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Site-specific Bioaccumulation of PCDD/PCDFs in Mothers and their Infants Living in Vicinity of Bien Hoa Airbase, Southern Vietnam

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Introduction of Bien Hoa Airbase in Viet Nam



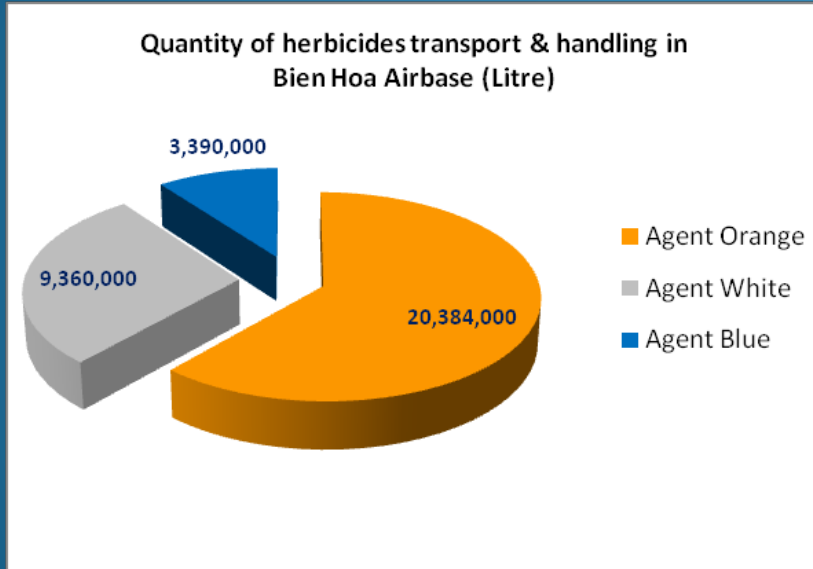
Bien Hoa Airbase



- Bien Hoa City belongs to Dong Nai provinces, 35 km north west of Ho Chi Minh City
- Population: 548,860
- Bien Hoa airbase was US military airbase during the VN war and used intensively for military activities such as Agent Orange spraying

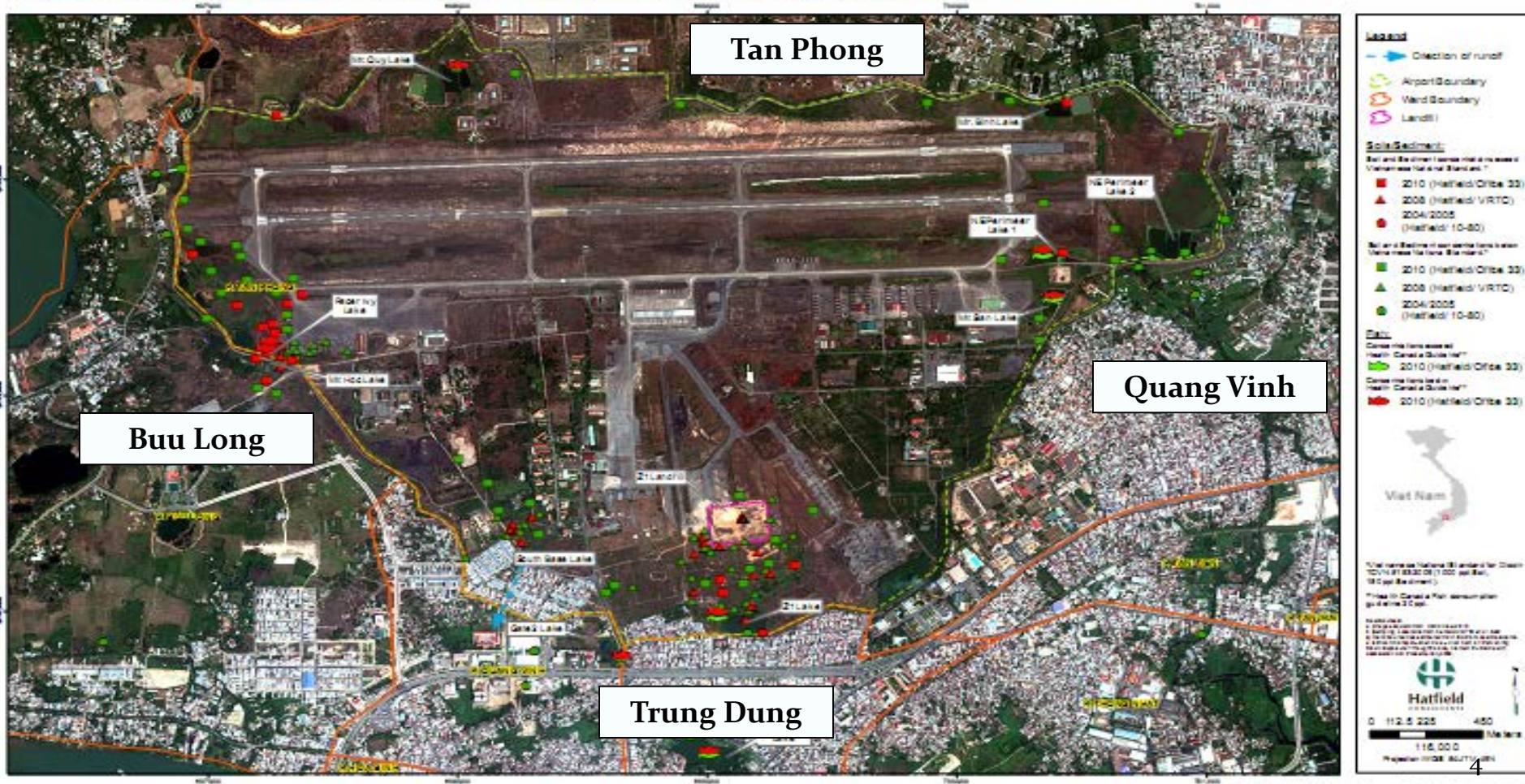
Transport and Handling of Herbicides in Bien Hoa Airbase

- Dec. 1966 – Feb. 1970, more than 33 million liters of herbicides (mostly Agent Orange) were transported and handled in Bien Hoa airbase for the U.S Ranch Hand Operation in VN War
- Apr. 1970 – Mar. 1972, in the Pacer Ivy mission (to revoke herbicides and transported back to the U.S), about 2.3 million liters were collected and re-drummed for necessary shipment
- During such periods, leakages and spillages from the operation caused serious contamination in soil



Contamination of Agent Orange/Dioxin in Bien Hoa Airbase

Figure 1.1 Overview of all dioxin sampling locations in Bien Hoa, Viet Nam by Hatfield/10-80 Division/VRTC/Office 33, 2004 to 2010.



