

# RESTORATION OF THE WAR-RAVAGED ENVIRONMENT: A SERIOUS CHALLENGE TO VIETNAM'S SUSTAINABLE DEVELOPMENT

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## Abstract

More than 76 million liters of toxic herbicides were sprayed over southern Vietnam, mostly Agent Orange (AO) that contains Dioxin compounds (TCDD). Some 3.3 million hectares of natural lands suffered from toxic substances and of which, more than 2 million hectares of forests have been badly affected at different levels. In many forest areas that were repeatedly sprayed, ecosystems have been completely destroyed, but no signs have indicated that indigenous forest trees are regrowing naturally. To this day, traces of dioxin can still be found in the soil of the most intensively affected areas. These dioxin contaminations heavily affect the environment, and the life and development of the inhabitants of these sites. The rehabilitation of the war-ravaged environment is a matter of particular urgency, since well-functioning ecosystems are essential to human health and the reduction of poverty. Vietnamese people have made some progress in restoring the damaged forest during the war, but much more remains to be done. In order to improve the quality of the restoration of damaged areas, to overcome the gap in knowledge, skills, and techniques need for the rehabilitation of degraded lands of local inhabitants, and other possible sources of failure, capacity building initiatives are needed.

## Introduction

Wartime destruction of the natural landscape is nothing new, but the scope of destruction of nature in the Vietnam War is unprecedented in the human history. The damage to the environment was so intense and widespread that it has given rise to the term "ecocide". The military attacks on the environment, which were conducted by the US on a massive scale for many years, were highly systematic and led to the destruction of many ecosystems in large areas of Vietnam. Among the means employed were high-explosive, large-sized bulldozers, and especially toxic chemical herbicides. They all resulted not only in serious health effects, but had an immediate and long-term impacts on the soil, nutrient balance, hydrological regimes, plants, animals, and perhaps even the climate of Vietnam and Indochina. In short, this US strategy represented the intentional disruption of both the natural and human ecologies of the region<sup>8</sup>. Nearly four decades later, many of the affected ecosystems have not yet recovered. The long-term consequences include loss of ecosystems and biological diversity, economic stagnation, severe constraints on human development, poverty, malnutrition, disease and other socioeconomic problems.

The most profound ecological impact was on the forest. Before the Vietnam war, forests in southern Vietnam covered an area of about 10.30 million hectares. During the last war, from 1961 to 1971, more than 76 million liters of toxic chemicals were used, mostly Agent Orange, that contains dioxin compounds (TCDD), a highly toxic substance<sup>2</sup>. Agent Orange-contaminated area make up over 24 percent of the land area of southern Vietnam; 86 percent of the amount of toxic chemicals was directed against forested areas; the remaining 14 percent was directed against agricultural lands, primarily rice production. The US attacks affected more than 2 million hectares of forests. The extent of the toxic chemicals' impact varied, but ultimately resulted in the destruction of 124,000 hectares of mangroves, about 130,000 hectares of *Melaleuca* forest in the Mekong Delta, and many hundreds of thousands of hectares of inland jungle. The toxic chemicals were sprayed from the 17<sup>th</sup> parallel, south to Cape Ca Mau. Many types of forest and natural resources in southern Vietnam were affected. This chemical war, the most extensive in history, substantially depleted the forests that are so important to the sustainable development of Vietnam.

## Methods and materials

First field surveys were undertaken by the author and scientists of Hanoi University in 1971 in Vinh Linh of Quang Tri province, and then in 1974, along the Ho Chi Minh Trail, from Quang Tri to Dac Lak. After the war,

from 1976 to 2007, surveys were also conducted in many places in southern Viet Nam, which were severely affected by toxic chemicals. A comparative study was applied to sprayed and non-sprayed areas by time and space in order to determine the extent of impact of toxic chemicals used on the forest, fauna, flora, soil, water and humans. The war ended over 30 years ago, but in Vietnam there remain many large areas affected by toxic chemicals, which have seen no economic activity by human so far. This give us the opportunity to observe, do research and correctly evaluate the long-term effect of toxic chemicals /dioxin and other military activities on the environment and forest ecosystems. Models on rehabilitation and reutilization of the affected areas have been put into practice in Quang Tri, A Luoi, Ma Da, Can Gio, Nam Can and Dong Thap areas.

