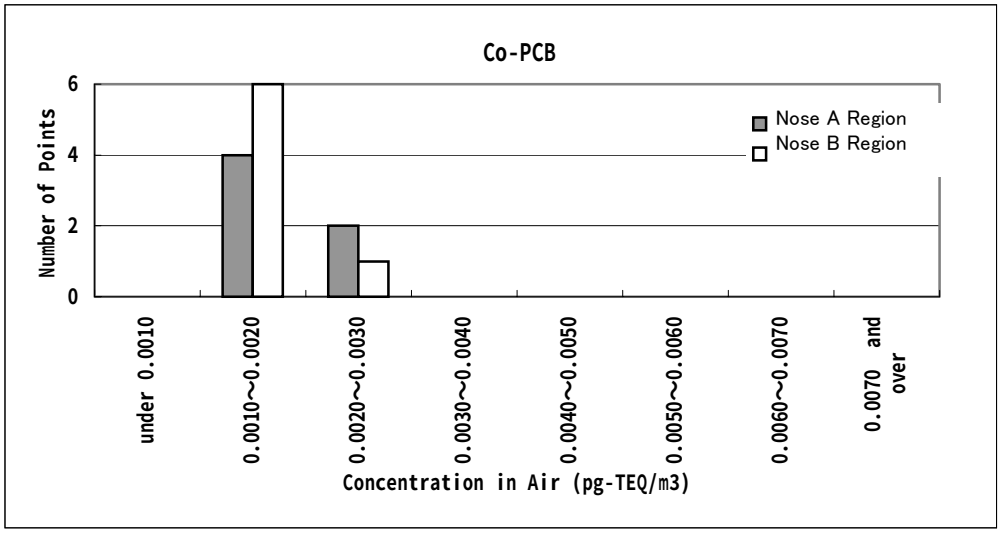

Figure 3-1-1B. Frequency Distribution of Concentrations in Air (Nose Area・Co-PCB)

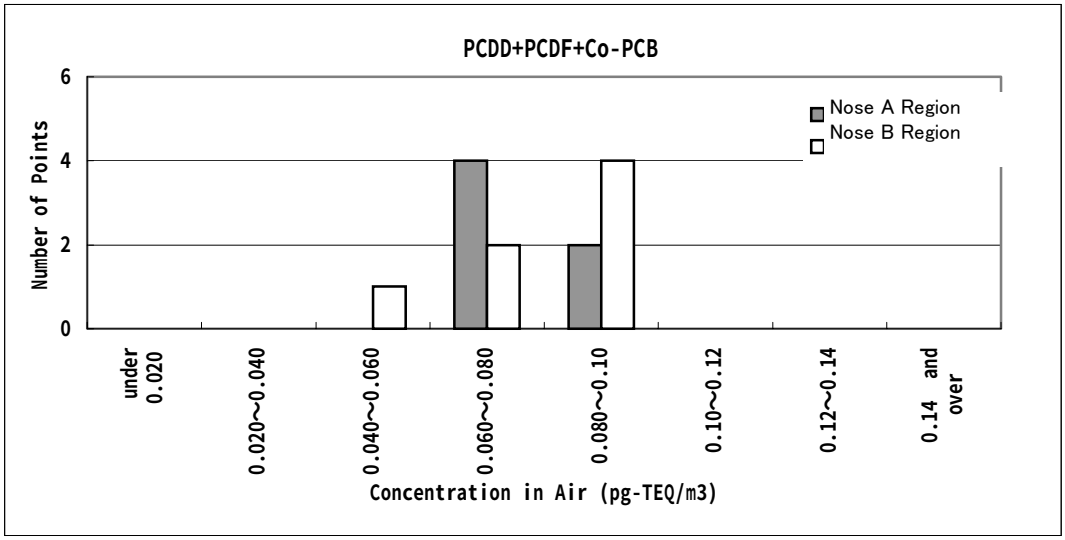

Figure 3-1-1C. Frequency Distribution of Concentrations in Air (Nose Area・PCDD+PCDF+Co-PCB)

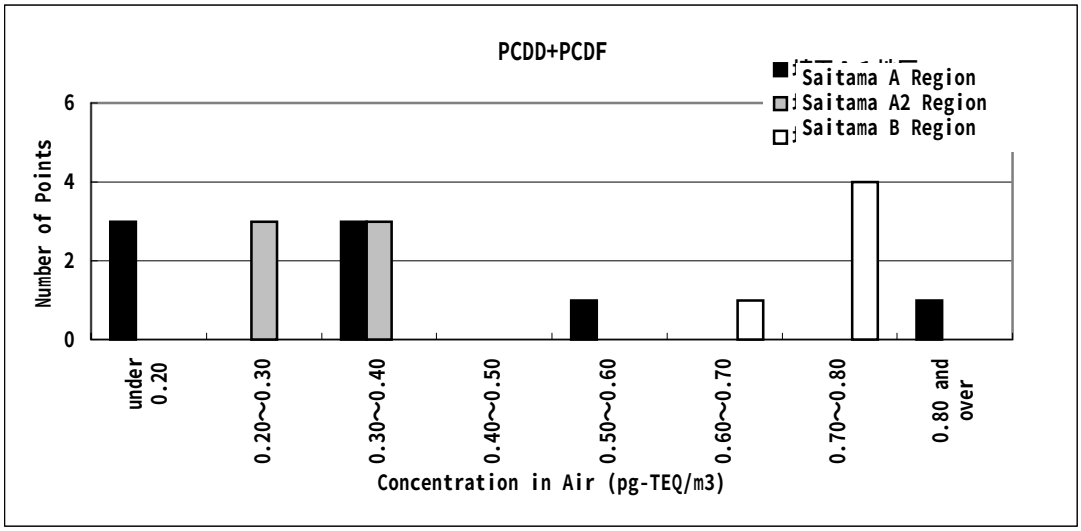

Figure 3-2-1A. Frequency Distribution of Concentrations in Air (Saitama Area・PCDD+PCDF)

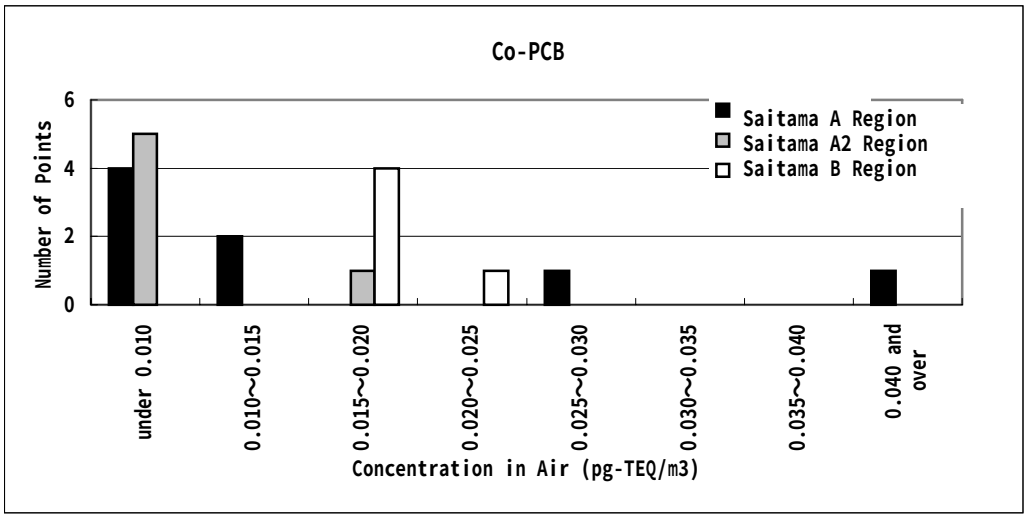

Figure 3-2-1B. Frequency Distribution of Concentrations in Air (Saitama Area・Co-PCB)

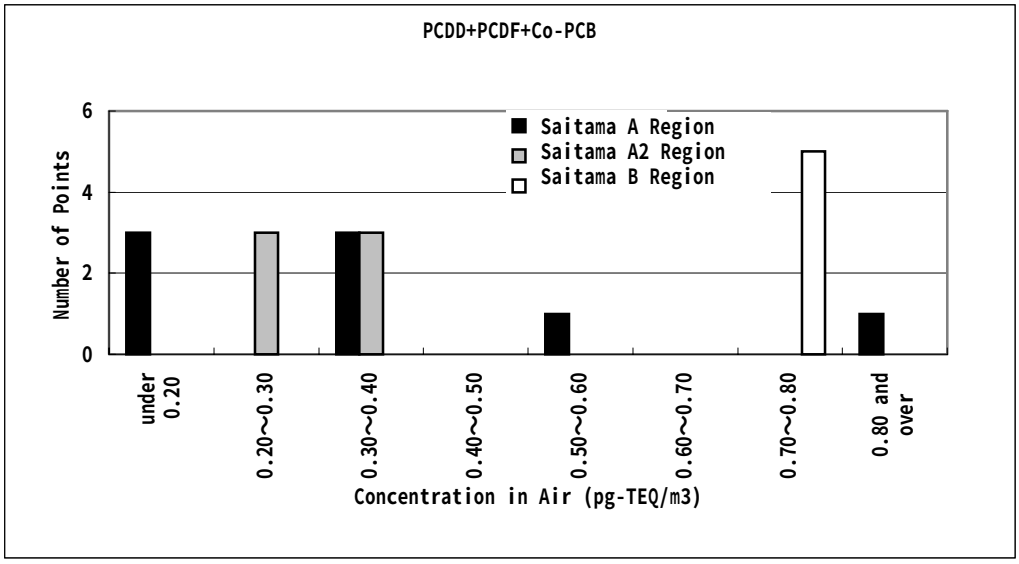

Figure 3-2-1C. Frequency Distribution of Concentrations in Air (Saitama Area・PCDD+PCDF+Co-PCB)

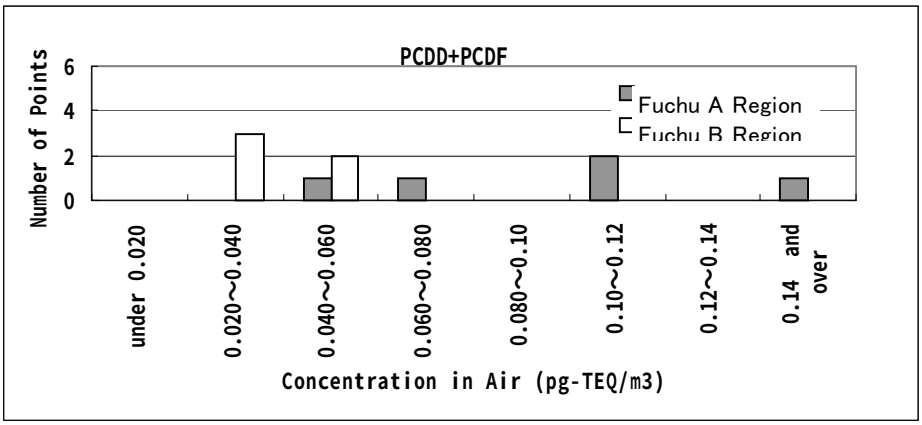

Figure 3-3-1A. Frequency Distribution of Concentrations in Air (Fuchu Area・PCDD+PCDF)