Research Objectives

- Assess levels of dioxin exposure in communities living in different areas near the Bien Hoa Airbase
- Assess the dioxin intake of infants via mother milk
- Suggest intervention options to reduce the human exposure to dioxins

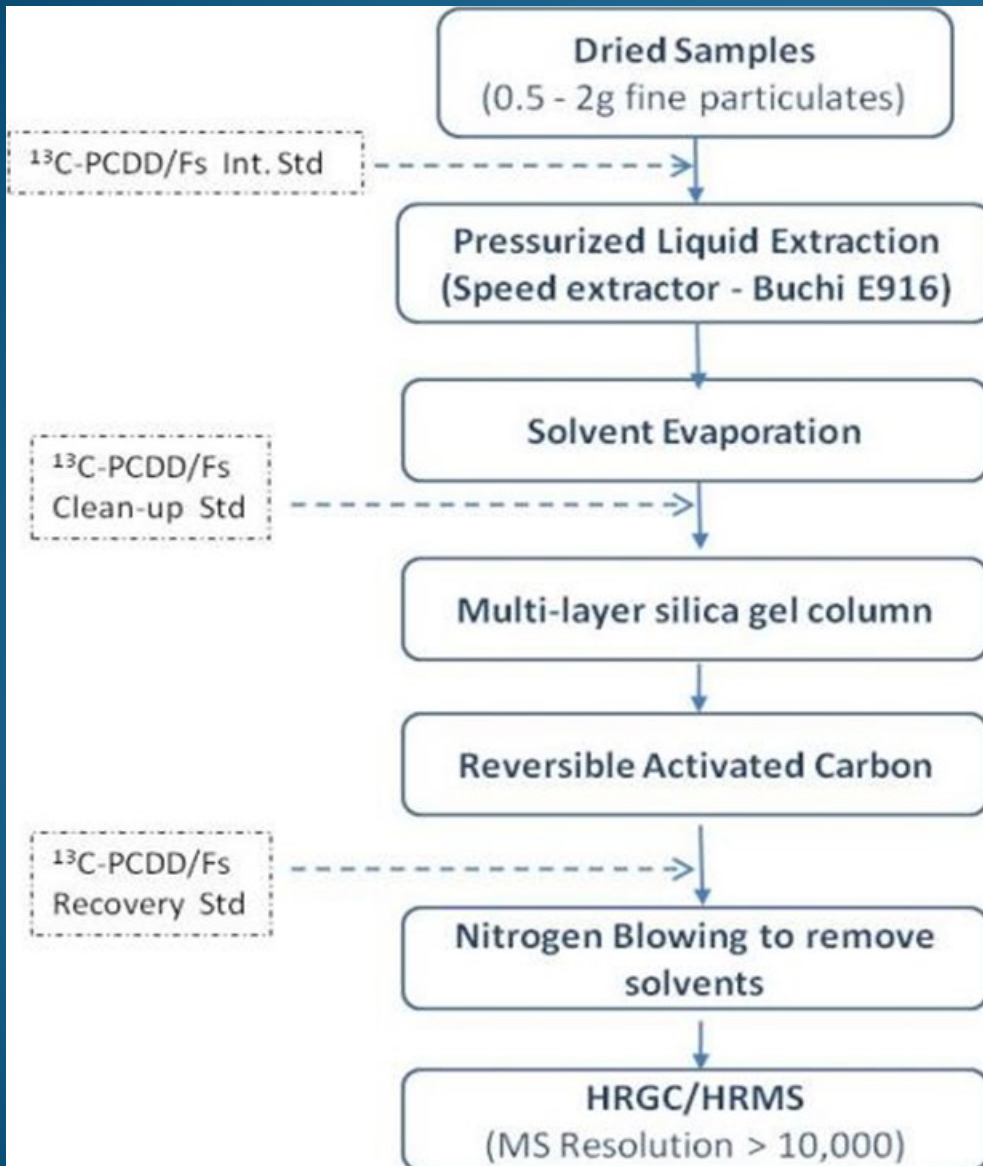


Mother Milk Collection

- 40 samples of mother milks were collected from primiparas living in 4 wards near the Bien Hoa Airbase (Bien Hoa City)
- Primiparas were at least 5 years living in the selected communities

	Value	Mother age (year)	Resident time (year)	Lactation period (week)
Buu Long	Mean	25	17	12
(n=10)	Range	19-31	5-31	4-24
Trung Dung	Mean	24	14	14
(n=7)	Range	19-29	5-28	8-24
Quang Vinh	Mean	25	9	18
(n=10)	Range	15-33	5-33	16-24
Tan Phong	Mean	27	14	14
(n=13)	Range	23-33	5-33	8-20