## Results and Discussion

***The seriousness of forest deterioration.*** A huge volume of highly-concentrated toxic chemicals was repeatedly sprayed over a vast area during a long period in southern Vietnam. It killed trees and animals, caused pollution to the environment and disturbance of natural ecosystems. It has left behind highly-depleted forest resources. During exposure to the toxic substances, many of species of good woody trees, within the upper and dominant forest layers, such as *Pterocarpus macrocarpus*, *Sindora siamensis*, *Azelia xylocarpa*, *Hopea odorata* died, leading to a scarcity of the genetic pool of some precious species. As the consequence, forest canopies were destroyed, the forest environment rapidly deteriorated, and for the most part, some species such as bamboo and fast - growing trees of lesser economic value have reappeared and encroached on the indigenous species of woody trees.

Many forest areas were heavily destroyed due to large, lengthy and repeated spraying of toxic chemicals in addition to other effects caused by bulldozers and napalm bombs that burnt out and killed naturally generative species under forest canopies. When forest trees died, species of wild weed such as *Pennisetum polystachyum* (known now to local people as “American grass”), *Imperata cylindrica*, and reds reappeared<sup>2</sup>. Satellite and aerial images taken from different periods reveal that forests that have not yet rehabilitated, that many of the sprayed tracks have become savanna, and that many steep areas remain bare due to erosion.

In our research, we attempted to reassess the effects of Agent Orange/dioxin on the tropical forest ecosystem, and to test the accuracy of our conclusion made at the seminar in Ho Chi Minh City in 1983: “Forests cannot recover naturally where toxic chemicals were repeatedly sprayed and where the forest ecosystem has been utterly destroyed”<sup>4</sup>. In the 1980’s, for lack of time-test evidence, scientists tended to deduce the long-term effect of Agent Orange/dioxin on tropical forest from the succession pattern of forests following human perturbations. Vidal (1983) cited the example of Nam Ngum forest in Laos and asserted that slash-and-burn farming and leaving the land fallow afterwards would lead eventually to an invasion of tall grass, wild banana and bamboo, then fast-growing wood trees, which in turn would facilitate the growth of trees of the Dipterocarpaceae family and other species typical of the tropical rain forest<sup>3</sup>.

Research outcomes have identified 3.3 million hectares of natural lands affected by toxic chemicals; of which about 2 million hectares of inland forests have been badly affected to different extents. Sprayed continually with toxic chemicals, many large forest areas have been completely destroyed (more than hundreds of square kilometers per site), and ecological conditions have changed. Since the forest cover was completely disrupted, surface soil is subject to erosion by heavy rain. Favorable conditions for the growth of forest trees, in terms of soil humidity, light, and temperature, are no longer available. Forest tree saplings cannot grow normally, and it is too difficult for seedlings and seeds to be transferred here from neighboring forests. Besides, once weeds invade the areas, forest fires may occur during the dry season, making it very difficult for forest trees to generate naturally.

The destruction of forests by toxic chemicals badly affected 28 river basins in the Centre of Vietnam: destroyed forest make up 30% of the total area in 16 basins; 30 - 50% in 10 basins, and more than 50% in two basins. Most of these rivers are short and run through complicated terrains, which directly influence lower sections<sup>1</sup>. Over the past years, floods have destroyed the Huong, Thach Han, Han, Thu Bon, Tra Khuc, Con, Ve, Cau, and Ba River basins, leading to great human and material losses.

We can say that Agent Orange, as the main component of the toxic chemicals used by US army during the war in Vietnam, has reversed the natural conditions and turned rich forest ecosystems with high biodiversity into exhausted ones<sup>7</sup>. Favorable habitats for many specific animals of rain forests, especially for large endemic species of Vietnam, have been lost. Many animals, including mammals and birds, were killed directly by the toxic chemicals. However, the most serious impact has been the destruction of the ecosystems, which provided habitats for many rare animal species in Southeast Asia such as Kouprey (*Bos sauveli*), Javan rhinoceros (*Rhinoceros sondaicus*), Elephant (*Elephas maximus*), Banteng (*Bos javanicus*), Gaur (*Bos gaurus*), Tiger (*Panthera tigris*), Gibbon (*Hylobates concolor*), Douc langur (*Pygatrix nemaeus*), Sarus crane (*Grus antigone*), Giant ibis (*Pseudibis gigantea*), White shouldered ibis (*Pseudibis davisoni*), White winged wood duck (*Cairina scutulata*), Edwards's pheasants (*Lophura edwardsi*), Imperial pheasant (*L. imperialis*), Crested argus (*Rheinartia ocellata*), and Crocodile (*Crocodilus siamensis*)... Most of them have become rare and some are now in danger of extinction<sup>4</sup>.