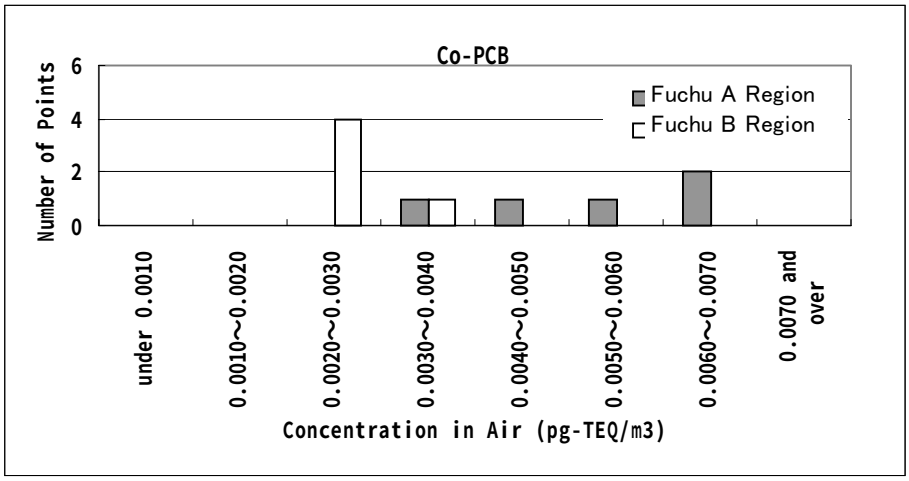

Figure 3-3-1B. Frequency Distribution of Concentrations in Air (Fuchu Area・Co-PCB)

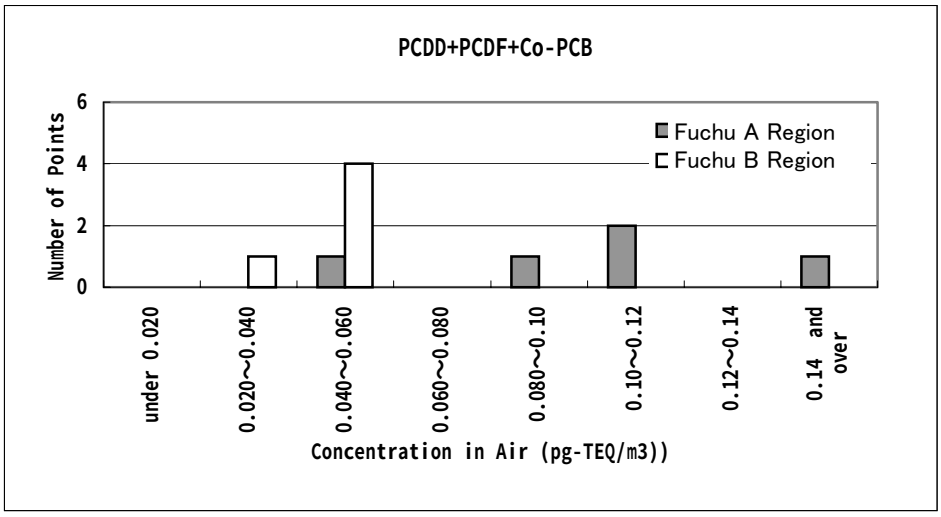

Figure 3-3-1C. Frequency Distribution of Concentrations in Air (Fuchu Area・PCDD+PCDF+Co-PCB)

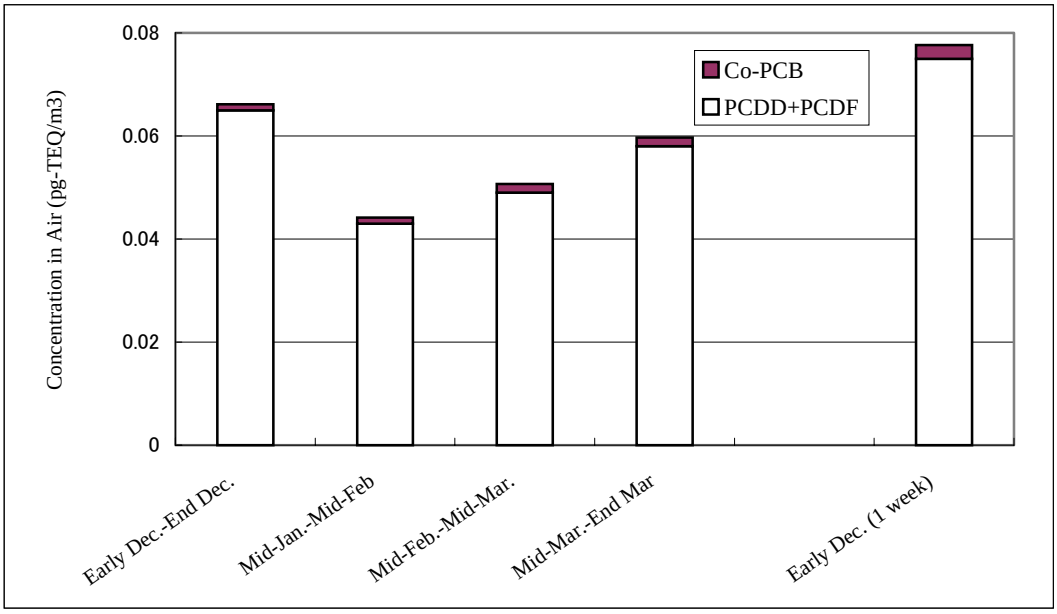

Figure 3-2-1. Long-Term Air Monitoring Location Measurement Results (Nose A-2 Area)

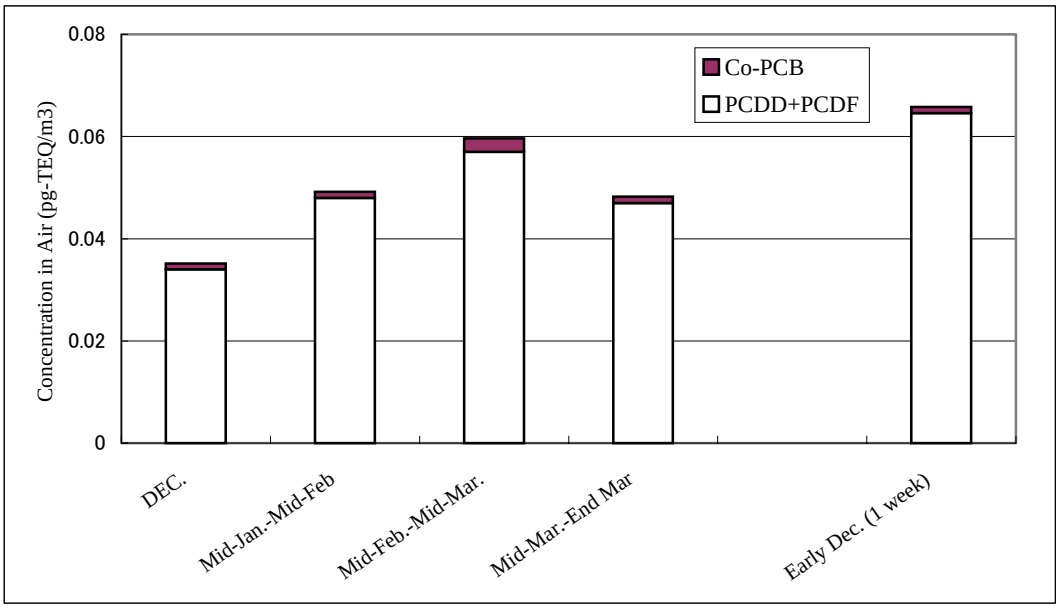

Figure 3-2-2. Long-Term Air Monitoring Location Measurement Results (Nose B-4 Area)

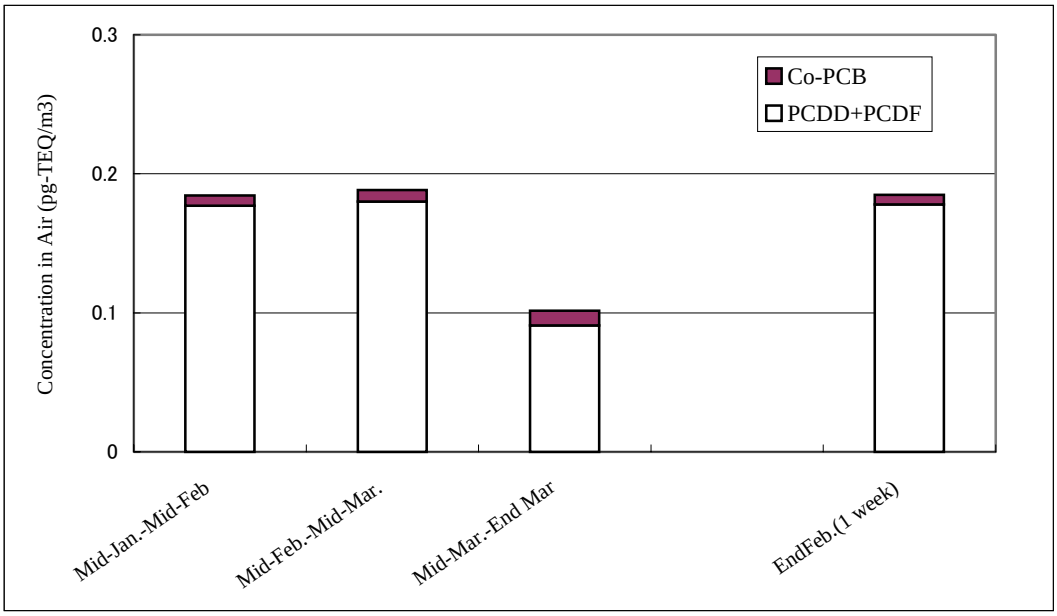

Figure 3-2-3. Long-Term Air Monitoring Location Measurement Results (Fuchu A-6 Area)

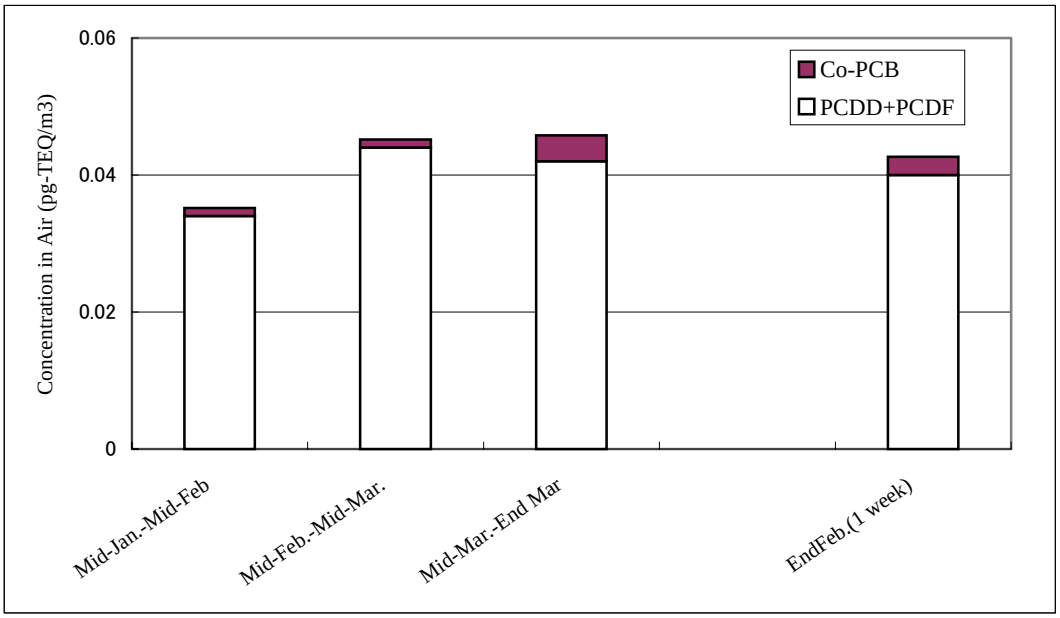

Figure 3-2-3. Long-Term Air Monitoring Location Measurement Results (Fuchu B-22 Area)

