

# DEVELOPMENT AND ENVIRONMENT IN VIETNAM

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## INTRODUCTION



A new road to future

Development and environment are interrelated to each other. Improper or uncontrolled development is likely to cause adverse impacts on the environment, and environmental pollution or degradation may become a major obstacle for social and economic development. The interrelationship between development and environment has been observed throughout the world, especially in fast-developing countries such as Japan, South Korea, China, and Thailand (1,2). Recognizing detrimental effects of environmental pollution and degradation on sustainable development, the United Nations Conference on Environment and Development, which was held from June 3 through June 14, 1992 in Rio de Janeiro, Brazil discussed and agreed on several global environmental issues including non-binding statements on the relationship between sustainable environmental practices and the pursuit of social and socioeconomic development. One of these agreements was Agenda 21, a wide-range assessment of social and economic sectors

with goals for improving environmental and developmental impact of each.

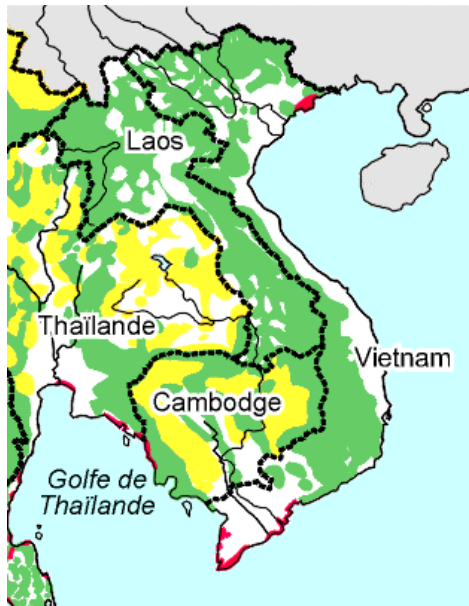
In Vietnam, the renovation policy (*doi moi*) initiated in 1986 has brought relatively rapid economic growth, but "...it is also coming at a high environmental cost..." Ten years later, according to Dr. Quy Vo, president of the Center for Natural Resources and Environmental Studies at the National University in Hanoi, "*Vietnam is being confronted with a number of serious environmental problems, including deforestation, degradation of land resources, shortages of fresh water, over-exploitation of biological resources, threats to ecosystems, and increasing pollution*" (3). Although Vietnam's environmental policies date back to 1985, the environmental problems are widespread and appear getting worse. This paper is an attempt to present most recent effects of development on the environment and resulting effects of environmental pollution and degradation on the economic growth and to provide recommendations for sustainable development in Vietnam.

## EFFECTS OF DEVELOPMENT ON ENVIRONMENT

### Deforestation

Deforestation has been a serious threat to the forests in Vietnam during the last 60 years, but its true causes and extent are still ambiguous. "*According to the most frequently quoted sources,*

between 1943 and 1993 the proportion of the national territory covered by forests declined from at least 43% to 20% (Vo Quy 1996) or even to as low as 16% (Table 2) – the various estimates differ somewhat, depending on the authors and their respective sources. Some observers go as far as claiming that the proportion of Vietnam still covered by forests has now fallen below 10%... it can be estimated that the forests of Vietnam recede by more than 200000 ha/year, that is, the proportion of the country still forested in 1997 vary between 10 and 20%, that is, between some 3.3 million and 6.6 million ha. In other words, the national annual rate of deforestation stands between 3 and 6%” (4). As a result, the area of forests destroyed between 1943 and 1993 in Vietnam was at least 76,000 square kilometers.



Forest cover in 1970



Forest cover in 1990

Vietnamese government officials and some researchers have pointed to the wars as the primary factor for deforestation in Vietnam. In fact, “... from 1945 to 1975, almost uninterrupted warfare resulted in the destruction of most of the remaining forest and farmland, giving rise to a new word – ecocide... American and Vietnamese scientists estimate that 22,000 square kilometers of forests and one-fifth of the country’s farmland were affected as a direct result of bombing, mechanized land clearing and defoliation” (5).

If this estimate is realistic, impacts of wars in 30 years was actually less than one-third the impacts of peace, i.e. growth and development, in 18 years between 1975 and 1993. According to De Koninck (4), “the massive development of the New Economic Zones” following the 1976 reunification was likely the primary cause.

Deforestation in Vietnam appears to continue at an alarming rate. In the Dak Lak province of the Central Highlands alone, the area of



Mangroves converted into shrimp ponds

tropical forests reduced at an average rate of approximately 4.5% per year, from 1,219,848 ha in 1995 to 1,000,000 ha in 2000 (6).

Since the last decade, the forest systems in Vietnam have faced with a new threat: destruction of mangroves for shrimp aquaculture. *“The rapid development of shrimp aquaculture has had a very serious impact on Vietnam’s mangrove forests. Over the last 50 years, Vietnam has lost at least 220,000 ha of mangrove forests – more than 80% of original cover has been deforested. In 2000, just 110,680 ha of mangrove were thought to remain. Although agriculture, salt pan development and the war-time use of chemicals were previously the most important threats to mangroves (see box), for the last decade the greatest threat has been shrimp aquaculture. In the Mekong Delta’s Ca Mau province, the area under shrimp farming trebled in the 12 months to mid-2001, and is now reported to cover over 202,000 ha. It has been estimated that mangroves cover in this area has dropped from over 200,000 ha prior to 1975 to 60,000 to 70,000 ha, and that almost all of this destruction has been from shrimp aquaculture.”* (7)

## Water Pollution



Untreated wastewater discharged into To Lich River

Rapid socio-economic growth since 1986 has resulted in water pollution in both urban and rural areas across the country, and quality of water resources in Vietnam appears to further degrade, at least in the short term.

