

REHABILITATION OF INLAND FORESTS IN SOUTH VIETNAM 3 DECADES AFTER CHEMICAL WAR (1961-1971)

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Abstract

This report aimed at briefly introducing the outcomes of the study on impact of chemical warfare on inland forests in South of Vietnam and measures for restoration of the forests 3 decades after chemical war (1961-1971) and a green corridor in key dioxin-hit areas of A Luoi district.

Introduction

In the Second Indochina war, U.S. army had sprayed about 21 million gallons of herbicides and defoliation clearing over an area of 24% of total land area of South Vietnam, over 2 million ha of Inland forest was heavily affected. Timber immediate loss of 90 million m³. The forest canopy has been destroyed, created negative impact on watershed protection on forests of 28 river catchments areas.

Study results showed that the quality of regenerated forest is poor, It requires a long process of at least from 80 to 100 years. Reforestation is the fastest way to rehabilitate one million ha of barren land in South Vietnam.

The green corridor in key dioxin-hit areas of A Luoi district is carried out by planting *Gleditsia australis*, a multi-purpose indigenous tree species that has many branches and many long thorns around the trunks. It is hoped that the "green fence" will create positive impacts to contribute and ensure safety for the people, and to mitigate the damages caused to human being and other animals.

Materials and methods

Our research uses a comparative method between affected and non-affected areas by time and space. Data has been collected from systems of sample plots and representative inventory lines. Analysis and interpretation of aerial photographs and satellite images, primary Landsat, of the study areas

Building model on rehabilitation and reforestation of affected forest areas.

Main documents have been used:

- Documents relating to forest inventory results in different periods.
- Landsat images 73, Landsat TM.90, Landsat TM 96, Aerial photographs AMS. 58, AF.68...

Figure on missions of toxic chemical sprayings during the war time from 1961 to 1971

References of different resources for study from foreign countries and in Vietnam

RESEARCH STUDY

The effects of Herbicides and defoliation on inland Forests

Vietnam Forest resources are abundant, occupying three-quarters of the total natural land area. The forests are closely related to the land and water resources, and to the livelihoods of 24 million people from different ethnic groups dependent on forest resources

In the Second Indochina war, U.S. army had sprayed about 21 million gallons of herbicides and defoliants clearing over an area of 24% of total land area of South Vietnam from 17 parallel to Ca Mau cape on different ecological zones. This is the largest scale chemical warfare compared with the history of the war in all times and is also the most destructive action against ecology in the century, and is also the reason causing the forest area declined during the period 1960 -1971.

Most of forest types in South Vietnam have been affected. Inland forest was heavily affected accounting for 86% of the total spraying missions.

Many forest areas have been seriously destroyed on a large scale by toxic chemicals and also affected by bombardments, poisoning and napalm,. Initial research results have showed that over 2 million ha of natural forests have been affected by toxic chemical sprayings.

Evergreen close forest occupies a large area with a growing stock of about 200- 300m³/ha, with complicated forest structure consisting of many forest layers. The emergent layer consists of valuable timber tree species with a diameter of 1 to 2 meters, 30 to 40m high, large canopies. The ecological dominant layers consist of dominant trees of *Dipterocarpaceae*, *Papilionaceae*, *Meliaceae*, and *Sapindaceae*... The density of sprayed agents used to be 20-40 times higher than in agricultural production.

Therefore, hundreds of tree species have been defoliated. The forest structure has been damaged. Particularly large timber trees belonging to emergent and ecologically dominant layers of high economic value have been died.. Only few species could resist and stand with toxic chemicals like *Irvingia malayana*, *Parinari annamensis*. ..

It has been roughly estimated that timber damage is immediate loss of 90 million m³. Consisting of many rare and valuable timber tree species of high economic value. Besides lost forests have taken away some other non-wood forest product and wildlife.

The forest canopy has been destroyed, secondary tree species, *bamboo* and wild grasses (*Pennisetum polystachyon*, *Imperata cylindrica*) have appeared and invaded indigenous tree species. Process of repeated defoliation at a time has resulted in dumping nutrients, and speeded up soil erosion and land slides. Such consequences have directly prevented from forest rehabilitation process and created negative impact on watershed protection on forests of 28 river catchment areas.

Distribution of sprayed area by absolute altitude

Absolute altitude	% of sprayed area
< 300 m	16%
300 - 700m	42%
700 - 1000m	30%
> 1000m	12%

FIPI,1999

Loss of timber led to diminished sustainability, reductions in overall floral and faunal biodiversity, reduced soil quality, increased water contamination, increased erosion and flooding, a reduction in nutrient availability and increased leaching of such nutrients, an influx of less desirable opportunistic plant species owing to forest removal.

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Rehabilitation of inland forests

After many years, the affected forest ecological system and other war activities have been being rehabilitated by two ways: natural regeneration and artificial regeneration. Study results showed that for less affected forest areas where can be naturally regenerated but its quality is poor. In order to restore the forest with high quality, as previously, it requires a long process of at least from 80 to 100 years.

