CONSEQUENCES OF THE CHEMICAL WARFARE IN VIETNAM – THE KNOWN AND THE UNKNOWN

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One of the largest man made environmental disaster in history is the chemical warfare during the US war in Vietnam. Between 1961 and 1971[1] about 19,5 million gallons[2] (approx. 73 million litters) of toxic chemicals including more than 12 millions gallons of dioxin-contaminated Agent Orange were sprayed on Southern Vietnam and neighbouring Laos and Cambodia. The purpose of the operation, called Ranch Hand, was to defoliate inland hardwood forests and coastal mangrove forests to improve observation and prevent enemy ambush. Other aims were to destroy 'unfriendly' food crops and to clear vegetation around military installations, landing zones, fire base camps and trails. Out of the total number of litres, over 80 percent were sprayed on forests and woody vegetation.[3] In their recent study, Stellman et al (1:2003) estimate that over 3000 of southern Vietnam's 20.000 hamlets were directly exposed to Agent Orange and almost 5 million people may have been affected, a much higher figure than previously thought.

The Agent Orange[4] was mainly sprayed from C-123 aircrafts and helicopters but also by soldiers on the ground from the rear of trucks and from spray units mounted on the backs of soldiers on foot. Navy riverboats also sprayed herbicides along riverbanks.[5] A number of sources[6], including maps, indicate where spraying was most frequent and intense. In summary, the most heavily affected areas in South Vietnam were:

1. The demilitarized zone (today's Quang Tri) and the provinces south of this zone: Thua Thien Hue, Quang Nam, and Binh Dinh provinces;

2. A strip along the western Central Highlands along the border to Laos and Cambodia (today's Kontum, Gia Lai and Dak Lak provinces);

3. A large area south of the Central Highlands bordering Cambodia: today's Binh Phuoc, Binh Duong, Tay Ninh, and Dong Nai

[1] According to Le Cao Dai (2000) the former Saigon regime and US allied continued to use Agent Orange until the end of war in 1975.

[2] A recent study by Stellman et al (in Environmental Health Perspectives, Vol. 111, Number 3, March 2003 and Nature, Vol. 422, April 2003) revealed an almost 50 percent increase of earlier figures.

[3] Westing (1976) and Westing et al (1984)

[4] A collective name for different types of herbicide including Agents Orange, White, Purple, Blue, Pink and Green; code names referring to the colour of the 4-inch band painted around the 55-gallon drum that contained the chemical. (Lindsey Arison III, 1999 and Le Cao Dai, 2000)

[5] Lindsey Arison III, 1999 and Le Cao Dai, 2000

[6] Westing,et al, 1984; 2nd International Symposium 1993; Le Cao Dai, 2000; Le Ke Son (2002); Stellman (1:2003)

provinces believed by the US to be the 'entry point' of the Ho Chi Minh trail back into Vietnam (from Laos and Cambodia). This area also included the so called Iron Triangle of which the angles are Boi Loi (Tay Ninh), Ben Cat (Binh Phuoc) and Ho Bo (Cu Chi district, Ho Chi Minh City);

4. The former Rung Cat area in today's Can Gio district of Ho Chi Minh City; a vast mangrove forest about 80 km south-east of the city by the sea; and north-east of this area: today's provinces of Ba Ria-Vung Tau and Binh Thuan.

5. Mangrove forests on the west and south coast of Vietnam; today's Kien Giang and Ca Mau provinces.

Herbicidal attacks on inland and coastal forest[7]

The main target of the spraying of herbicides was the dense inland (upland) forest as it was 'the militarily most important of South Vietnam's land categories' according to Westing (1984). In other terms, the forest covered the bases and military communication lines of the liberation forces. About 1.4 million hectares, or 14 percent, of the total extent of South Vietnam's woody vegetation was sprayed one or more times. The dense forest land in the area 3 (see above) was particularly hard hit. On forest land under more than one herbicidal attack (occurred on about 34 percent of all sprayed land), the level of tree mortality increased with each spraying and resulted in defoliation of both canopy and lower storeys. In economic terms the spraying of South Vietnam's dense inland forest resulted in a loss of commercial timber in the order of 20 million cubic metres. It goes without saying that birds and wildlife were also severely hit by the spraying.

The mangrove (coastal) forest is much more sensitive to herbicide spraying. 'Virtually nothing remained alive even after single attack'. It is estimated that about 40 percent of the total mangrove area in South Vietnam was subjected to spraying. Considering that the mangrove is the habitat of a rich variety of aquatic fauna increases the fatal impact of the herbicides. According to Westing (1984) the mangrove forest was the ecosystem most seriously affected by the war.

