

of income due to the conflicts forced families to clear trees for farmland and increase grazing for supplemental income. Overall, in the last two decades, there has been a significant decline in the forest cover as well as in agricultural productivity. The deforestation and mismanagement of water resources have created environmental problems such as soil erosion and frequent the flash floods. The violent nature of conflicts and the political instability have also constrained the enforcement of forest and environmental legislation or regulations. Several forest officers have lost their lives in these conflicts along with scores of innocent local villagers.

In the last couple of years, the government, NGOs and other agencies have shown a growing concern for the loss of forests and associated environmental problems. Various prospects have emerged. An important aspect of this has been the focus on strengthening the institutional set up at various levels. However, this seems to be a difficult task as it is not only dependent on the efforts of local villagers and forest department staff but it also requires greater involvement of other agencies such as the military, or the police. The prospects involve creating awareness of all the stakeholders as well as strengthening the confidence of local people to participate in such processes. As there is very little experience of dealing with such a situation in the state, national and international development organisations could play a role by sharing their expertise and resources to restore Kashmir, once known as the 'Paradise on Earth'.

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EFFECTS OF WARFARE ON NATURAL ECOSYSTEMS AND BIODIVERSITY IN VIETNAM

By Dang Huy Huynh and Ho Thanh Hai

Destructiveness of warfare to humans and their civilization is well appreciated. Warfare can cause not only a tremendous loss of human life but also damage to ecosystems and biodiversity, and long-term effects on the natural environment. Thirty years after the end of the war in Vietnam there are still major hazards and long-term effects of the conventional munitions, and especially of the military use of herbicides.

Explosives. During the second Indochina war of 1961-1975, the total quantity of munitions used by United States forces alone was more than 14.3 million metric tons, about twice the amount used by United States during World War II. About half of the explosive tonnage was delivered from the air, half by artillery: about 20 million bombs of various sizes, 230 million artillery shells and more than 100 million grenades, plus additional millions of rockets and mortar

shells. This caused great damage to the landscape of Indochina. For example, in 1967-1968 the explosion of 225-and 340-kg bombs dropped in a saturation pattern by B-52 bombers formed an estimated 2.5 million craters in about 4.5 million ha, 26 percent of South Vietnam. An important long-term effect has been the presence a vast number of unexploded devices, which cause a lingering hazard in the landscape. An estimated 10 percent of US munitions did not explode, causing an explosive legacy of about 2 million bombs, 23 million artillery shells and tens of millions of other high-explosive items.

Bomb explosions often started forest fires. It was estimated that more than 40 percent of South Vietnam's pine plantations was burned during the war, with most fires being ignited by exploding bombs.

Herbicides. Approximately 76 million litres of herbicides were sprayed over 10-14 percent of South Vietnam. The most frequently used formulation was a 50/50 mixture of 2,4,5-T plus 2,4-D, known as Agent Orange. About 86 percent of the spray missions were targeted on forest, the remainder on cropland. The Aluoi Valley in central Viet Nam, near the Laos border, was one of the heavily sprayed areas.

The most extensively sprayed type of vegetation was forest, which covered more than 10 million ha, about 60 percent of South Vietnam. Mangrove forest is particularly sensitive to herbicide. About 110,000 ha of coastal mangrove were sprayed at least once, about 36 percent of the total. The spraying devastated the mangrove ecosystem and created a large area of poorly vegetated or unvegetated coastal barrens.

The Society for Social Responsibility in Science funded a March 1969 trip of biologists to learn about the effects of defoliants. One of their field trips, for example, was to Rung Sat near Ho Chi Minh City. They concluded that the Rung Sat mangroves were extremely susceptible to defoliants. Only one application was apparently necessary to kill most trees. Most of the areas they visited remained completely barren although they had been sprayed several years earlier. They speculated that "*The unusual soil conditions of mangrove forests may result in a failure of the herbicides to be decomposed. If the molecules remain bound to the soil particles, they might influence seed germination for a long time*".

Effects were also severe in the much more species-rich inland forests, including rain forest with a total area of 10.5 million ha. Mature forest of this type has many angiosperm species, especially of the families Dipterocarpaceae and Fagaceae. The tree height is up to 40m or taller, and diameter at breast height is up to 2m. Studies in Aluoi valley show that herbicide spraying changed a continuous upland tropical forest to an 80% cover of grassland with only 24 bird and 5 mammal species, compared with 145-170 bird and 30-55 mammal species in two unsprayed reference areas.

Reports from freshwater ecosystems in the Aluoi Valley show a correlation between spraying and decreased overall species diversity and morphological abnormalities in freshwater algae. However, it is not possible to attribute these effects with certainty to persisting toxicity of herbicides or their residues because of the variety and magnitude of other environmental abuses

during the war such as bombing and of the post-war agricultural practices and population growth.

A study on the impact of orange/dioxin on mammal diversity in Ma Da forest (Dong Nai province) found a clear decrease, only 29 genera and 38 species, compared with 39 genera and 52 species recorded before spraying. Orange/dioxin destroyed forest ecosystems and mammals lost their habitats and food sources. Many species had fled to other areas.

A study in 2000-2002 on the long-term effects of orange/dioxin on biodiversity in Aluoi district found that these compounds, used in the war by the American army, destroyed natural ecosystems by breaking the fragile ecological structure and nutrient web, resulting in pollution and deterioration of habitats and a strong decline of biodiversity. More than 30 years after the end of the war, the long-term impacts are still clear: in Dong Son commune, for example, there are only grasses and bushes where there was multi-storey primary forest before herbicide spraying. Species composition and quantity of mammals, birds, reptiles, amphibians, soil macrofauna and soil microorganisms is lower than in an unsprayed area with the same landscape. There are morphological abnormalities in some species of fish, earthworms and springtails. The specific causes of these abnormalities still need to be studied. However, some aquatic ecosystems have been gradually rehabilitated. Communities of algae, macrophytes, zooplankton and benthos recovered in species composition and in quantity.

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LOGGING IN THE SOLOMON ISLANDS – THE LOST LEGACY

By Jim Sandoms

In 1893, in response to pleas of missionaries to put an end to inter-tribal warfare and headhunting, the British Government declared the Solomon Islands a Protectorate. Exactly 110 years later, and after 4 years of violence and ethnic tension, the Solomon Islands turned to its neighbours and begged them to send help to re-establish peace.

The reasons behind the country's political, social, and economic disintegration are largely cultural and historical – but the management, or mismanagement, of the