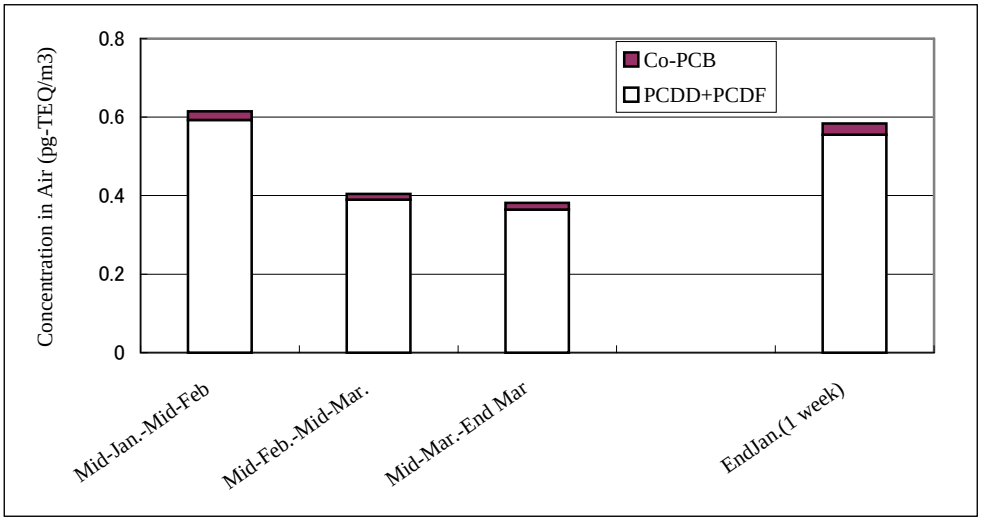

Figure 3-2-5. Long-Term Air Monitoring Location Measurement Results (Saitama A1-15 Area)

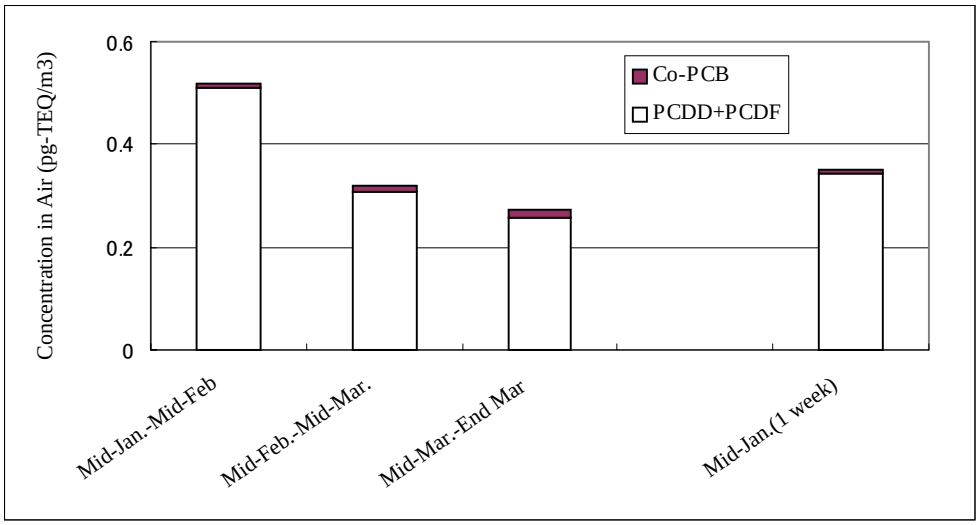

Figure 3-2-6. Long-Term Air Monitoring Location Measurement Results (Saitama A2-25 Area)

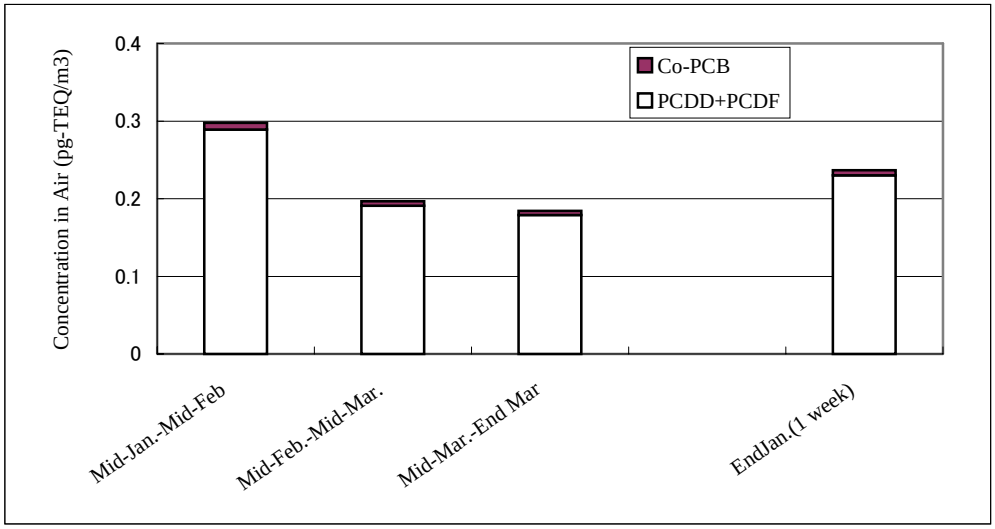

Figure 3-2-7. Long-Term Air Monitoring Location Measurement Results (Saitama A2-27 Area)

Note: Locations A1-15 and A2-27 were for long-term air quality measurements only, so they were compared with the closest locations where one-week measurements were carried out.

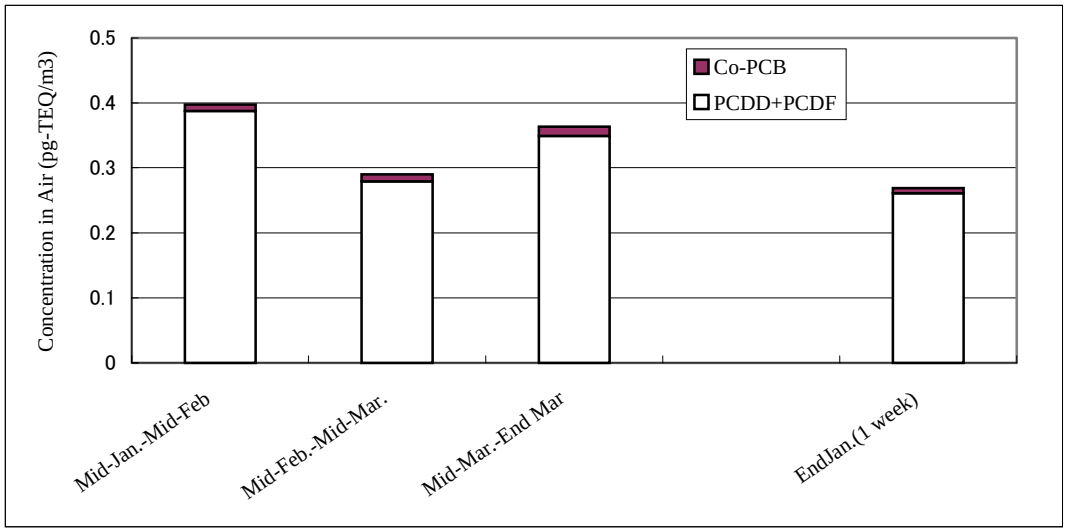

Figure 3-2-8. Long-Term Air Monitoring Location Measurement Results (Saitama A2-28 Area)

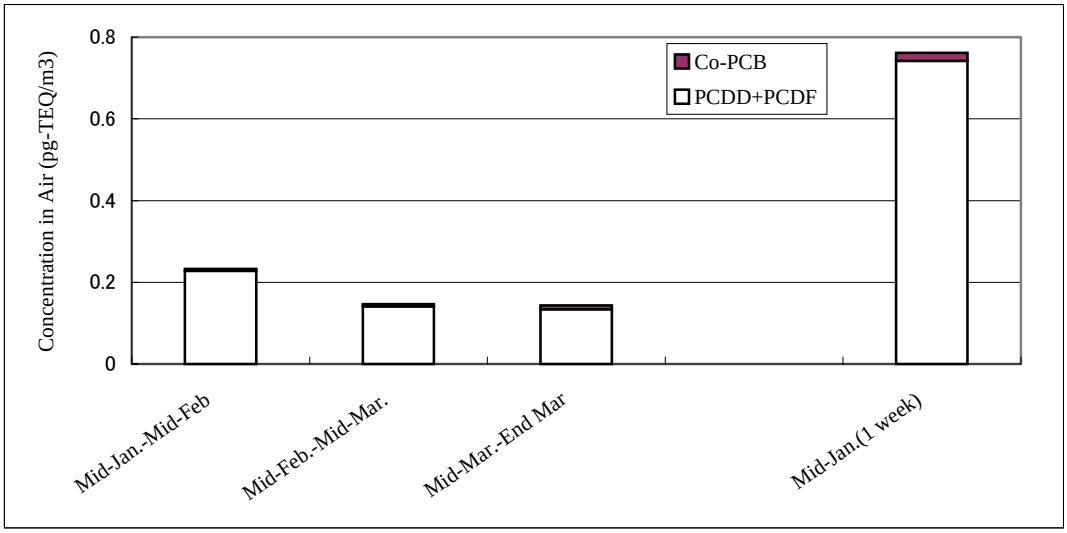

Figure 3-2-9. Long-Term Air Monitoring Location Measurement Results (Saitama B-15 Area)

Note: Locations A2-28 and B-15 were for long-term air quality measurements only, so they were compared with the closest locations where one-week measurements were carried out.

(2) The Indoor Air Survey

For the indoor air survey, collection devices were placed in the residences of survey subjects for a one-week period. In addition to collecting indoor air samples, the survey monitored the time spent inside and outside the room, the amount of time spent ventilating the room where the collection device was placed, and the number of cigarettes smoked.

The results of the indoor air survey aggregated by region are shown in Table 3-2.

Table 3-2. Concentrations of PCDD+PCDF+Co-PCB in Indoor Air

	Osaka Prefecture Nose Town Regions		Saitama Prefecture Regions			Hiroshima Prefecture Fuchu City Regions	
	A region (n=7)	B region (n=7)	A1 region (n=8)	A2 region (n=6)	B region (n=5)	A region (n=5)	B region (n=5)
PCDD+PCDF							
Mean	0.086	0.64	0.21	0.16	0.36	0.066	0.027
Standard deviation	0.056	1.6	0.15	0.077	0.067	0.037	0.0090
Median	0.064	0.061	0.16	0.15	0.34	0.078	0.025
Range	0.038 – 0.20	0.021 – 4.2	0.082 – 0.51	0.071 – 0.29	0.28 – 0.45	0.023 – 0.11	0.021 – 0.043
Co-PCB							
Mean	0.0061	0.0013	0.0050	0.0038	0.0059	0.0052	0.0016
Standard deviation	0.0054	0.00089	0.0046	0.0022	0.0020	0.0020	0.0012
Median	0.0042	0.00076	0.0039	0.0040	0.0057	0.0060	0.00079
Range	0.0016 – 0.017	0.00068 – 0.0027	0.00084 – 0.014	0.00074 – 0.0068	0.0035 – 0.0081	0.0022 – 0.0071	0.00077 – 0.0034
PCDD+PCDF +Co-PCB							
Mean	0.092	0.64	0.21	0.16	0.37	0.072	0.029
Standard deviation	0.062	1.6	0.16	0.079	0.067	0.039	0.0086
Median	0.068	0.062	0.16	0.15	0.35	0.085	0.026
Range	0.040 – 0.22	0.022– 4.2	0.083 – 0.53	0.073 – 0.30	0.29 – 0.46	0.025 – 0.12	0.022 – 0.044

（Unit：pg-TEQ/m^3）

Notes:

3 When the actual measurement of an isomer was below the lower limit of determination (ND), its actual concentration was calculated by applying one-half the value of the detection limit (according to the survey manual, only the calculated results of ND×1/2 were shown).