Some 366 kilograms of dioxin were sprayed over the landscape, primary in rural South Vietnam<sup>2</sup>. Even today, traces of dioxin can still be found in the soil of most extensively affected areas. Dioxin contamination is heavily affecting the local environment and inhabitants. Studies in some "hot spots" such as A So area (Thua Thien-Hue), and the Da Nang, and Bien Hoa airbases show that TCDD contamination has passed from the soil to humans via the food chain. Other possible modes of ingestion of TCDD include dust inhalation, absorption through skin, and unintentional direct ingestion of dioxin-contaminated objects by small children. We can say that **War does not end** when the bombs have stopped falling and the fighting has finished. Its devastating aftermath continues long after, on the land and in the minds and bodies of people. Over three decades have passed since the ending of the Vietnam War, but many dioxin-sprayed areas continue to deteriorate, and the people are still suffering. Rehabilitation efforts on regions identified as dioxin contaminated "hot spots" need immediate and substantial attention.

**Forests need to be replanted.** In order to regenerate the forest cover in the large areas destroyed by toxic chemicals, it is necessary to reforest because we cannot expect a natural evolution of the affected forests, and we do not know how long it will take. The rehabilitation of forests destroyed by toxic chemicals is an urgent and difficult task and a costly and resource-consuming process. Realizing that forest loss is the most serious factor threatening the long-term productivity of the country's natural resources, we have begun a large-scale planting program in order to regreen our war-scarred land and also correct the mistakes of rapid development. The aim is to reforest 40-50% of the country's area in the 21<sup>st</sup> century. By doing so, we hope to reestablish the ecological balance in Vietnam, to preserve its biodiversity, and to do our part in delaying global warming.

We hope to reach this goal through diverse means. Firstly, to achieve success, we must secure the support of the local people. The rural people must be helped in securing more resource-efficient, environmentally-friendly technologies, so that they can use natural resources rationally and sustainably. Forest rehabilitation that ensures the survival of the peasants is desperately needed in many rural regions of Vietnam damaged by toxic chemicals. We are trying to promote sustainable rural development with the involvement of the population, especially in mountainous areas. As a result of such activities, forest cover has increased from 28% of the natural land of the country in 1994 to 37.5% in 2008.

To grow one or two trees is very easy, but to plant thousands of hectares of forests is not simple, especially given the fact that the soil has become far less fertile. Many years ago, afforestation in Vietnam followed the "monocultural" pattern, with timber production as the focus. There were few convincing examples of successful large scale and long-term afforestation projects based on monoculture. Today, we are developing a village-level production pattern, according to which local people produce a large variety of indigenous tree seedlings to be planted in villages and their surrounding areas and to be used for reforestation projects.

After the war, Vietnamese scientists attempted to replant several species of indigenous trees in the areas that had been destroyed by the US's massive toxic chemicals raids. However, their trials failed, largely because the young saplings were killed in forest fires ignited by the intense tropical sunlight during the dry season. Nowadays, we have successfully planted thousands of hectares of rain forests. To protect seedlings from the burning tropical

sunlight, Vietnamese scientists have established a forest cover of fast-growing trees. When these trees gain a sufficient height - which takes about three years - we plant several indigenous species of forest trees beneath them. Availing themselves of the experiences of the Ma Da Forest Farm, people in many regions cut and burn wild grass in the areas affected by Agent Orange, then they plant fast-growing shade trees such as *Acacia*. After three or four years, they plant beneath them seedlings of the native forest trees, such as Dipterocarp species. It is hope that, in the future, good tropical forests and fauna will cover the areas affected by Agent Orange, and the Vietnamese people will be able to erase the scars of the war and to correct the mistake of unsustainable development<sup>4</sup>.

Even during the war, the Vietnamese launched a program to replant the mangrove forests in the areas destroyed by herbicides. This effort was particularly intensified after the war. Large areas were replanted with *Rhizophora apicauca* seedlings. Today, some 70,000 hectares of mangrove forests have been successfully restored. The mangroves now yield a self-sustaining and profit-making source of fuel and construction wood for the local population. As a result of reforestation, aquatic resources are growing year by year. Wetland birds colonies that had completely disappeared during the war have now reemerged. Over seven major birds colonies are now protected, new colonies are emerging, and bird populations are returning<sup>6</sup>.