Chemical spraying on agricultural crops[8]

It is estimated that chemical crop destruction affected some 236 thousands hectares of agricultural land in South Vietnam one or more times (about 8 percent of the total land). In addition, at least 8 thousand hectares of crop land were sprayed in Laos and Cambodia. The crop spraying resulted in the immediate destruction of food. Also, it is estimated that 30 percent of South Vietnam's 135 thousand hectares of rubber plantations were destroyed. Discussing the long term impact on flora and fauna, Westing (1984) citing contributing authors, estimated that it would take eight to ten decades following herbicidal spraying for a stand comparable to the pre-spray one to become established. Repeated fires induced by villagers to get rid of the grassy cover (caused by the spraying) have also prevented the re-establishment of trees. Other long term effects are loss of nutrients and soil erosion. Studies also show the sharp decrease in wildlife

[7] This section is entirely based upon information and data from Westing ed. (1984) and so are the quotations.

[8] As in footnote 7.

populations. For example when comparing with non-sprayed forest areas, up to 170 different bird species were recorded whereas only 24 species were found in a destroyed forest, now grassland area. Similar values have been recorded for mammals (55 relative to 5). A close canopy of mangrove forest can be expected within a decade or two. Fishery (fresh water) was also affected as the algae and invertebrates providing food for the fish were seriously reduced by the spraying.

Immediate effects of the spraying on humans

While the herbicidal attacks were aimed at different kinds of plants, no particular attention was paid to possible effects on humans. However during the war medical problems were reported by people staying (and living) in the sprayed areas.[9] Reports concerned mainly temporary ailments such as dizziness, headaches, vomiting, diarrhoea, lacrimation, coughing, difficultiesand difficulties in respiration.[10]

Another effect of the spraying was human displacement, contributing to the spread of infectious diseases. Also, the reduced food intake because of the crop destruction resulted in both acute and chronic health problems. The herbicidal operations also increased a number of other disease problems due to the improved habitat conditions for various vector organisms such as mosquitoes and rats.[11]

Long term effects of the sprayings on human health

Dioxin is described as the most toxic substance discovered by mankind to date. It is very persistent in human tissues and the environment. It enters the body through food and water, through breathing polluted air and direct skin contact. Dioxin infiltrated the country's water and soil, entering the food chain and accumulating in people's tissues. Samples of fish, shrimp and breast milk collected from southern Vietnamese women in the early 1970s showed very high levels of dioxin, while decreasing levels were demonstrated in the late 1970s and 1980s (Schecter et al 1995).

More recent studies have shown elevated levels of dioxin in soil and human blood samples from different localities in Vietnam, the highest being near former US bases with Agent Orange storage facilities and loading areas. Between 1996 and 1999, extremely high levels of TCDD were found in A Luoi district and in Bien Hoa and Da Nang US military bases for the operation Ranch hand (Dwernyschuk, 2003). From Bien Hoa, one of the largest US bases in former South Vietnam, human blood samples showed elevated dioxin levels up to 271 parts per trillion (ppt), compared to dioxin level of 2 ppt in blood samples from Hanoi, where Agent Orange was not used (Schecter et al, 2001). The authors suggest that the high dioxin level in the blood samples is due mainly to contaminated fish, a typical food in the Vietnamese diet. Thus, many years after the end of the war in Vietnam, severe environmental contamination remains. Recent research carried out at various 'hot spots' in South Vietnam by the Hatfield Consultants' (Dwernyschuk 2003) and Paepke et al (2004) indicate that the long term impacts of the dioxins are likely to be strongest around these reservoirs or 'hotspots', suggesting that new population groups outside of the sprayed areas are also affected. The authors note that "due to the unexpected high dioxin values found in human samples in the various areas, special attention

[9] A number of references listed in Westing (1984).
[10] As in footnote 7.
[11] As in foot note 7.

should be given to potential exposure of babies during the breast feeding period" (Paepke et al, 2004).

Dioxin accumulates in breast milk. During nursing, it is transferred from mother to baby, who may absorb as much as 95 per cent of dioxin in the milk. Evaluations of the impact of elevated dioxin levels in mothers' blood and breast milk show that the most adverse associations are found with *in utero* exposure through the umbilical cord, including neurological effects, low birthweight and intrauterine growth retardation (The American peoples dioxin report 1999). Schecter (1994) compared dioxin levels in pooled breastmilk samples from various countries. Highest of all was the city of Da Nang (34 ng/kg lipid), compared to Thailand and Cambodia with levels of 3 ng/kg.