4 The lower limits of determination were as follows:

T_4CDD, T_4CDF: 0.01 (pg/ m^3), P_5CDD, P_5CDF: 0.01 (pg/ m^3)
H_6CDD, H_6CDF: 0.01 (pg/ m^3), H_7CDD, H_7CDF: 0.01 (pg/ m^3)
O_8CDD, O_8CDF: 0.01 (pg/ m^3), Co-planar PCB: 0.01 (pg/ m^3)

Analysis and Evaluation

In addition to comparing the indoor air concentrations of PCDD+PCDF+Co-PCB between the regions, the survey also studied the correlation with various factors (concentrations of PCDD+PCDF+Co-PCB in the air, time spent ventilating rooms, and number of cigarettes smoked).

(a) Comparison of Regions

The comparison of regions did not reveal any significant differences.

(b) Correlation between Concentration of Dioxins in Indoor Air and Concentration of Dioxins in ambient Air

The correlation between the concentration of PCDD+PCDF+Co-PCB in air at the survey location closest to residences of survey subjects and the concentration of PCDD+PCDF+Co-PCB in indoor air was analyzed.

The survey found that:

In the vicinity of the locations where the concentration of PCDD+PCDF in ambient air and the concentration of Co-PCB in ambient air were higher, the concentration of PCDD+PCDF in indoor air and concentration of Co-PCB in indoor air at the residences of survey subjects were also higher (see Figure 3-4).

(c) Correlation between Concentration of Dioxins in Indoor Air and Various Factors

No clear correlation was observed between the concentration of PCDD+PCDF in indoor air, the concentration of Co-PCB in indoor air, and the concentration of PCDD+PCDF+Co-PCB in indoor air, on the one hand, and the time spent ventilating the room (*1) and the number of cigarettes smoked (*2), on the other (see Figures 3-5 and 3-6).

*[1] Ventilation conditions: Low ventilation: 0-20 hours/week; medium ventilation: 21-50 hours/week; high ventilation: 51 or more hours/week

*[2] Number of cigarettes smoked: Smoked none: 0/day; smoked few: 1-9/day; smoked many: 10 or more/day.

A concentration in indoor air of 4.2 pg-TEQ/m^3 was observed, and it will be necessary to conduct further surveys to determine the reasons for this.

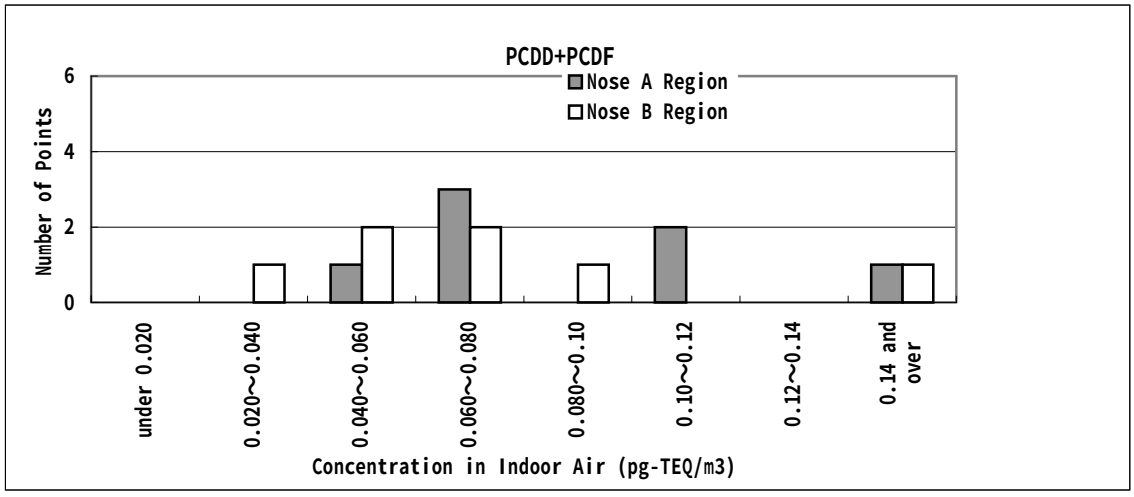

Figure 3-3-1A. Frequency Distribution of Concentrations in Indoor Air (Nose Area･PCDD+PCDF)

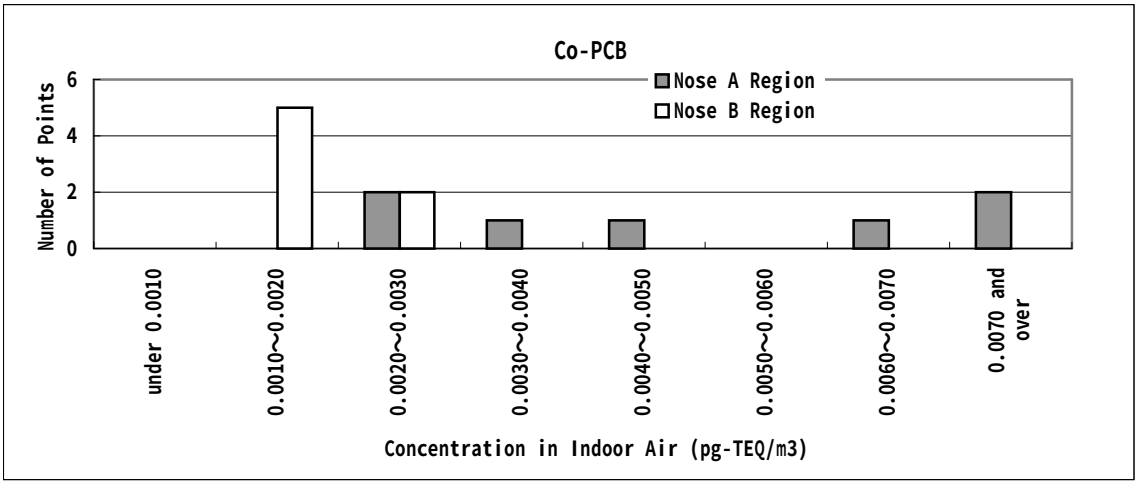

Figure 3-3-1B. Frequency Distribution of Concentrations in Indoor Air (Nose Area･Co-PCB)

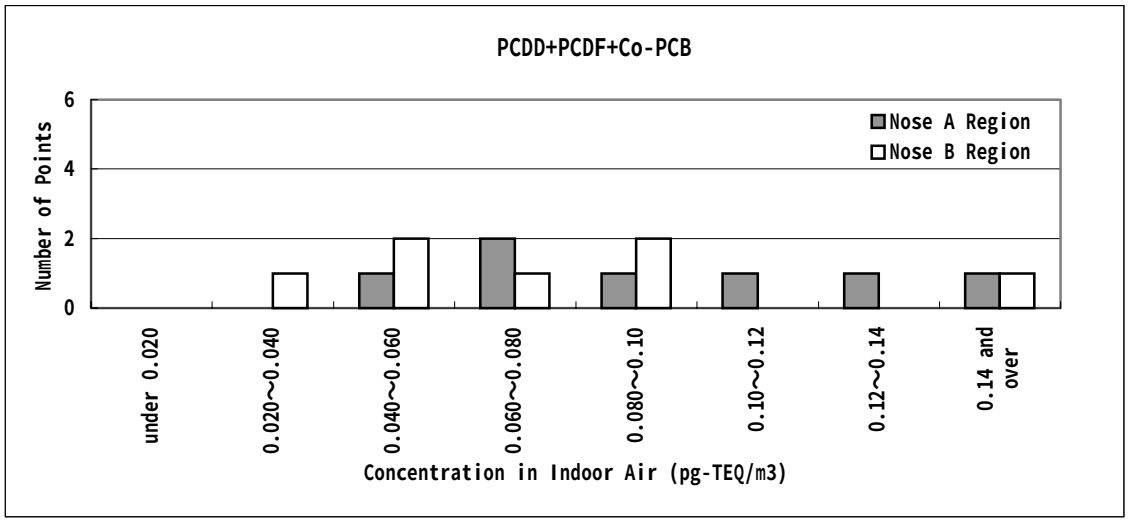

Figure 3-3-1C. Frequency Distribution of Concentrations in Indoor Air (Nose Area･PCDD+PCDF+Co-PCB)

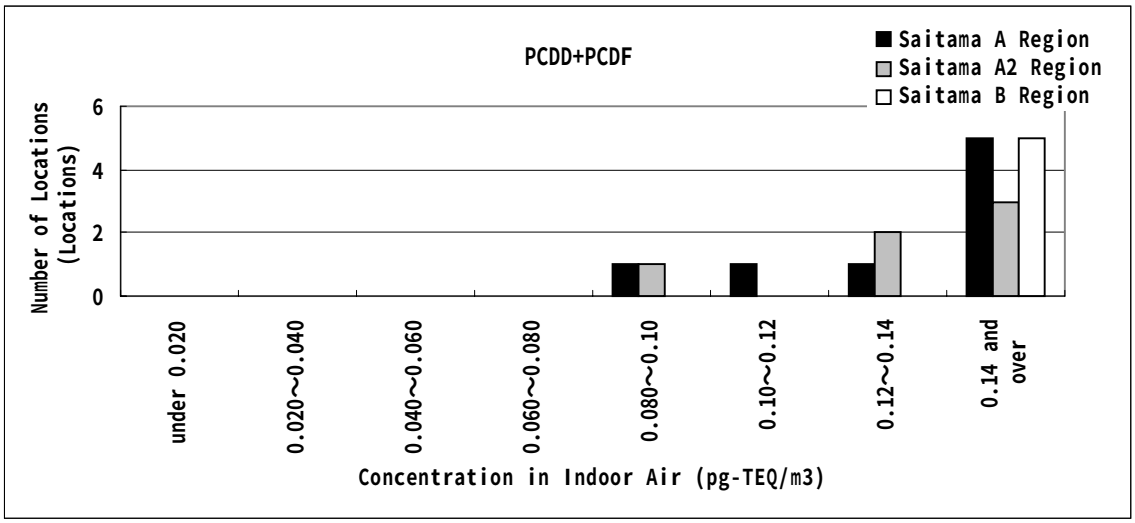

Figure 3-3-2A. Frequency Distribution of Concentrations in Indoor Air (Saitama Area・PCDD+PCDF)