Analytical Methods

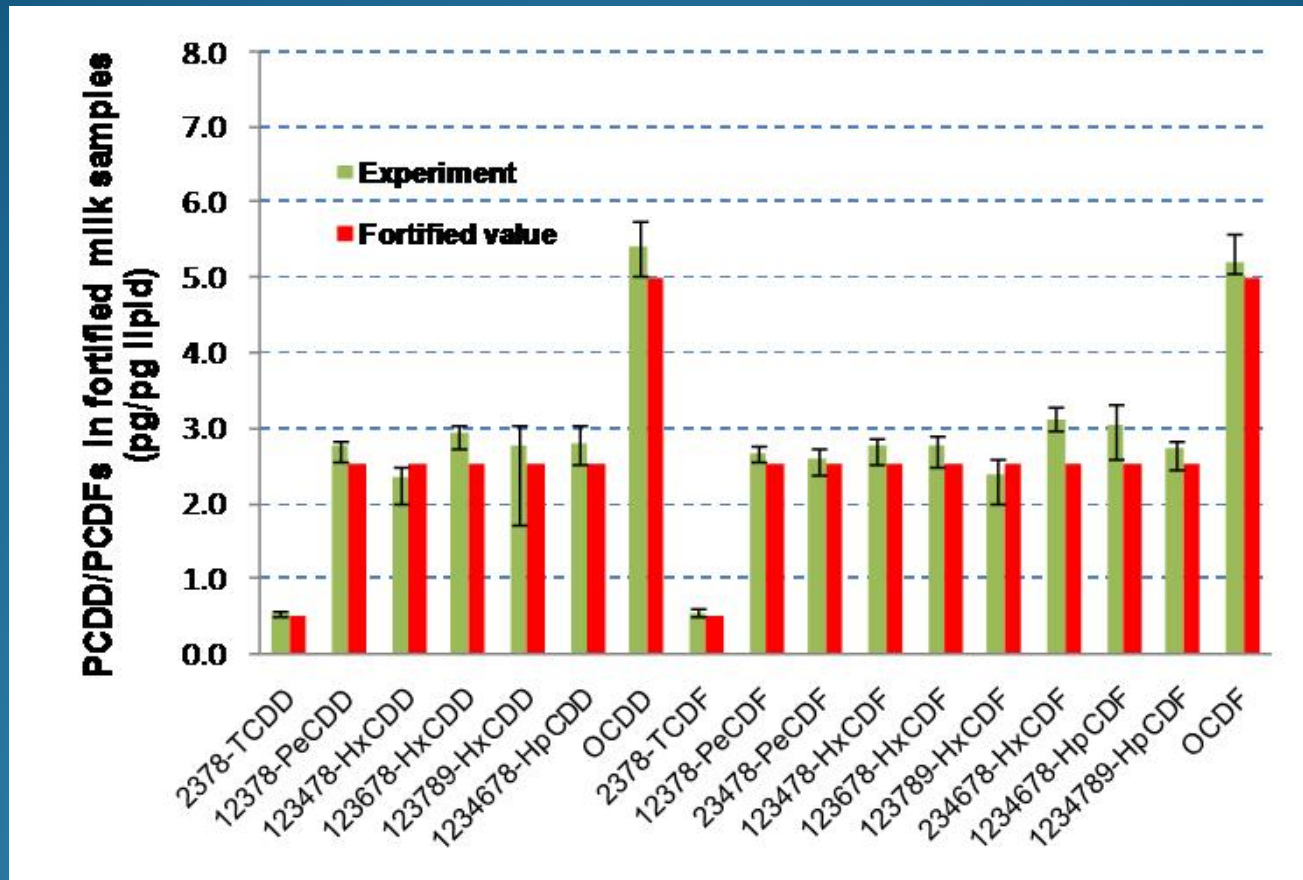


Quality Control

- Laboratory blank samples, laboratory duplicate samples
- Cross-check analysis with Eurofins Laboratories Germany
- Laboratorial practices follow guidelines of ISO 17025 (VILAS 545)
- QC Assessment carried out by independent consultants



Repeatability and accuracy



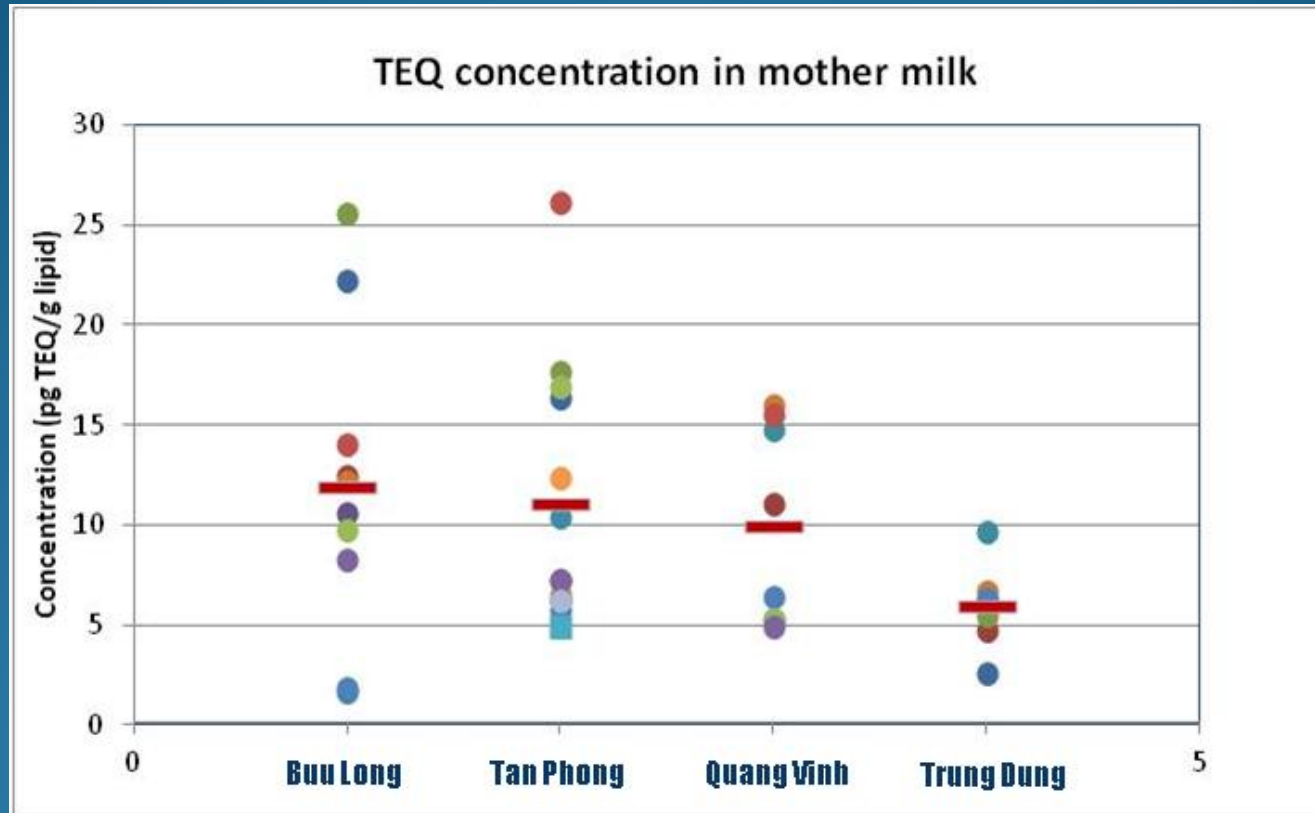
- RSDs (n = 7) ranged between 2 – 10%
- LODs of 2,3,7,8-TCDD and TEQ: 0.06 and 0.26 pg/g fat