Research on American ex-servicemen exposed to Agent Orange during the war has given 'sufficient evidences' of associations between exposure and chronic lymphocytic leukaemia, soft tissue sarcoma, non-Hodgkin's lymphoma, Hodgkin's disease and chloracne. 'Suggestive evidences' of an association are also found for respiratory cancers, prostate cancer, multiple myeloma, early onset trans peripheral neropathy, porphyria cutanea tarda, type 2 diabetes and spina bifida in offspring (Veterans and Agent Orange. Update 2004)[12]. Effects on the reproductive system and the ability to bear healthy children are more long term and therefore very difficult to establish. It is known that dioxin is an endocrine-disrupting chemical with a highly toxic effect on the reproductive system (Schecter et al 2003). Even at very low concentrations, it has been shown to seriously disrupt normal reproduction in humans, e.g. lowering fertility, increasing antenatal mortality and the risk of endometriosis. Though the mechanisms by which dioxin acts are not clear, it interferes with the production and function of many different hormones, growth factors and enzymes. Its effects and toxicity are much more consistent and severe in the early stages of human development than in adults. Erickson (1984) reported higher incidence of spina bifida, cleft lip, hydrocephalus and childhood cancers among children of US Vietnam war veterans than in controls. Stellman (1988) showed a higher incidence of miscarriages in women whose husbands were war veterans compared to controls. However, data from US war veterans are limited by the lack of information on dioxin level in the blood at the time of conception. The power of the studies for detecting an increase in the rate of a specific birth defect is also limited because of the relatively small numbers in the exposure groups.

Similar limitations of sample size, lack of exposure measurements and diagnostic criteria characterize much of the research carried out on Vietnamese soldiers and civilians on the associations between Agent Orange exposure and health. Case reports and limited epidemiological studies suggest higher incidences of miscarriages and premature births, birth defects, low birthweight and childhood cancer in offspring among women who themselves or whose husbands were exposed to Agent Orange during the war (2nd International

[12] Because of the continued uncertainty about the long term health effects on Vietnam veterans who were exposed to Agent Orange during the war, the US Congress passed 'the Agent Orange Act' in 1991. The US National Academy of Science (NAS) was charged to evaluate scientific and medical information, which is published bi-annually, the first time in 1994 and extended until 2014.

Symposium Report 1993). Harada (1993) noted: 'There is no one definite feature of the congenital malformations observed in Vietnam; if anything, diversity is their characteristic'. According to Le Cao Dai (2000) many neural disorders have been observed among children of dioxin contaminated parents, ranging from organic anomalies such as anencephalie (no brain) or hydroencephalie (enlarged brain), deformities of the spinal column (including spina bifida) and loss of the ocular globe. Functional problems observed include memory loss, mental retardation, idiocy, blindness, muteness or deafness. Other defects such as cleft lip and cleft palate, and twisted and withered limbs are also reported to be common (Le Cao Dai 2000). The same author noted that 30 conjoined twins were born at four hospitals in the South of Vietnam during 1980 – 1985. This an extremely rare condition throughout the world with approximately one in 20 million births, a rate which under normal conditions would give one case of conjoined twins in 20 years in the whole of Vietnam.

According to the new estimates of dioxin contamination (Stellman et al, 2003), the volume of dioxin deposited on southern Vietnam could be as high as 600 kg, which is several times higher the standard estimates used for decades of about 170 kg of TCDD. These new estimates indicate that the extent of the health risks for the people exposed is much higher than previously thought. The risks are obviously much more ominous for the Vietnamese population than for the US soldiers who were subject to exposure only during their relatively brief tours in Vietnam. The Vietnamese combatants and civilians were exposed to constant risks during all the years of spraying and, as shown above, at certain 'hot spots' they have continued to be at risk during the 30 years since the spraying stopped.

While the new findings on the amount and distribution of dioxin have yielded extremely valuable information, they do not address the question of possible links between exposure and the subsequent development of birth defects and other health problems among the Vietnamese exposed. Such questions could be answered by sufficiently large scale epidemiological studies which so far have not been conducted in Vietnam. There seems to have been a total lack of political will on the part of those responsible for the chemical warfare to ascertain the evidences of the consequences of the dioxin contamination for people's health in Vietnam. This makes it possible for the US administration to refer to the 'lack of scientific evidence' when the topic of compensation for the Vietnamese 'Agent Orange victims' is on the agenda, despite the fact that over 20.000 US ex-servicemen have received compensation for a whole range of diseases scientifically proven to be associated with Agent Orange exposure, including spina bifida in children born to the war veterans (Veterans and Agent Orange. Update 2004). Likewise, 'lack of scientific evidences' from the Vietnamese population was one of the reasons for Judge Weinhart to reject the law suit against the chemical companies which procured Agent Orange to the US army in the war. The recent cancellation of the planned Vietnam – US research project, which intended to fill some of the research gaps on the long term consequences of Agent Orange, has sadly perpetuated this situation. The burden of proof continues to lie on the victims of the chemical warfare.

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