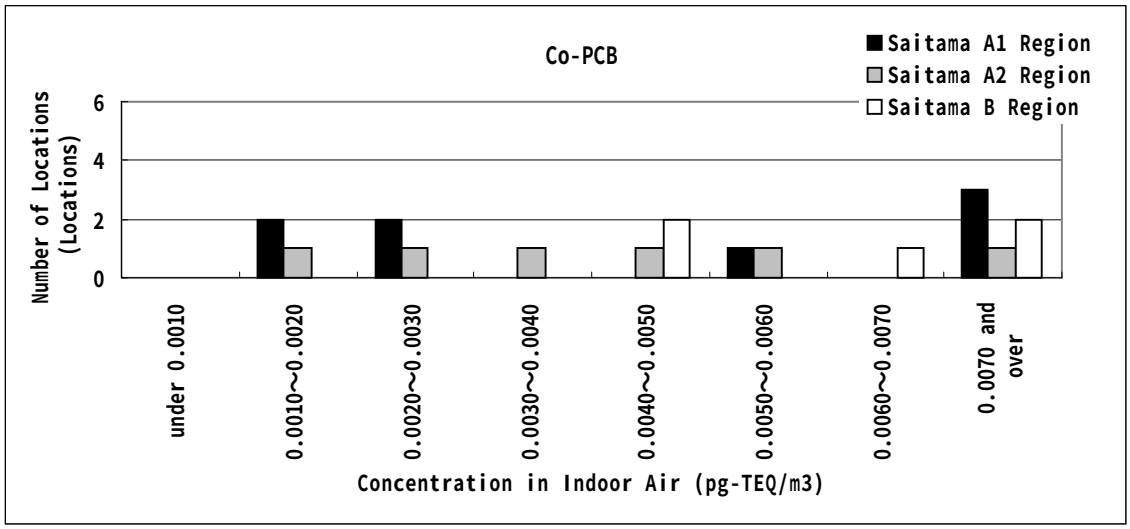

Figure 3-3-2B. Frequency Distribution of Concentrations in Indoor Air (Saitama Area・Co-PCB)

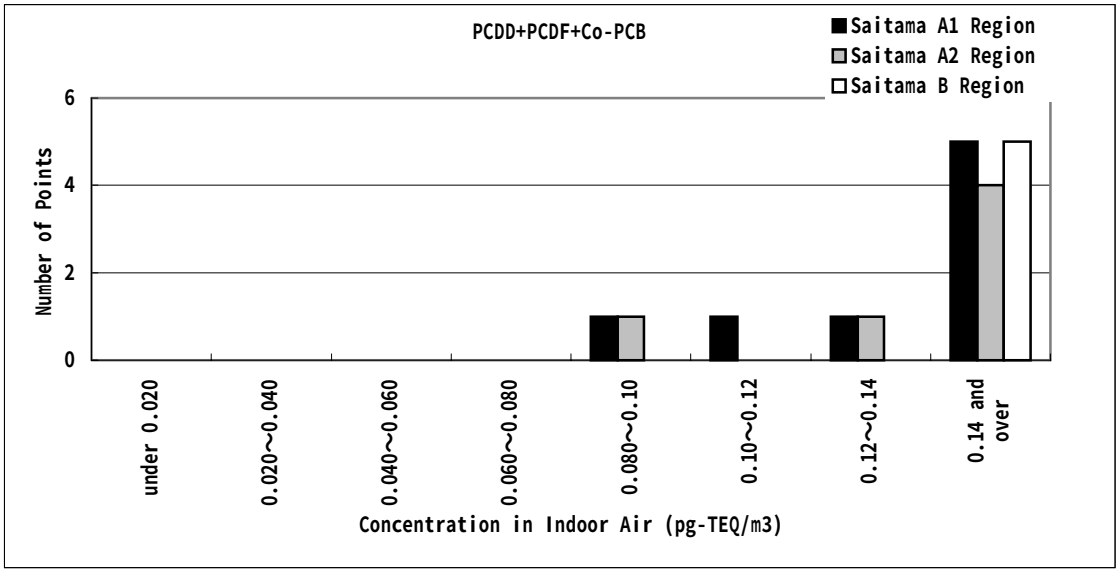

Figure 3-3-2C. Frequency Distribution of Concentrations in Indoor Air (Saitama Area・PCDD+PCDF+Co-PCB)

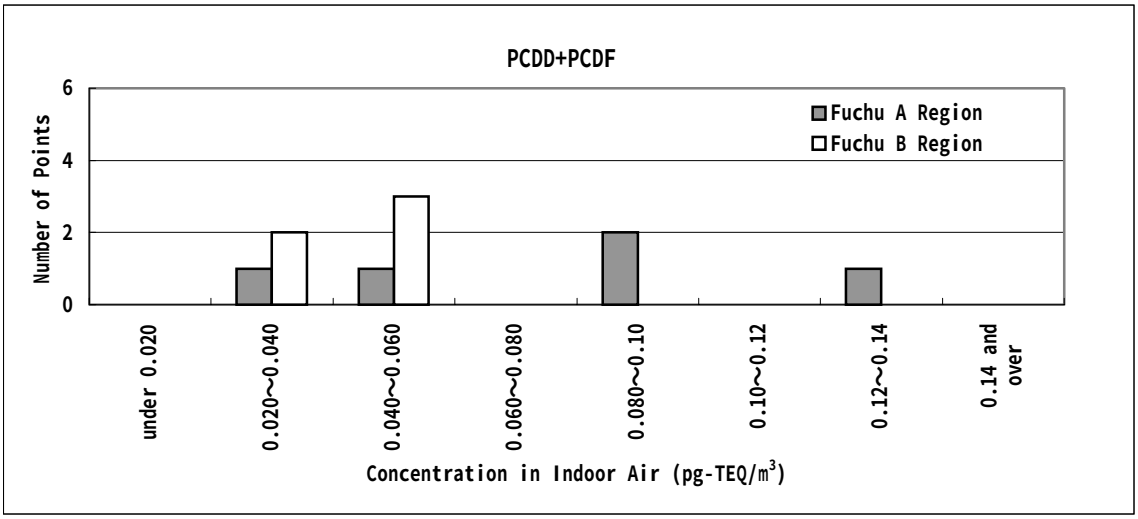

Figure 3-3-3A. Frequency Distribution of Concentrations in Indoor Air (Fuchu Area・PCDD+PCDF)

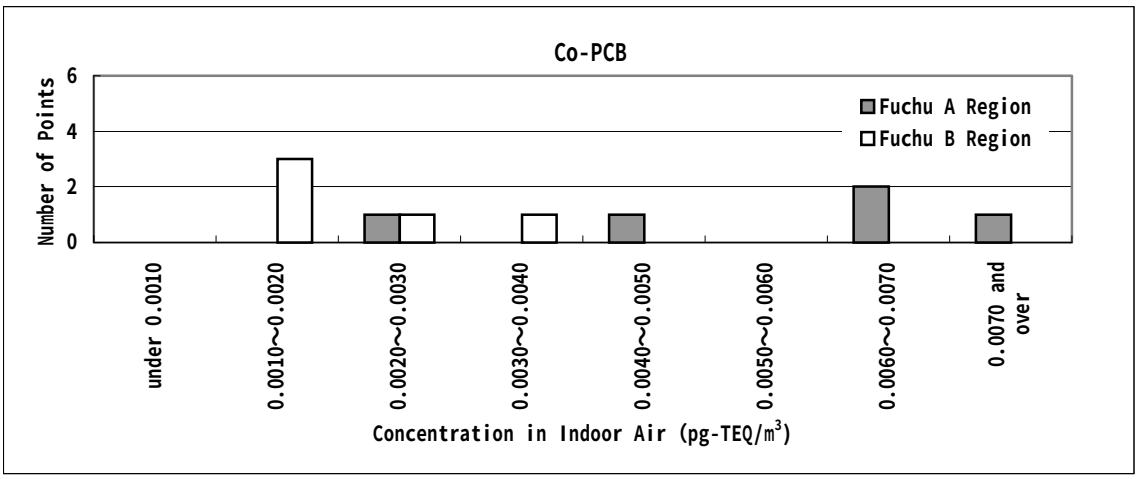

Figure 3-3-3B. Frequency Distribution of Concentrations in Indoor Air (Fuchu Area・Co-PCB)

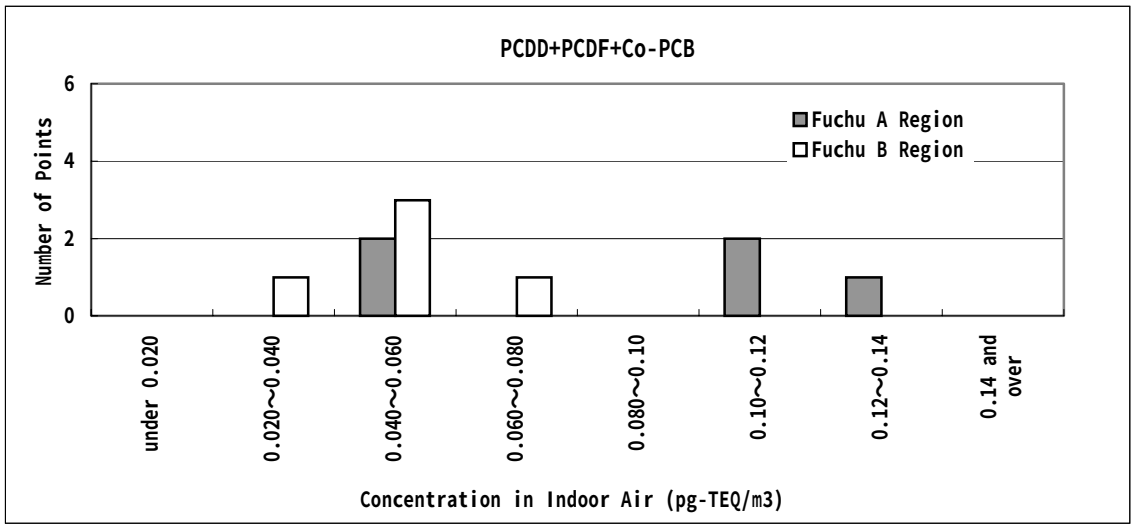

Figure 3-3-3C. Frequency Distribution of Concentrations in Indoor Air (Fuchu Area・PCDD+PCDF+Co-PCB)