Results and Discussion

Dioxin in Mother Milk in Bien Hoa

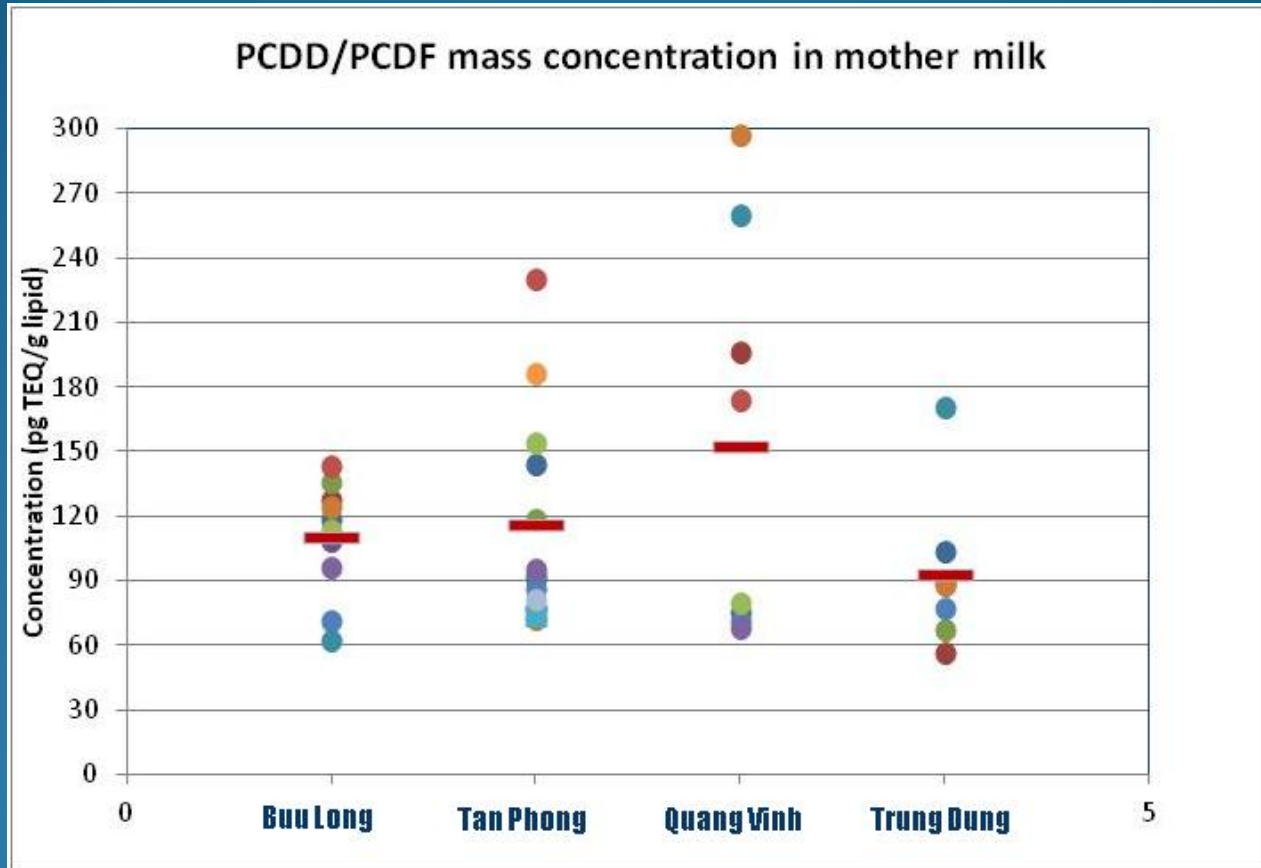
Location	Year of sampling	TEQ-PCDD/Fs (pg/g lipid)	Reference
Vietnam			
Thach Hoa (Hanoi)	2008	1.7	Tue et al., 2014
Trang Minh (Hai Phong)	2008	1.8	Tue et al., 2014
Bui Dau (Hung Yen)	2008	1.4	Tue et al., 2014
Kim Bang (Thai Binh)	2008	4.3	control site
Bien Hoa (n=40)	2014	9.6 (1.8-26)	This study
Bien Hoa (Dong Nai)	2008-2010	9.3	Manh et al., 2015
Phu Cat (Quy Nhon)	2008-2010	14.1	Manh et al., 2015
Thanh Khe (Da Nang)	2008-2010	14.3	Manh et al., 2015
Son Tra (Da Nang)	2008-2010	13.9	Manh et al., 2015
An Khe (Da Nang)	2008-2010	23.0	Manh et al., 2015
Asian countries			
China	2006-2007	4.2	Sun et al., 2010
China	2008	2.8	Shen et al., 2012
China	2007	3.73	Li et al., 2009
Japan	2002-2004	7.4	Tokada., 2008
Taiwan	2001	7.37	Chao et al., 2005

Dioxin TEQ in the milk from different Areas near BH airbase



- Contamination level (TEQ pg/g lipid): Buu Long (11.84 ; 1.85-25.57); Tan Phong (11.03; 4.86-26.06); Quang Vinh (9.89; 4.88-15.98); Trung Dung (5.93; 2.54-9.61)
- The dioxin exposure and bioaccumulation are different among areas

Dioxin mass concentration from different Areas near BH airbase



- Pattern of dioxin mass concentration is different compared to those of TEQ
- Reason for the difference is due to different contribution of 2,3,7,8 TCDD in TEQ