At present, many inland forest areas are still being seriously affected and degraded. Previously dead tree trunks have been almost decayed while *Pennisetum polystachyon*, *Imperata cylindrica* grasses remain well developed, which are risky to forest fire. Reforestation is the fastest way to rehabilitate the heavily affected forests or lost forest situation.

Ma Da Forest Enterprise (Dong Nai) , with an area of over 27.000 ha, Primary forests in Ma Da with dominant *Dipterocarpus* tree species. During wartime, 80% of the forest area has been heavily affected by toxic chemical (4-5 times of spraying. After 20 years, the Forest Enterprise has invested 6 billion VN Dong to plant 1.400 ha of new forest, consisting of tree species (*Eucalyptus*, *Acacia* ...) to replace wild grasses. This also contributing to soil improvement and environment, facilitating favorable conditions for growing indigenous tree species (*Hopea odorata*, *Dipterocarpus*, *Azelia xylocarpa*, *Pterocarpus macrocarpus*, *Aquilaria*...)

Thanks to the forest restoration efforts, the fauna in this area has been partly rehabilitated. Out of 46 animal species, 10 species have been listed in the Red Book of Vietnam like: *Wild oxen*, *wild buffalo*, *elephant*, *bare*

The survey results have indicated that at present the whole South Vietnam still remains one million ha of barren land and open hills which are unable to be rehabilitated itself. Reforestation is the fastest way to rehabilitate the heavily affected forests. But plantation or enrichment by indigenous tree species require good soil and have very long rotation, and require a very large investment which people can hardly afford.

Planting a green corridor in key dioxin-hit areas of A Luoi district

Herbicide applications ceased in 1971. However, a decade of research has shown that there remain significant hot spots of TCDD in select areas of southern Viet Nam. There exist two primary sources of continuing TCDD contamination in south Viet Nam: from spray missions by aircraft, and contamination on former US military installations. Most studies have demonstrated that aerially sprayed regions do not retain high levels of TCDD, given years of tropical rains, erosion, chemical breakdown, and other environmental factors. However, areas of most concern for human health include those where Agent Orange and other defoliants were spilled, loaded onto aircraft, applied by truck-mounted sprayers, or transported, the resultant dioxin loading to soils in and near former military installations was significantly higher than that resulting from aerial applications, and continue to exist as dioxin hot spots or dioxin reservoirs to this day (Dwernychuk, 2005) results from the A Luoi Valley studies in the vicinity of the former A So US military base demonstrate that foods, human blood and breast milk had a very high dioxin content, showing that TCDD contamination has spread from soils to humans via the food chain (Dwernychuk et al., 2002). The former US airbases at A So / A Shau in Thien Hue province. The A So base remained operational from 1963 to 1966 (Stanton, 1985). The highest TCDD levels were recorded at the A So base: 897.85 pg/g (Dwernychuk et al., 2002). So we have some very dangerous on-going contamination, more than 30 years after the war ended, of children and other innocents who were not even born during the original hostilities. We have been for some time trying to find the means to remediate these sites. Thus we have been involved for the past few years in carrying out a new project "Planting a green corridor in key dioxin-hit areas of A Luoi district". A Luoi is a small valley in mountainous area of Thua Thien Hue province, where inhabited by different ethnic minority communities; this area suffered from 256 missions of sprayings with a sprayed area of 71,169 ha accounting for 61% of the total natural land area of the whole district. A Luoi can be seen as a small picture of the chemical warfare in Vietnam as it houses three former Special Forces bases. A great worry is the danger posed to children and other residents who come into contact with the contaminated soil. Our project has been researching and planting green fences around contaminated

areas in the hopes that mechanical isolation will raise awareness on the harm of the dioxin caused to the people, so that they can themselves avoid the hot spots. The green fence is carried out by planting *Gleditsia australis*, a multi-purpose indigenous tree species that has many branches and many long thorns around the trunks. It is easy to plant in difficult conditions and resistant to diseases and pests. After 3 years, the trees grow into dense thorny fences so that people and animals cannot access the contaminated areas. Another aspect of the program is that *Gleditsia australis* fruits are used to produce soaps, shampoo and medicinal drugs, and local people can sell them for income. This green fence is sustainable and its life span is up to 50-60 years. The production cost for establishment of the fence is cheap, and the incomes from the *Gleditsia australis* fruits collected yearly can be used for paying for the protection of the fence.

We hope these "green fences" can be expanded to other hot spots together with reforestation in sprayed areas. It is hoped that the "green fence" will create positive impacts to contribute and ensure safety for the people, to protect the health of the community, and to mitigate the damages caused to human being and other animals.

CONCLUSION

Many scientists consider Vietnam as the biggest natural laboratory in the world for studying the effect of dioxin on human health and environment. Today, at this forum we hope that interest and support from the international community will permit a widening of the research, reforestation and remediation on sprayed areas.

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