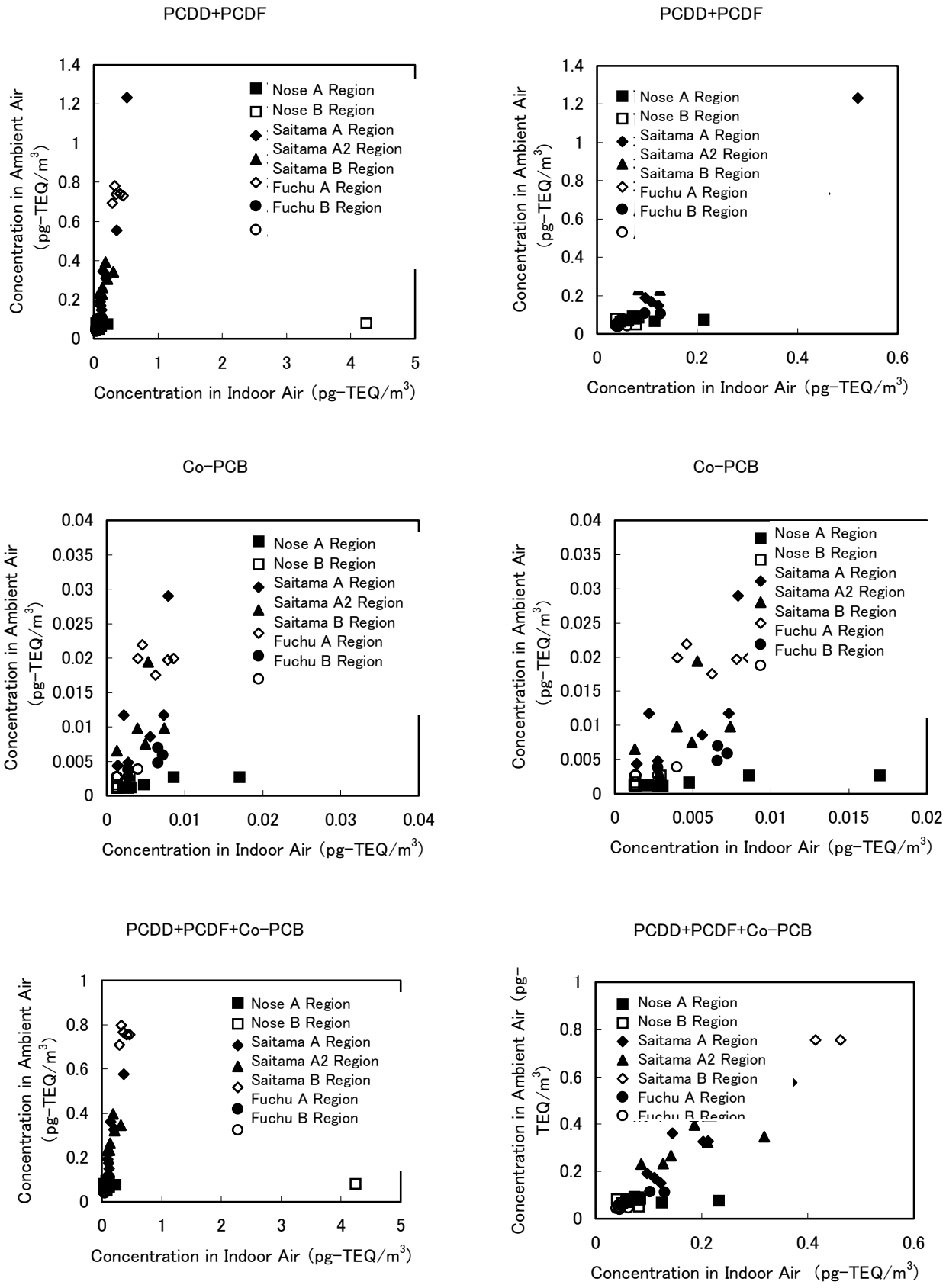

Figure 3-4. Relationship between Concentration in Indoor Air and Concentration in Ambient Air (Graphs on Right are Enlargements of Graphs on Left)

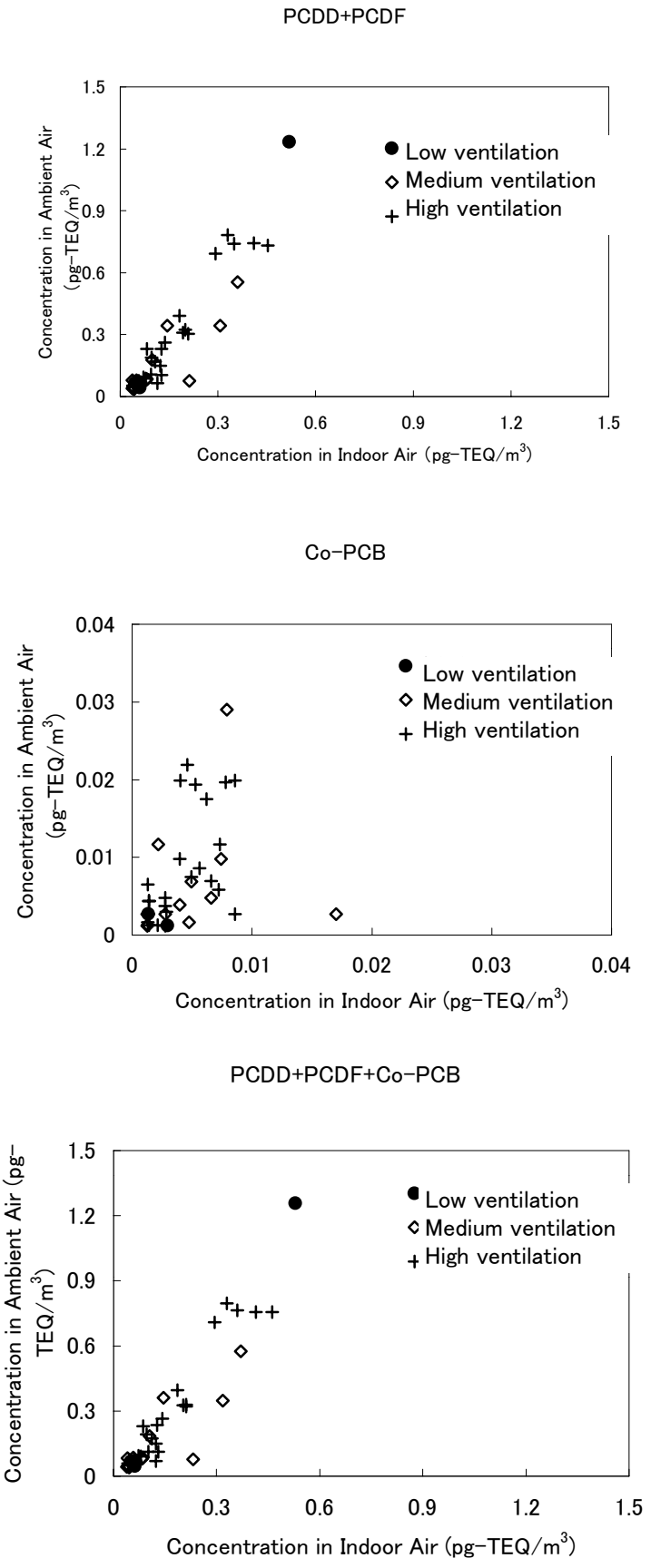

Figure 3-5. Relationship between Concentration in Ambient Air and Concentration in Indoor Air by Ventilation Conditions

Note: Ventilation time: Low: 0-20 hours/week; medium: 21-50 hours/week; high: 51 or more hours/week

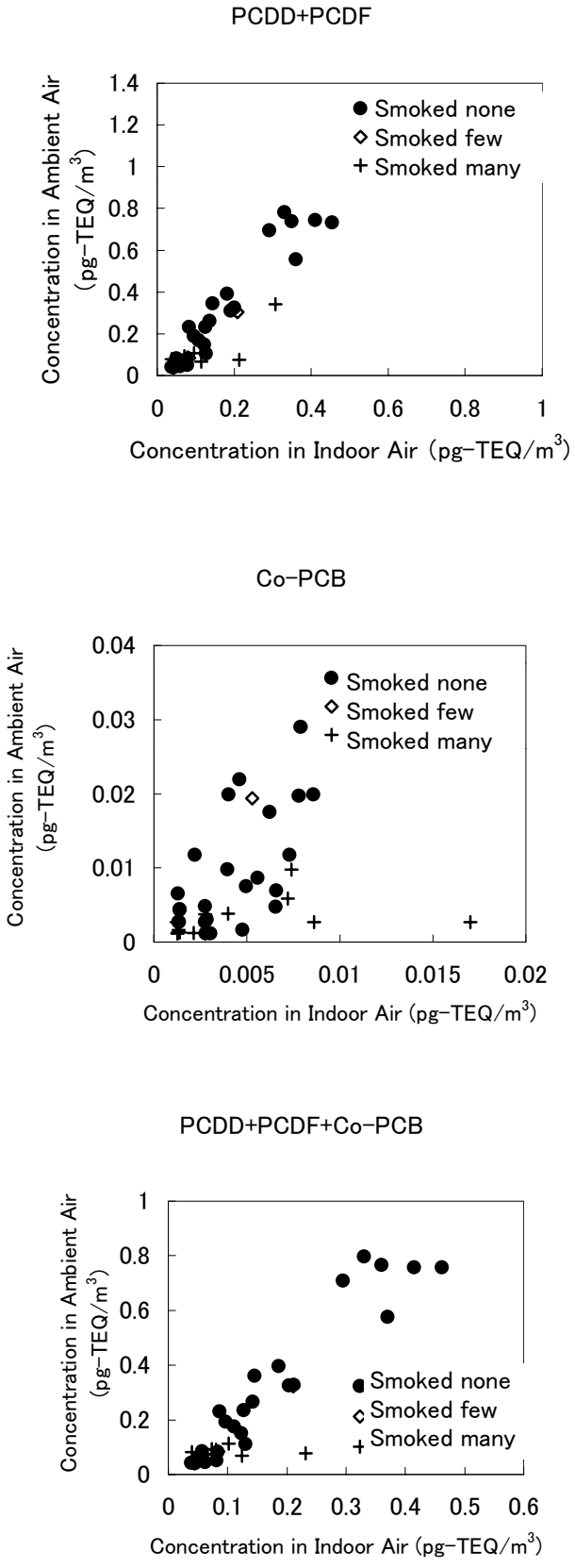

Figure 3-6. Relationship between Concentration in Ambient Air and Concentration in Indoor Air by Smoking Conditions

Note: Number of cigarettes smoked: None: 0/day; few: 1-9/day; many: 10 or more/day

(3) Soil Survey

The measurement locations for the soil survey were selected with reference to residences of survey subjects and land use conditions.

The results of the soil survey aggregated by area and region are shown in Table 3-3 (cf. Table 3-4).

Table 3-3. Concentrations of PCDD+PCDF+Co-PCB in Soil (Unit: pg-TEQ/g)

	Osaka Prefecture Nose Town Regions		Saitama Prefecture Regions			Hiroshima Prefecture Fuchu City Regions	
	A region (n=8)	B region (n=8)	A1 region (n=8)	A2 region (n=5)	B region (n=6)	A region (n=5)	B region (n=5)
PCDD+PCDF							
Mean	12	19	38	41	8.1	2.5	0.094
Standard deviation	15	37	28	44	9.0	3.3	0.028
Median	7.9	4.6	31	24	6.9	1.5	0.099
Range	0.35 – 44	0.48 – 110	5.2 – 79	11 – 130	0.90 – 23	0.14 – 8.2	0.064 – 0.13
Co-PCB							
Mean	0.91	0.53	3.5	4.1	0.46	0.15	0.0083
Standard deviation	1.4	0.64	2.7	2.3	0.10	0.23	0.014
Median	0.76	0.40	3.0	4.0	0.48	0.0058	0.0033
Range	0.00020 – 4.1	0.0055 – 2.0	0.41 – 9.7	1.2 – 6.8	0.31 – 0.57	0.0029 – 0.52	0.0070 – 0.033
PCDD+PCDF +Co-PCB							
Mean	13	20	42	44	8.5	2.7	0.10
Standard deviation	16	37	30	43	8.8	3.5	0.038
Median	8.1	5.0	34	29	7.4	1.5	0.10
Range	0.35 – 48	0.48 – 110	5.6 – 88	12 – 130	1.4 – 23	0.14 – 8.7	0.065 – 0.16

Notes:

1 Isomers that were detected at levels below the lower limit of determination (ND) were assigned a zero value in calculation.