*Melaleuca* forest is a unique type of flooded forest in the Mekong Delta. It once covered an area of 250,000 hectares in low-lying, seasonally inundated areas. But, after the war, only some 116,000 hectares remained. When the war ended, in order to make the plain prosper again, the people came to realize that the soil of this area had to be well-watered in the dry season and covered with *Melaleuca*, as it once had been. Since then, they have built dikes to prevent the plain water from draining into the canals during the dry season. They have also planted *Melaleuca* on thousands of hectares of acidic soil, because it is the only tree species able to thrive in such conditions. Now that the wetland habitat of this area has been restored, natural plants and animals are gradually emerging or returning there. Aside from fresh water fish, which are a source of food for local people, turtles, snakes, and several birds species have returned in surprising numbers, including rare species such as the Sarus Crane (*Grus antigone*), Painted Stork (*Mycteria leucocephala*), and Adjutant (*Leptotilos dubius*, *L. javanicus*). In early 1986, with the help of researchers from Hanoi University, the people of Tam Nong District set aside 9,000 hectares of land for crane reserve. There are about 500 cranes in Tram Chim and the Plain of Reeds today, and many other species of birds keep returning.

Nowadays, we have made great effort to re-green the Agent Orange/dioxin ravaged areas, but much more remains to be done, and our available resources are very limited. In order to improve the quality of the restoration of damaged areas, to overcome the gap in knowledge of local inhabitants, and other possible sources of failure, capacity building initiatives are needed. Priorities include organizing training courses to equip the managers, technical staffs and key farmers in areas affected with the understanding of the effects of toxic chemicals on their environment and their lives; and to provide them the knowledge, skills, and techniques need for the rehabilitation of degraded lands and therefore to improve their livelihood, to develop a mechanism and network of managers and practitioners of sustainable utilization of natural resources in order to rehabilitate the degraded lands.

In 2008, a project "Training of trainers in habitat restoration and reutilization of forest areas and other lands damaged by herbicides during the war" had been developed in one target province, Quang Tri Province, in the centre of Vietnam with the participation of totally 183 persons, among them there are 92 managers and technical staffs and 91 farmers from 7 districts of the province. Awareness of participants for three target groups have been raised significantly. Staffs of provincial departments have understood the sustainable development in linkage with restoration of degraded lands effected by chemicals used during the war by using comprehensive measures, especially those of agriculture and forestry production. Technical staffs of provincial and district's departments on environment and agriculture and rural development departments have obtained concrete solutions appropriate for provincial condition in order to direct production as well as environmental protection in the direction of restoration of degraded lands or to prevent the degradation. At scale of household, good farmers have assessed their strength and weakness in the production according the sustainable principles and propose appropriate measures to solve the problems. Many participating farmers begin to apply the knowledge obtained from the course into their production and have commitment to share their experiences with other farmers.

### Conclusion

Alteration of the earth's ecosphere is part of an ongoing process that is increasingly influenced by human activities, of which warfare is among the most destructive. Its negative impact is reflected at virtually all levels of evolution – from simple one-celled organisms to plants and human beings. However, the chemical war conducted by the US in the South of Vietnam has been the worst yet of all of its kind, and its impact on the environment and human beings is unprecedented in history of mankind. Its tragic consequences persist even today and will continue for generations to come, and the poor, who depend most directly on natural resources, suffer the most from it. Restoration of the war-ravaged environment is a matter of particular urgency, since well-functioning ecosystems are essential to human health and the reduction of poverty. There is also a need for research in a number of areas to provide a solid basis for sustainable development. Among the highest priorities for further research and measures to deal with the continuing aftermath of the Vietnam War are:

- 1) collection and assessment of ecological data from the wartime period, in order to have good documentation for land-use planning;
- 2) environmental restoration in areas affected by toxic herbicides;
- 3) cleaning of "hot spots" contaminated by dioxin, especially at some former US military bases in South Vietnam;
- 4) help for the local people, especially minority groups living in the areas affected by US toxic chemicals, to improve their livelihood in order to reduce the environmental pressure caused by their attempts to exploit forests and endangered species.

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