

DIOXINS AND THE ENVIRONMENT IN VIETNAM

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ABSTRACT:

During the US-Vietnam war, between 1962 and 1971, parts of southern Vietnam were heavily sprayed by Agent Orange and other herbicides contaminated with 2,3,7,8-TCDD. In 1970 several American scientists made a study in the Dong Nai river area, north of Bien Hoa air base which was a heavily sprayed area and found 2,3,7,8-TCDD in human milk at levels over 1000 ppt, in fish and shellfish at levels of 14 ppt to 1020 ppt. Over time the 2,3,7,8-TCDD levels in soil, animals and humans decreased. A recent publication reported that 2,3,7,8-TCDD in some Vietnam food was : minimum 0.001 ppt, median 0.01 ppt, maximum 0.07 ppt in 2003.

However due to conditions such as storage, leaks, rain and flooding, in some locations 2,3,7,8-TCDD accumulated at high levels in soil, silt and marsh of some low and limited sites. Animals, especially free ranging fat animals like ducks and also some fish living in these contaminated sites become exposed. Some people became contaminated with TCDD by consuming these animals and fish. One example of this special situation was the precinct Trung Dung, next to the Bien Hoa Air Base. We found: Silt in lake 114-117 ppt (in 2000), fish in the ponds 65 ppt (in 2003), free ranging ducks 276-331 ppt (in 2003), human blood of 9 donors, born decades after Agent Orange spraying ended, had 35 ppt to 413 ppt 2,3,7,8-TCDD.

INTRODUCTION AND FINDINGS:

From 1962 to 1971 southern Vietnam was sprayed by the herbicides Agent Orange, Purple, Pink and Green which contained a very toxic substance, 2,3,7,8-TCDD. According to J. M. Stellman, the amount of 2,3,7,8-TCDD sprayed was 600 kg¹. This 2,3,7,8-TCDD, has polluted parts of the southern Vietnam environment.

In Northern Vietnam 17 samples collected around Hanoi city (1989 year), at Nghe an province (1996 year) as control were not detectable (ND) for TCDD^{2,3}.

In southern Vietnam between 1989-1991, in forests the mean level of 2,3,7,8-TCDD in soil detected in 14 of 54 samples from Tay Ninh province was 14 ppt (range 1.2-38.5 ppt), in 4 of 6 samples from Thua Thien Hue province was 8.6 ppt (range 4.4-17 ppt), in 1 of 11 samples from Binh Duong province was 6 ppt. (2). By way of contrast, in flatland areas, 10 samples in Dong Thap province, 4 in Tien Giang province, 4 in Vinh Long province, 4 in Soc Trang province, and 4 in Ca Mau province all were ND². This suggests that in forests 2,3,7,8-TCDD can persist for a long time in soil, but in flatlands where the soil is repeatedly ploughed and exposed to the sunlight, 2,3,7,8-TCDD can to some extent be destroyed.

Under favorable conditions, for example in soil where there is much shade, as in jungles, and also in sediment or silt 2,3,7,8-TCDD persists for a long time. An example of this can be found in analyses of 2 soil samples collected in the same site (Tabat-A Luoi-Thua Thien Hue) in 1990 and 1999³ where it has been found that the dioxin levels appeared to be constant: 12.8 ppt (range 8.5-17 ppt, n=2) and 11.9 ppt (range 4.3-35 ppt, n=10).

2,3,7,8-TCDD presumably moved by rain, floods from the upper ground to the ponds, where it can be bound to silt in the bottoms of ponds and marshes. In A Luoi in 1990 the farmers dug fishponds. Nine years after the accumulation of 2,3,7,8-TCDD in silt a level of 5,6 ppt was found (range 1.8-8.5 ppt, n=5)³. So it is apparent that 2,3,7,8-TCDD can pollute the environment sometimes very far from the sites where it landed with the Agent Orange during the sprayings.

Another cause of accumulation of 2,3,7,8-TCDD is that during the war, in order to protect their military bases, commanders sprayed as much Agent Orange defoliant as possible around base perimeters from backpacks or other means of ground spraying. Even more important an explanation for the elevated 2,3,7,8-TCDD in a site, we believe, is that spills of large amounts occurred during manipulation of Agent Orange barrels.

In locations with higher 2,3,7,8-TCDD levels in soil/silt some samples in animals had higher 2,3,7,8-TCDD level. For example in A So-A Luoi: Fish 17.1 ppt (range 1.9-51 ppt, n=7) Duck 67 ppt (range 52-82 ppt, n=2)³. These animals contain high 2,3,7,8-TCDD levels because they are species that the farmers leave free ranging in TCDD contaminated areas. They often search for food in ponds, channels, or silt.

In turn, humans are contaminated by eating contaminated food from animals including fish^{4,5}. During the Ranch Hand fixed wing airplane Agent Orange spraying between 1962-1971 three women from Ho Chi Minh city who lived all their lives in the center of Ho Chi Minh City (which was not sprayed) had TCDD tissue measurements made. These women were never exposed directly to Agent Orange from spraying. However 2,3,7,8-TCDD levels in their fat tissues were 10 ppt, 5.2 ppt, and 4.2 ppt whereas uncontaminated persons had less than 2 ppt TCDD. This very strongly suggests that they were contaminated through food⁶.