2 The lower limits of determination were as follows:

T_4CDD, T_4CDF: 1 (pg/g-dry), P_5CDD, P_5CDF: 1 (pg/g-dry)
H_6CDD, H_6CDF: 2 (pg/g-dry), H_7CDD, H_7CDF: 2 (pg/g-dry)
O_8CDD, O_8CDF: 5 (pg/g-dry), Co-planar PCB: 5 (pg/g-dry)

Table 3-4. Concentrations of PCDD+PCDF+Co-PCB in Soil (for Reference)

(Unit: pg-TEQ/g)

	Osaka Prefecture Nose Town Regions		Saitama Prefecture Regions			Hiroshima Prefecture Fuchu City Regions	
	A region (n=8)	B region (n=8)	A1 region (n=8)	A2 region (n=5)	B region (n=6)	A region (n=5)	B region (n=5)
PCDD+PCDF							
Mean	12	21	38	42	9.1	4.0	2.1
Standard deviation	14	37	28	44	8.3	2.8	0.045
Median	7.9	5.7	31	25	7.6	3.0	2.1
Range	2.3 – 44	2.4 – 110	5.9 – 79	12 – 130	2.6 – 23	2.2 – 8.8	2.1 – 2.2
Co-PCB							
Mean	0.94	0.56	3.5	4.1	0.47	0.22	0.12
Standard deviation	1.3	0.61	2.7	2.3	0.098	0.18	0.013
Median	0.60	0.41	3.0	4.0	0.49	0.12	0.11
Range	0.11 – 4.1	0.12 – 2.0	0.42 – 9.7	1.2 – 6.8	0.32 – 0.57	0.11 – 0.53	0.11 – 0.14
PCDD+PCDF +Co-PCB							
Mean	13	21	42	45	9.6	4.2	2.2
Standard deviation	15	37	30	43	8.5	2.9	0.055
Median	8.5	6.1	34	29	8.1	3.1	2.2
Range	2.4 – 49	2.5 – 110	6.3 – 88	13 – 130	3.1 – 24	2.3 – 9.3	2.2 – 2.3

Note:

When the actual measurement of an isomer was below the lower limit of determination (ND), its actual concentration was calculated by applying one-half the value of the detection limit.

Analysis and Evaluation

(a) Comparison of Regions

In the Nose Town area of Osaka Prefecture, no distinct difference was observed between regions in PCDD+PCDF concentrations in the soil and Co-PCB concentrations in the soil. In the Saitama Prefecture areas, concentrations in A1 regions and A2 regions were higher than concentrations in B regions. In Hiroshima Prefecture Fuchu City areas, levels in A regions were higher than those in B regions.

Figure 3-7 shows the frequency distribution of concentrations in soil.

(b) Correlation between Concentration of Dioxins in Soil and Distance from their Origin

In the Nose Town area of Osaka Prefecture, the correlation between distance from the waste incineration facility (Toyono-gun Beautification Center) and concentration in the soil is shown in Figure 3-8. No distinct relationship was observed between distance from the location of origin and concentration in the soil.

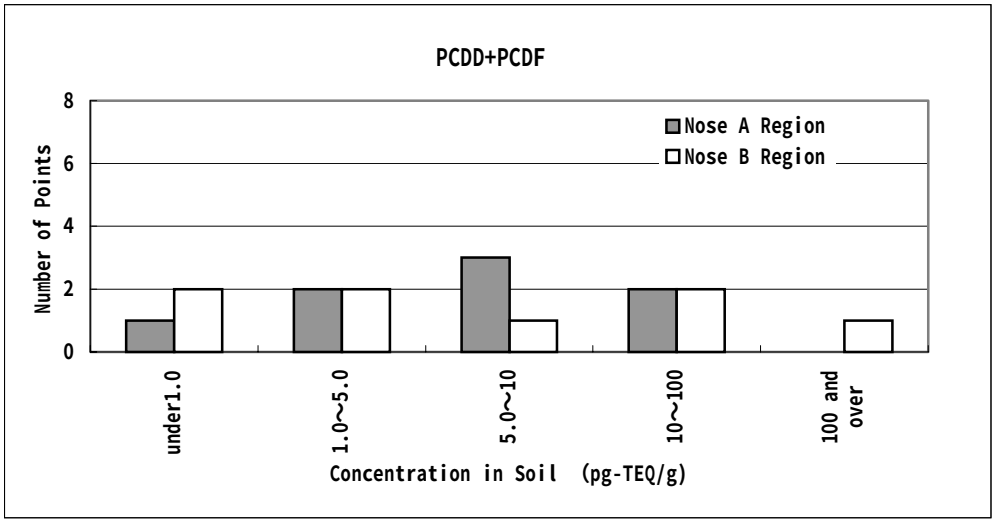

Figure 3-7-1A. Frequency Distribution of Concentrations in Soil (Nose Area・PCDD+PCDF)

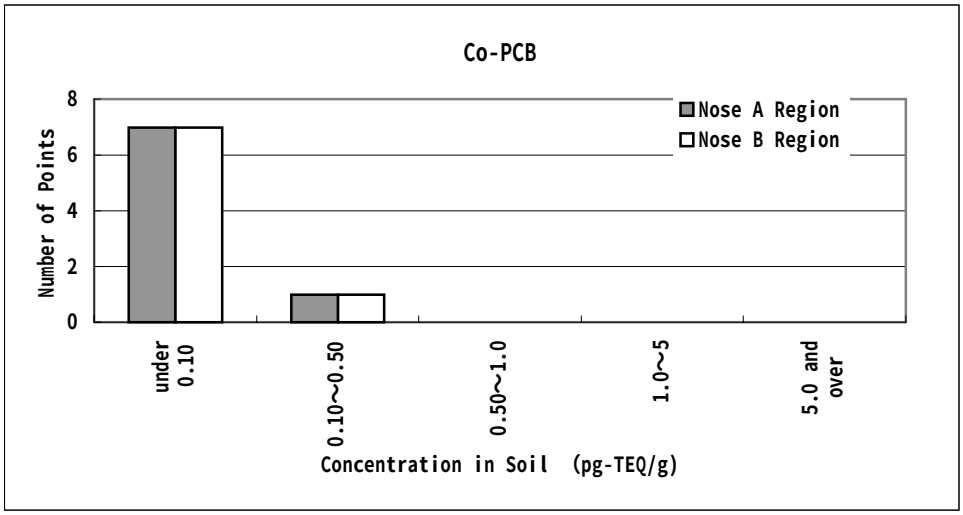

Figure 3-7-2B. Frequency Distribution of Concentrations in Soil (Saitama Area・Co-PCB)

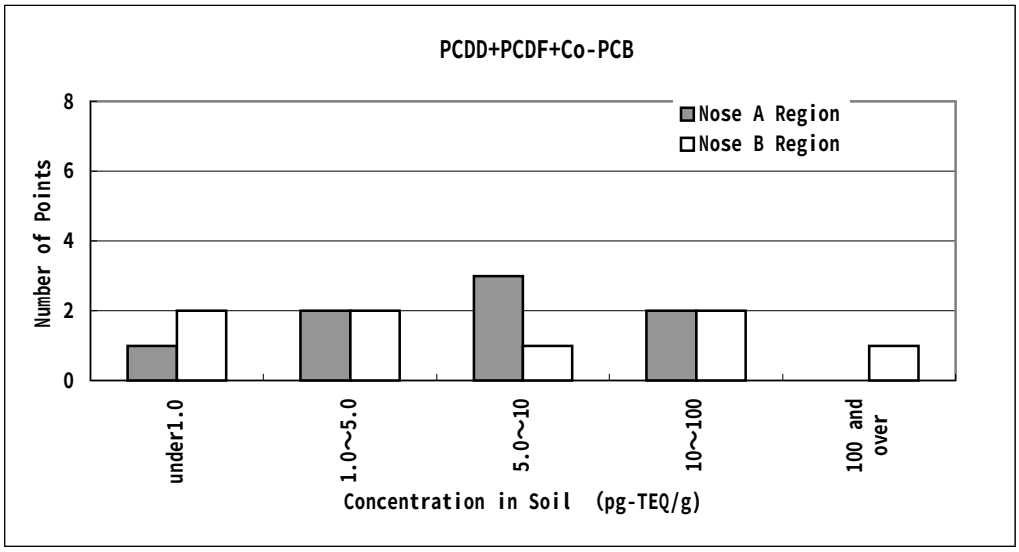

Figure 3-7-1C. Frequency Distribution of Concentrations in Soil (Nose Area・PCDD+PCDF+Co-PCB)

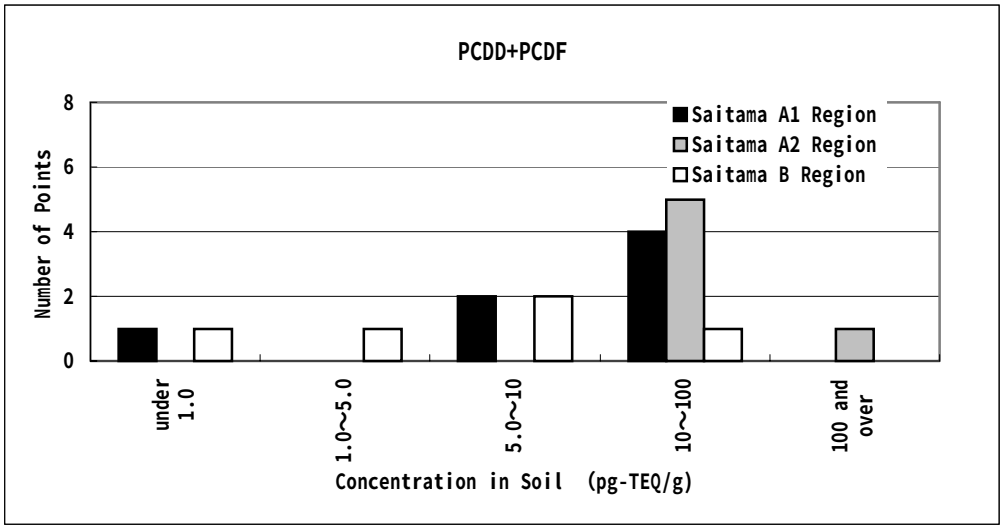

Figure 3-7-2A. Frequency Distribution of Concentrations in Soil (Saitama Area・PCDD+PCDF)

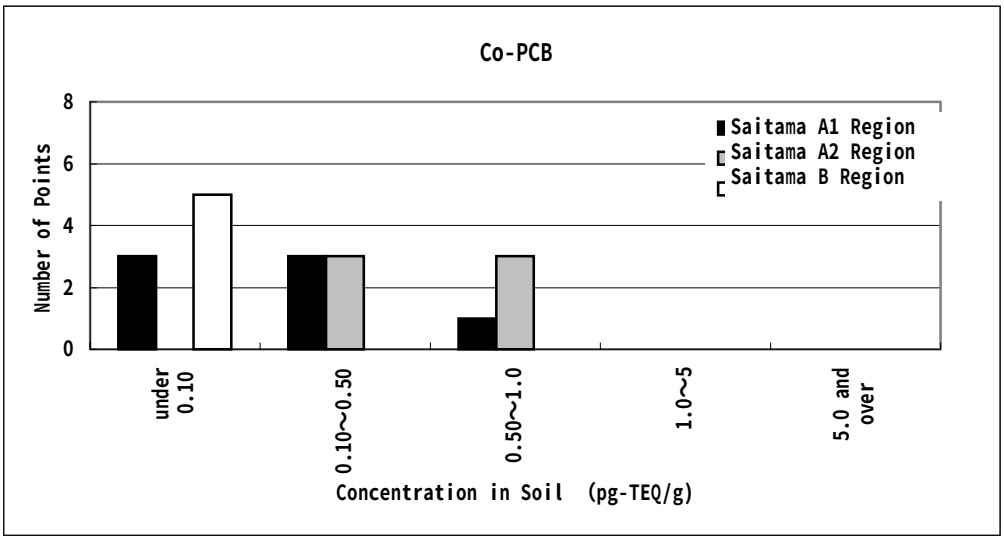

Figure 3-7-2B. Frequency Distribution of Concentrations in Soil (Saitama Area・Co-PCB)