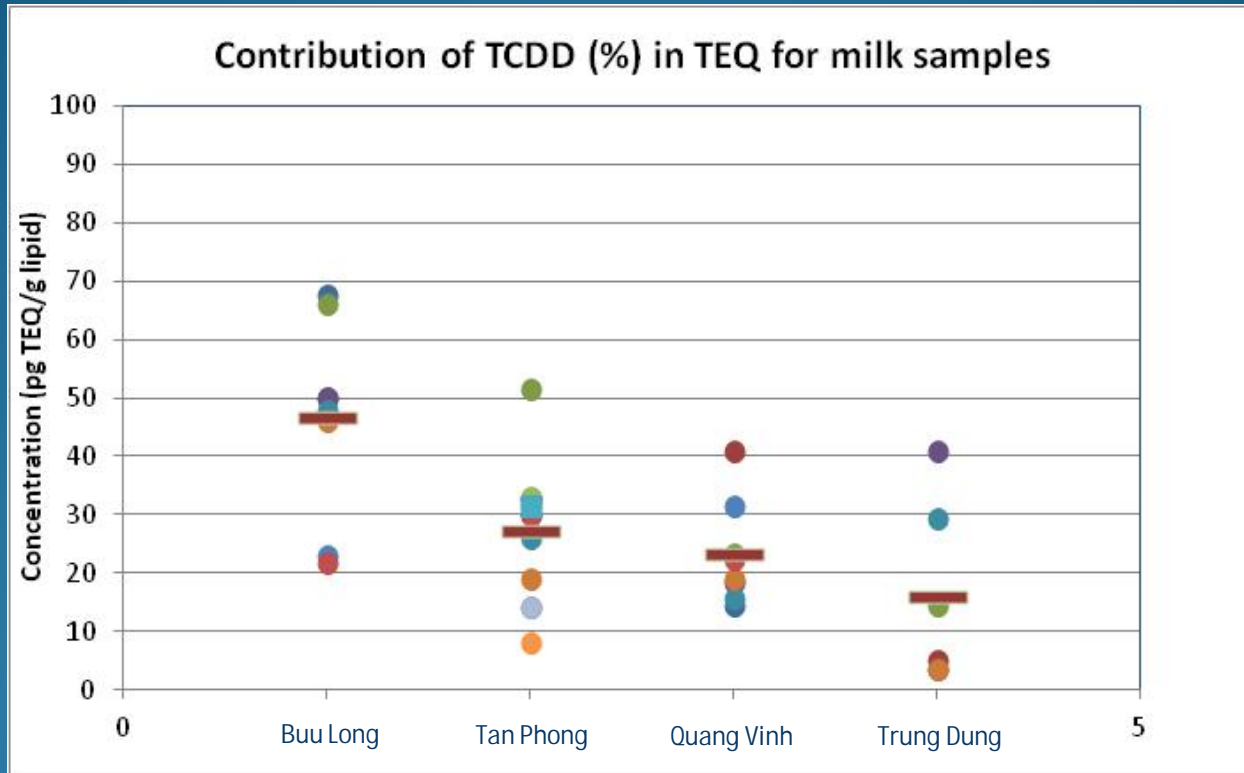
Contribution of TCDD in TEQ

Buu Long

Tan Phong

Quang Vinh

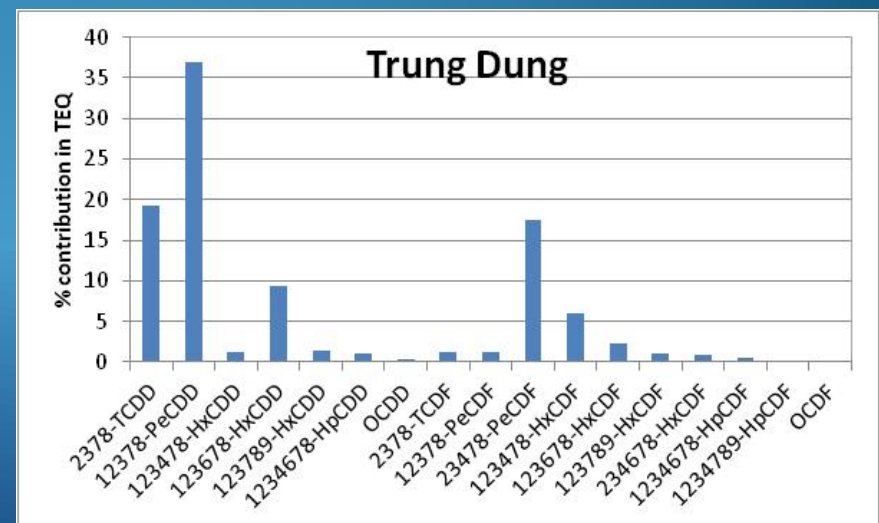
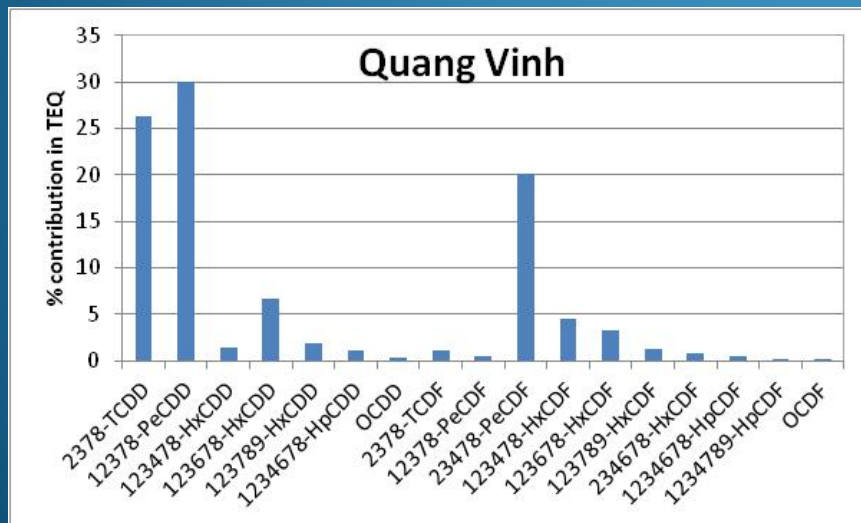
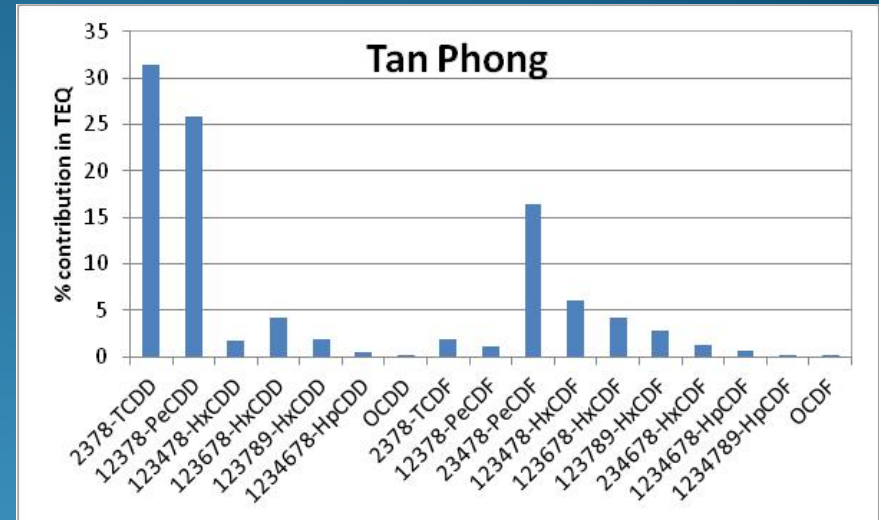
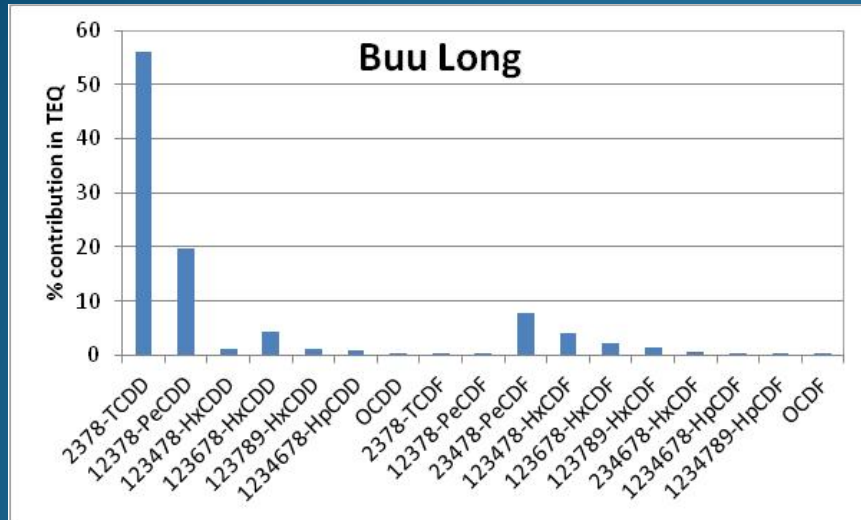
Trung Dung