People who were born after herbicide spraying ended in 1971, and who lived for 15-25 years in A Luoi, an Agent Orange sprayed area, had a mean value 8.55 ppt of 2,3,7,8-TCDD in blood serum which again to us appears to be from contamination by food which occurred after the spraying ended³. This reinforces our belief that contaminated food now and in the past was to a great extent responsible for human contamination with TCDD⁷⁻¹¹.

Bioaccumulation plays an important role in contamination. Although 2,3,7,8-TCDD is usually found at low levels in soil, it exists everywhere. So animals have opportunity to continuously consume it. In A Luoi after 8 months contamination in fish was found to be 18.2 ppt. In 1998 an analysis of pooled blood of people living in A Luoi showed that the levels of 2,3,7,8-TCDD in pooled blood of males who were born after Agent Orange spraying ended in 1971 was 21 ppt (n=50), of females was 12 ppt (n=50)³.

So in polluted areas, ending the use of free ranging species for food consumption for people living there and instead consuming food not contaminated with TCDD should help reduce exposure to dioxin.

The environmental movement of dioxin is:

SOIL and SILT → ANIMALS → HUMANS

BIEN HOA AIRBASE: A WELL CHARACTERIZED HOT SPOT

During the war Bien Hoa was a military airbase and much Agent Orange was stored there. Every day the Agent Orange barrels were used to fill the aircraft tanks with herbicides. In 1979 there was a spill of 28,425 liters of Agent Orange on the ground of the airport¹².

After the war Bien Hoa airbase was found to have the highest level of 2,3,7,8-TCDD found to date in Vietnamese soil: 1,100,000 ppt of 2,3,7,8-TCDD⁷.

Investigation objectives: 2 precincts, Trung Dung and Thanh Binh

In 2000: A 1st investigation was carried out to collect silt in Bien Hung Lake and ponds.

In 2000: A 2nd investigation was done to collect blood samples.

In 2003: A 3rd investigation was done to collect animal samples

Trung Dung precinct is situated next to the airbase, separated with it by a barbed wire fence. The precinct had a lake named Bien Hung and many ponds. The water for drinking and food came from the made man wells existing in the inhabitants' houses.

As the ground of the precinct was lower than that of the airbase, in the rainy season the rain water from the airbase flooded the entire precinct ground, the wells, and the ponds.

People lived in the thatched houses or low brick houses. The husbands were almost all handicraftsmen. Because the handicraftsmen's salary was very low, housewives stayed at home to plant vegetables, to raise free ranging ducks, chickens, to catch fish in the lake and in the ponds by fish nets. The food for the family was to a large extent from these ducks, chickens and fish.

RESULTS:

- Silt in Bien Hung lake and ponds: 114-117 ppt (2000 year).
- Snakehead fish from the ponds 65 ppt (2003 year)
- Free ranging duck 276-331 ppt (2003 year)
- Free ranging chicken 8-15 ppt (2003 year)
- Toad 56 ppt (year 2003)
- Human blood serum (40 blood donors):
 - +15 donors having 1-50 ppt
 - +10 donors - 51-100 ppt
 - +3 donors - 101-150 ppt
 - +7 donors - 151-200 ppt
 - +2 donors - 201-250 ppt
 - +1 donor - 251-300 ppt
 - +1 donor - 301-350 ppt
 - +1 donor - 413 ppt

Nine donors born after Agent Orange spraying ended in 1971 had 2,3,7,8-TCDD levels of :35 ppt, 50 ppt, 57.3 ppt, 62.2 ppt, 63 ppt, 67,4 ppt, 91 ppt, 174 ppt, and 413 ppt.

By way of contrast, Thanh Binh Precinct is 3 km far from the airbase fence. There is no fish pond, no vegetable garden, and no raising of ducks. The water for drinking and food comes from the city central water supply system. During the rainy season, floods from the airbase cannot flow to this precinct. People, males and females, are almost employees and workers. The food is bought at the precinct market and is not home raised. Their food was brought from other places.

- Fish collected from the market 0.22 ppt (2003 year)
- Chicken - 0.034 ppt (2003 year)

- Pig - 0.86 ppt (2003 year)
- Cow - 0.82 ppt (2003 year)
- Human blood donors: 3.4 and 5.7 ppt

DISCUSSION:

The lodging and food conditions of people in Trung Dung are favorable for exposure to 2,3,7,8-TCDD. Moreover, when one family member of Trung Dung Precinct has an elevated level of 2,3,7,8-TCDD, the others members of this family sometimes also have elevated levels of 2,3,7,8-TCDD. For example:

- V. T. B. T., born in 1966, and the eldest sister, had blood TCDD of 102 ppt
- V. T. B. L., born in 1973, a younger sister, had blood TCDD of 413 pp
- V. D. T., born in 1985, the youngest brother, had blood TCDD of 117 ppt

There are 7 families of this kind with several members having elevated blood TCDD in the precinct. This shows that family members have the same diet which is rich in 2,3,7,8-TCDD.

Fortunately in 2006, at Trung Dung precinct, the ponds, lakes, and wells were filled, large roads lined with asphalt and large homes were built. This caused the dioxin to move deeper into the ground. People came here to live and use the water from city central water supply system, but used food from other places. The threat of dioxin was therefore low.

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