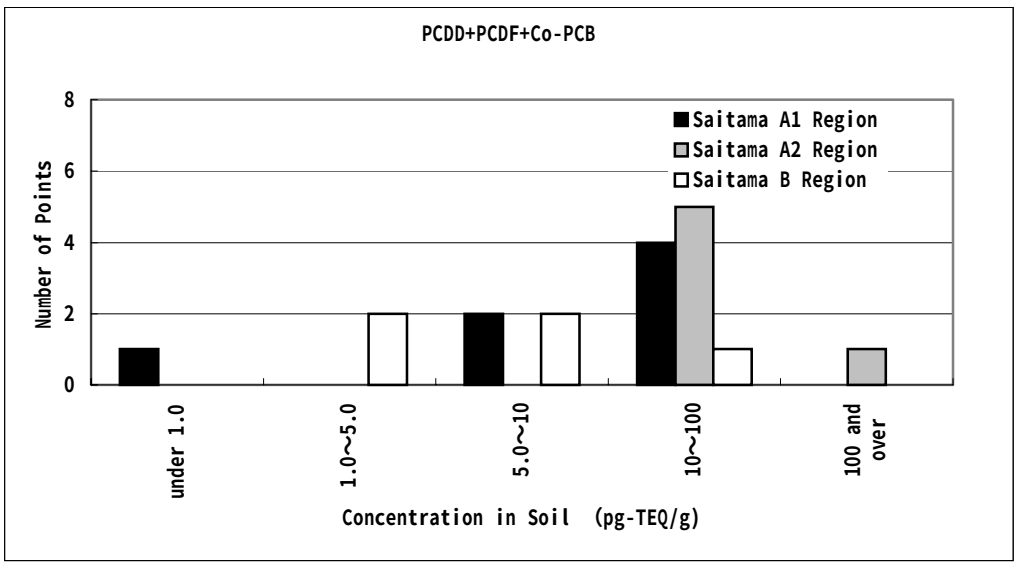

Figure 3-7-2C. Frequency Distribution of Concentrations in Soil (Saitama Area・PCDD+PCDF+Co-PCB)

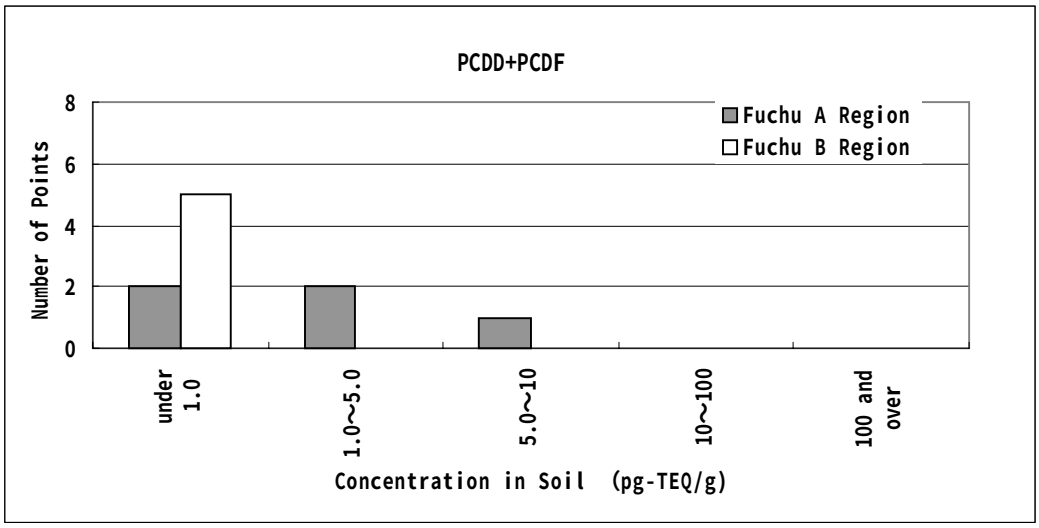

Figure 3-7-3A. Frequency Distribution of Concentrations in Soil (Fuchu Area・PCDD+PCDF)

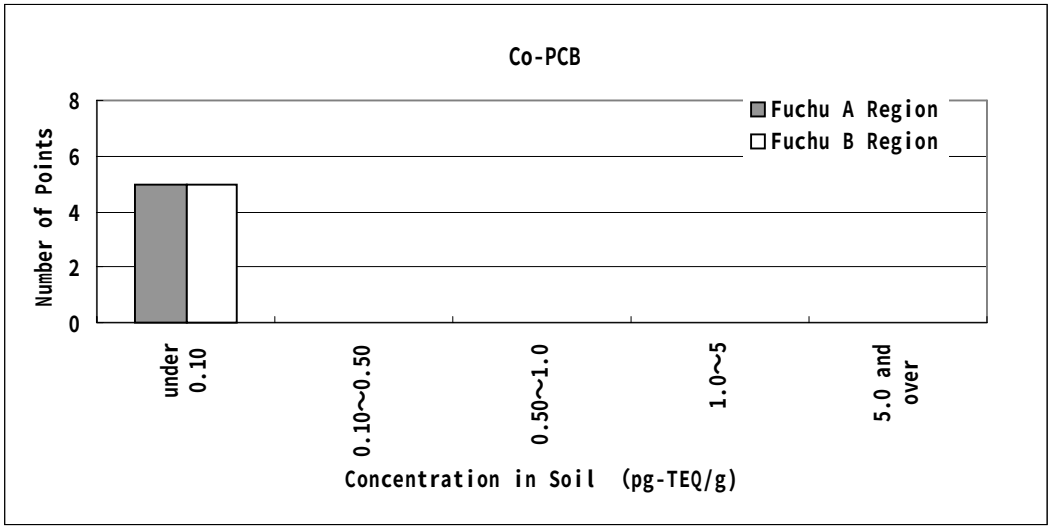

Figure 3-7-3B. Frequency Distribution of Concentrations in Soil (Fuchu Area・Co-PCB)

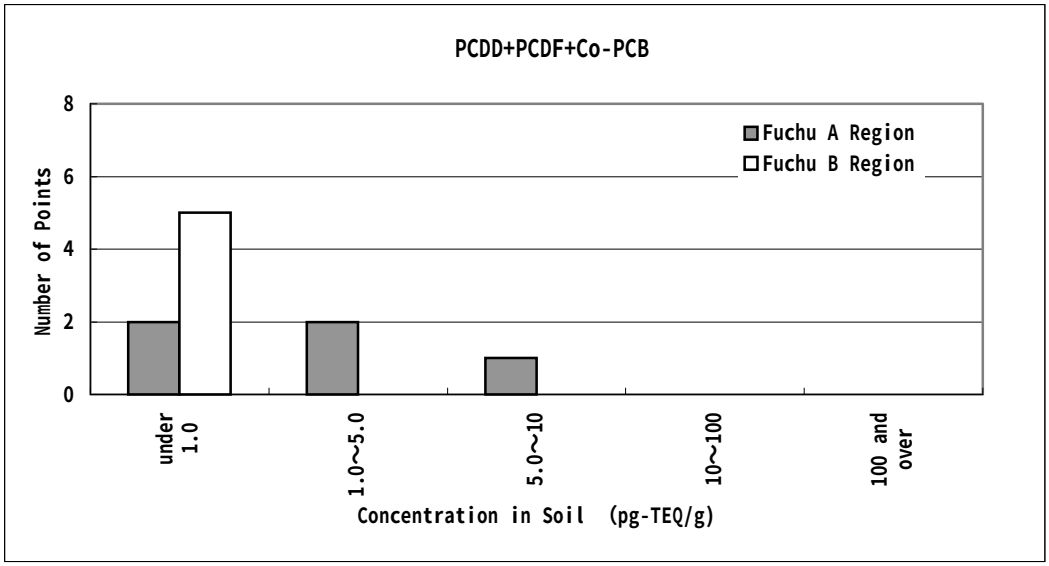

Figure 3-7-3C Frequency Distribution of Concentrations in Soil (Fuchu Area・PCDD+PCDF+Co-PCB)

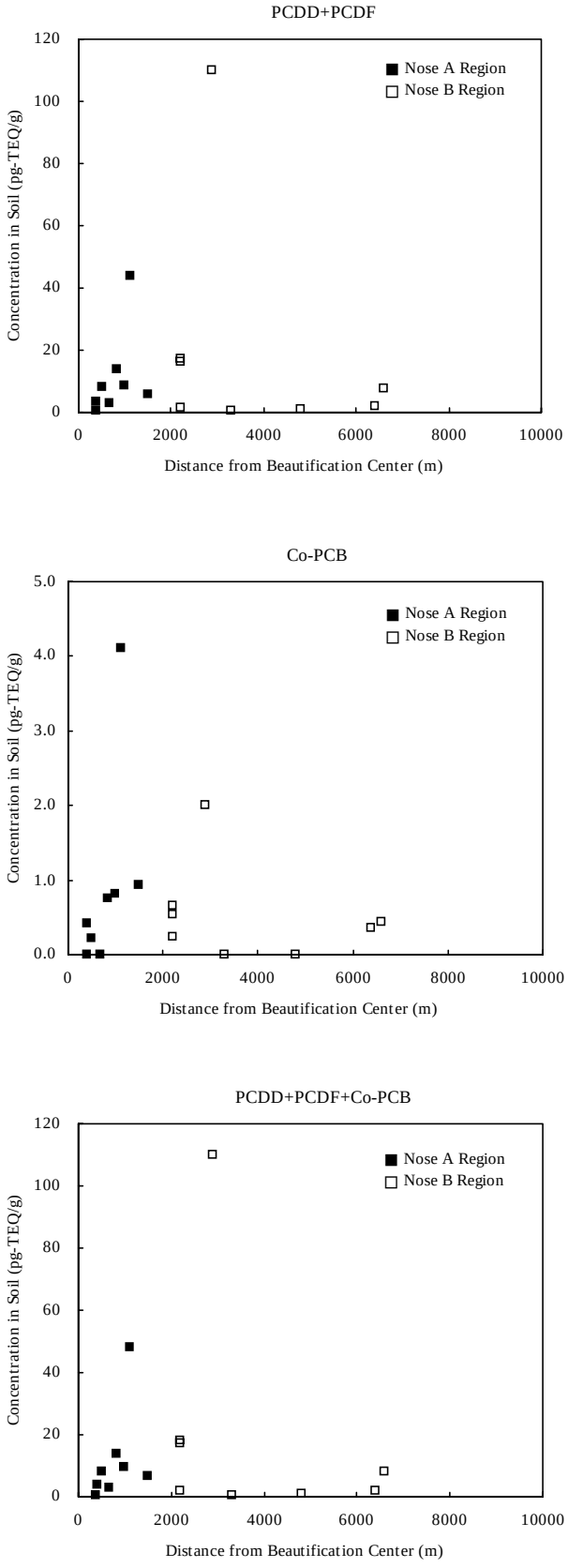

Figure 3-8. Relationship between Distance from Toyono-gun Beautification Center and Concentration in Soil