- Higher contribution of TCDD in TEQ was observed in Buu Long , maybe suggesting the more recent exposure to Agent Orange in this areas
- Exposure pathways need to be studied in details

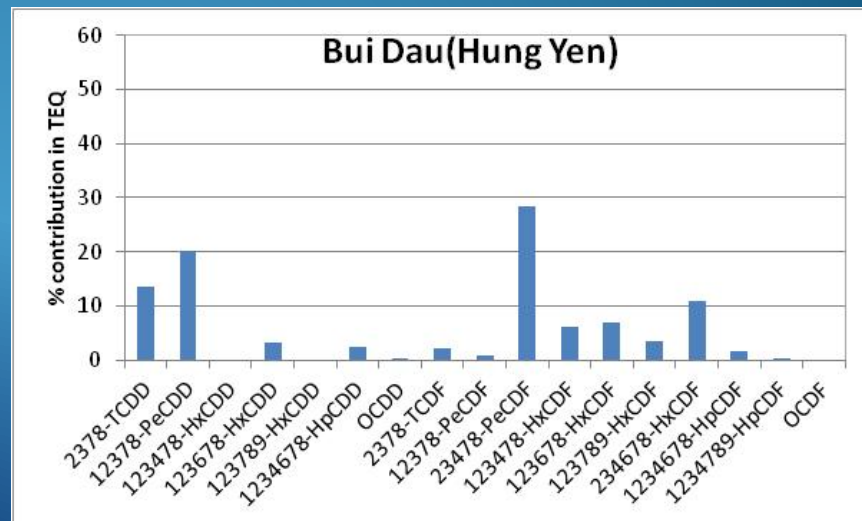
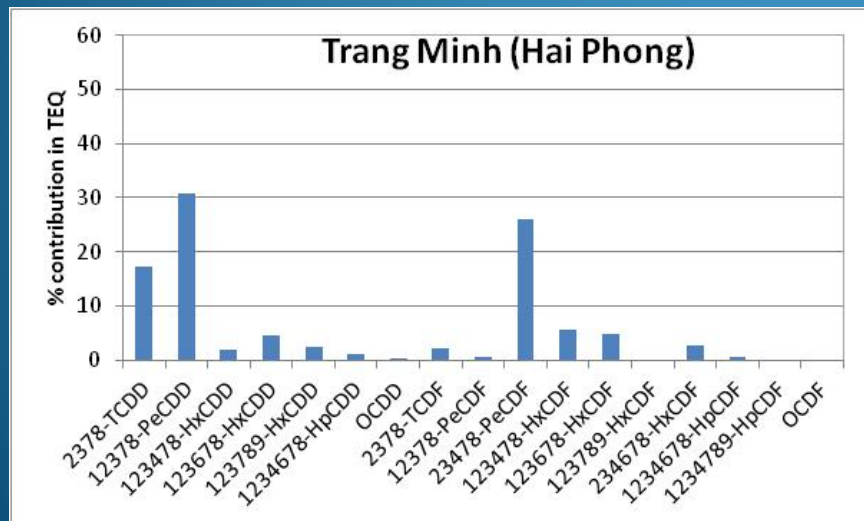
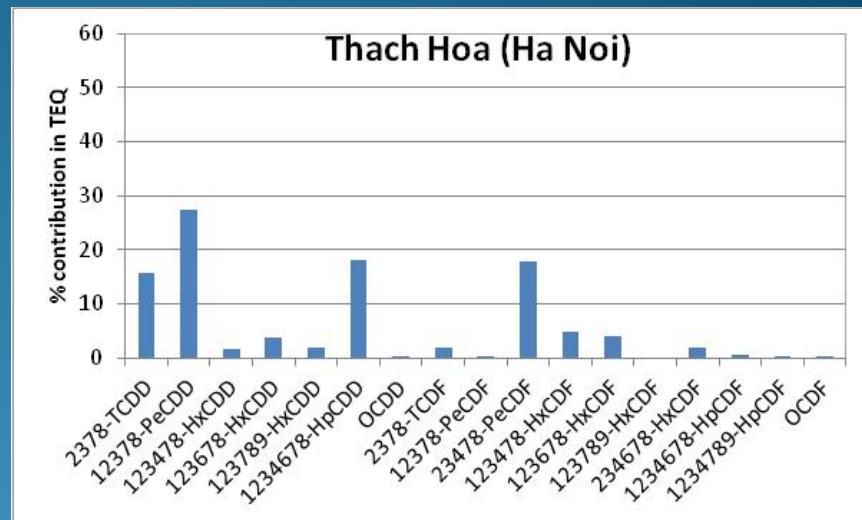
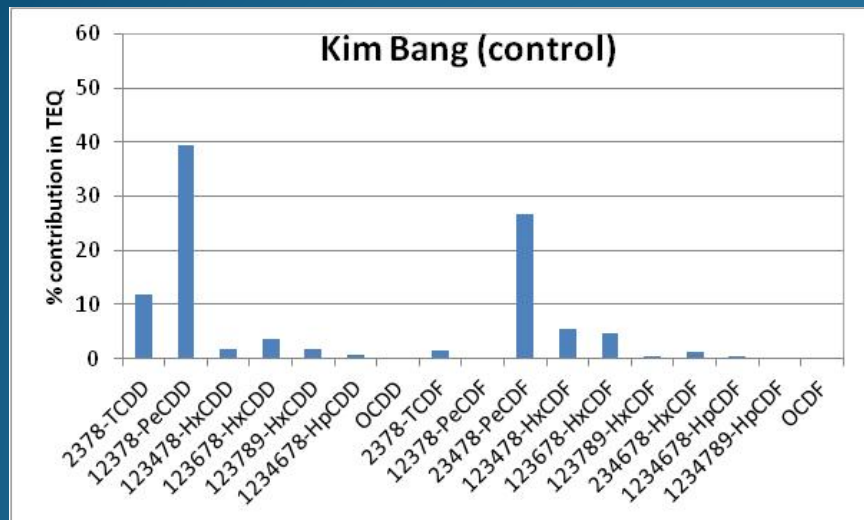
TEQ Congener profile in Bien Hoa

Higher contribution of 2,3,7,8-TCDD and 1,2,3,7,8-PeCDD in TEQ



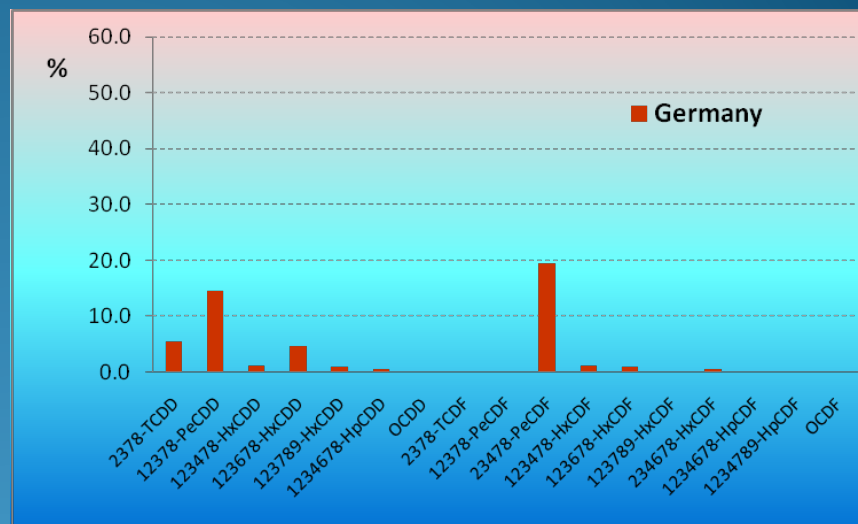
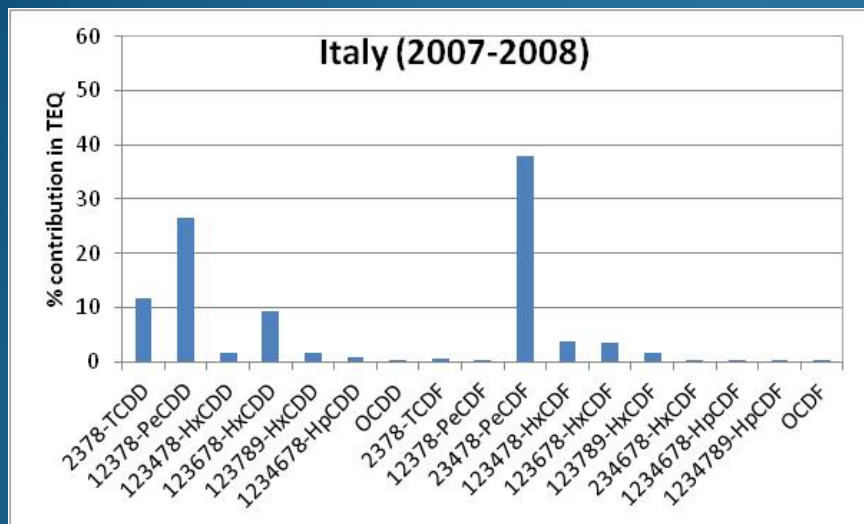
TEQ Congener profile in other areas

Higher contribution of 1,2,3,7,8-PeCDD and 2,3,4,7,8-TCDF in TEQ

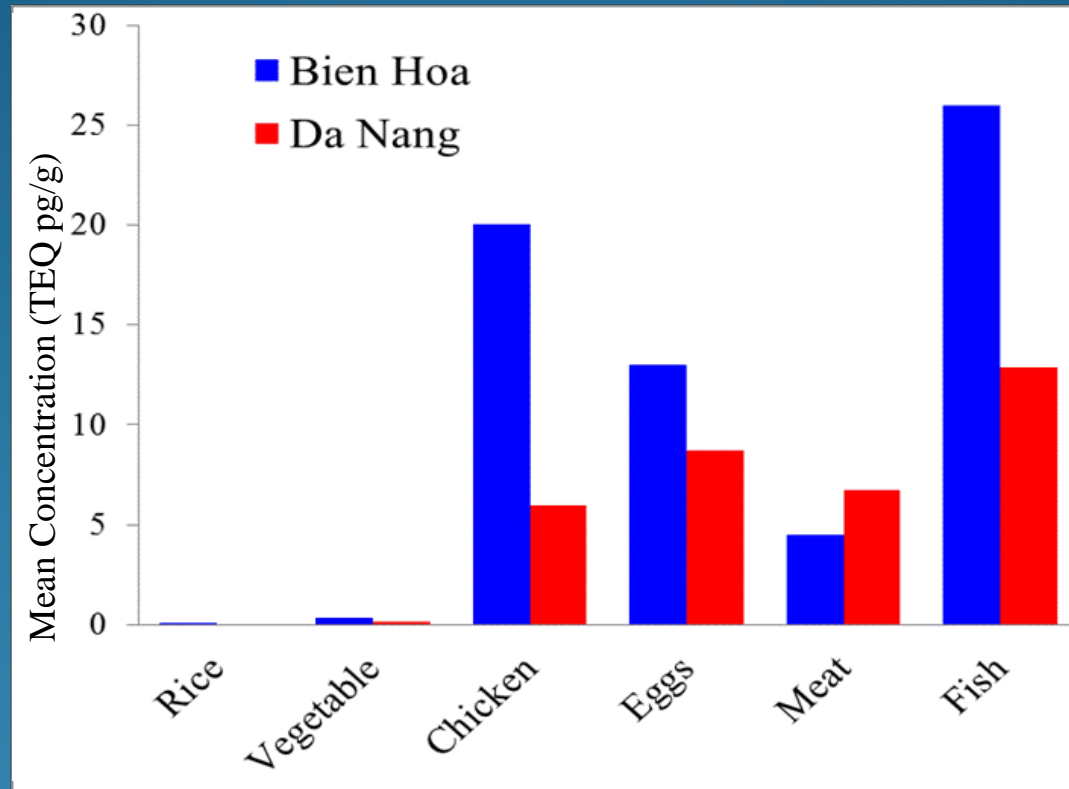


TEQ Congener profile in other countries

Higher contribution of 1,2,3,7,8-PeCDD and 2,3,4,7,8-TCDF in TEQ



Dioxin (TEQ, pg/g) in Some Foodstuffs Collected near Bien Hoa and Da Nang airbases

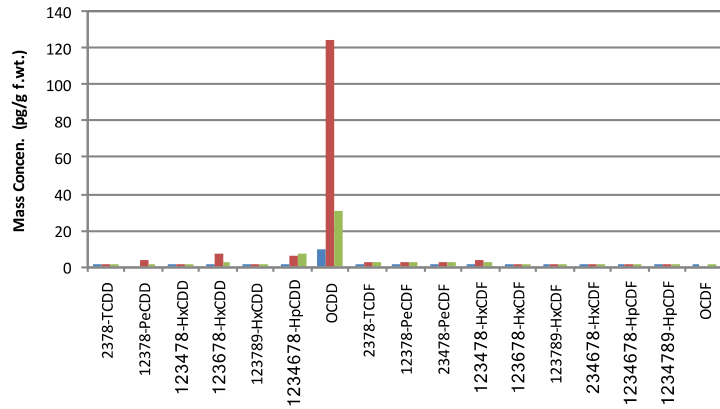


Bien Hoa airbase: Fish > Chicken > Egg > Pork/Beef > Veget > Rice

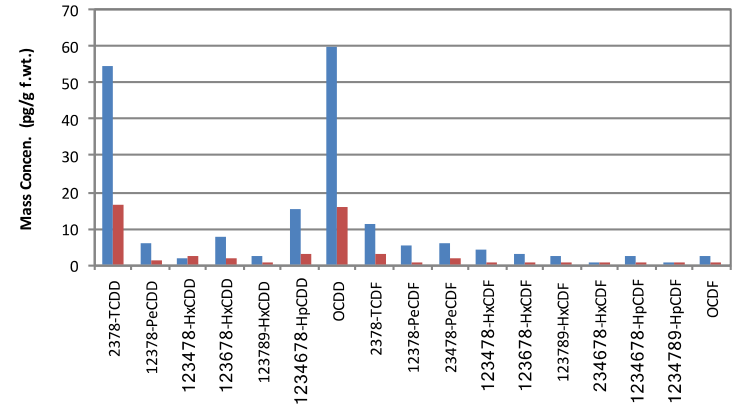
Da Nang airbase: Fish > Egg > Chicken > Pork/Beef > Veget > Rice

TEQ Congener profile in chicken and egg

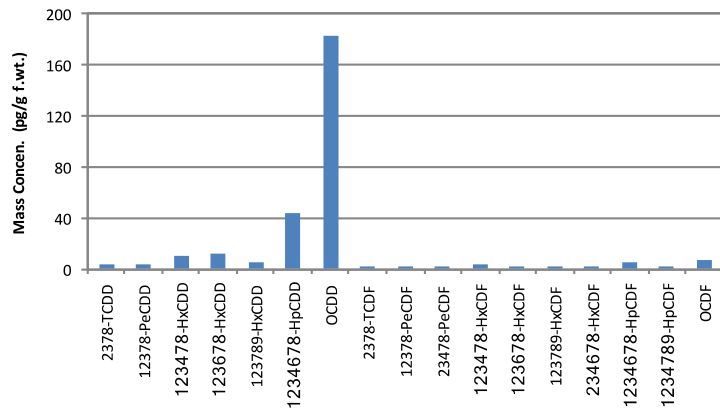
PCDD/Fs Profile of Tan Phong chicken/duck samples (n = 3)



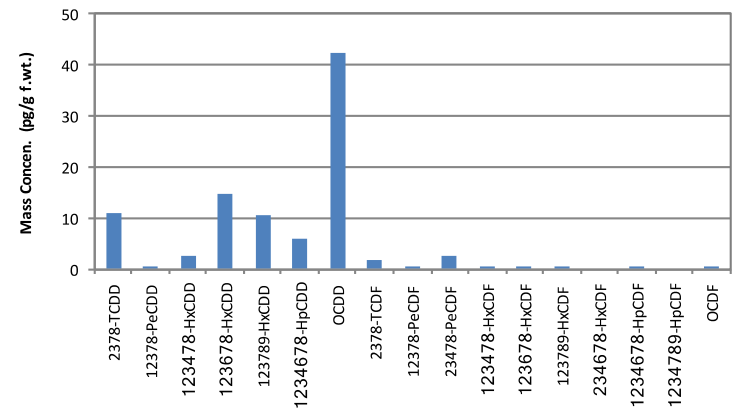
PCDD/Fs Profile of Buu Long chicken/duck samples (n = 2)



PCDD/Fs Profile of egg samples (n = 4)



PCDD/Fs Profile of Buu Long egg sample (n = 1)



Estimated Daily Intake for the Infants

The estimated daily intake (EDI) of TEQ for the infants was calculated:

$$\text{EDI (pg/kg bw/day)} = (800 \times L \times [\text{TEQ}]) / 5.8$$

The EDI-TEQ for the infants in Da Nang much higher compared with those recommended by WHO (4 pg TEQ/kg bw/day)

EDI_TEQ	Mean	Min	Max
Buu Long	69.8	9.5	150.7
Quang Vinh	34.4	0.9	69.0
Trung Dung	29.4	12.6	47.6
Tan Phong	51.9	22.9	122.6
Σ Bien Hoa (n=40)	47.4	1.1	129.0

CONCLUSION

- Elevated levels of dioxin in mother milk samples near Bien Hoa airbase were found demonstrating impacts of the AO/Dioxin hotspot to the local communities.
- The local population is being exposed to different levels of dioxin depending on their residing areas
- A portion of infants may be exposed to elevated levels of dioxin via breast feeding
- More studies toward dioxin exposure pathways is necessary for effective interventions to reduce the exposure to dioxins in the local communities

Details can be found at Environ Geochem Health (2018) 40:2539–2549

***THANK YOU SO MUCH FOR YOUR
ATTENTION !***