Untreated wastewater from municipal and industrial areas has been discharged directly into rice fields, canals, lakes, and rivers without treatment. *“Nationally, the annual discharge of untreated sewage and industrial wastewater into major rivers is estimated at 240-300 million cubic meters, an amount the World Bank projects will grow 10-fold within 15 years [in 2010]”* (3).

Discharge of untreated wastewater has caused serious water pollution problems in major cities such as Ha Noi, Ho Chi Minh City, Hai Phong, Viet Tri, and Bien Hoa. According to the State of Environment in Vietnam 2001, *“most of the monitored rivers are found to be polluted with substances like N and P, from 4 to nearly 200 times compared with water resource of category A [for potable water] and from 2 to 20 times in comparison with water source of category B [for non-potable water]. Organic pollution in Sai Gon River, Vam Co Dong River and canals is very serious while it is rather severe in Dong Nai River”* (8). *“Rivers in the major cities have a biological oxygen demand (BOD) of 2.5-7.5 times the Vietnamese and European Community’s standards for surface waters that supply drinking water, indicating that the water has a high organic content. These rivers cannot support fish, since their dissolved oxygen is less than 4 milligram per liter”* (3).

In addition to organic substances and nutrients, toxic chemicals have also been found in wastewater. For example, studies for the Bai Bang Paper Mill in the Vinh Phu province revealed low levels of dioxins accumulated in biota, sludge from the receiving waters and the sedimentation basin (9), and polychlorinated biphenyls (PCBs) were found in municipal sewage from Ho Chi Minh City (3). Organochlorine pesticides and PCBs were also detected in marine sediment around Hau River estuaries (10).

In rural areas, according to Dr. Quy Vo, agricultural activities (including aquaculture and flood control structures) are causing “a serious problem with water pollution in many regions of the country” (3). Surface water has been polluted with nutrients and coliforms from fertilizers and human and animal wastes. “According to a report from the Ministry of Agriculture and Rural Development, the value of fecal coliforms, averaging between 1,500 and 3,500 MNP/100 ml [MPN/100 ml] along the Tien and Hau Rivers, increases to between 3,800 and 12,500 MNP/100 ml [MPN/100 ml] in irrigation and drainage canals” (11). Current international water quality standards require that no coliforms are present in drinking water. Arsenic has been found in groundwater at elevated concentrations in many areas in the Red River delta (12). In the Mekong River delta, the arsenic concentration in groundwater is approaching its allowable level (13). The arsenic problems, which are similar to those in India and Bangladesh, appear to be caused by construction of more than 210,000 wells in the Red River and Mekong River deltas since 1980.



Restroom over water

### Chemical Pollution

Improper use of large amounts of chemicals and pesticides for agricultural and industrial production and for fighting disease such as malaria has resulted in serious chemical pollution across the country. These chemicals may contain persistent organic pollutants (POPs) such as PCBs, (hexachlorobenzene) HCB, hexachlorocyclo-hexanes (HCHs), dioxins, furans, and DDT.

The amount of fertilizer used in 1996 was estimated at approximately 3,300,000 tons (14). “The total amount of NPK (N is used for nitrogen, P for  $P_2O_5$  and K for  $K_2O$ ) used over the past 10 years has increased on average by 11.6% per year. This is one of the highest increases in South East Asia; comparative figures are 3.2% for Indonesia; 7.2% for the Philippines and 12.1% for Thailand” (15).



Chemicals retailer

“According to data from the Ministry of Trade, in 2000, approximately 34,000 tons of pesticides were imported. This figure does not include approximately 15 [1.5] million tons of highly toxic pesticides illegally imported and sold in the market. Although domestic production of pesticides from 50 existing manufacturers exceeds 130,000 tons/year, which is double the demands, smuggling of illegal pesticides continues” (16).

Between 27,000 and 30,000 tons of oil contaminated with PCBs have been imported from former Soviet Union, China, and Rumania. PCBs are used extensively in transformer and large capacitors, hydraulic and heat transfer fluids, paint additives, and lubrication oil. A portion of the contaminated oil was discharged directly into the environment and caused environmental pollution (17).

DDT was first used in Vietnam to combat malaria in 1949. The quantity of DDT used, however, was 315 tons in 1961 and decreased to just 22 tons in 1974. Between 1957 and 1990, the quantity of imported DDT totaled 24,042 tons. Although the use of DDT was banned in 1992, importation and use of DDT continued until 1994. Between 1992 and 1994, the quantity of DDT imported from Russia totaled 423,358 tons (18).

*“Vietnam faces a tradeoff between trying to contain an environmental disease and allowing environmental contamination”* (3). In fact, DDT has shown up in the environment and in people. A study conducted in the Nghe An province indicates that DDT still remains at a storage facility, which was operated between 1965 and 1985. The DDT concentration varied between 3.38 and 960.6 mg/kg in soil samples and between 0.00012 and 0.00168 mg/l in water samples. For many years, strong odor spread as far as 600 meters from the source. Twenty-five people died because of cancers, and 22 cases of birth defects were reported (19).

High levels of DDT between 4,220 to 7,300 parts per billion (ppb) were detected in human breast milk in a 1989 study conducted by Dr. Arnold Schecter (3). Another study conducted in 1999 detected elevated levels of not only DDT and its metabolites (up to 1,600 ppb for DDT and 8,900 ppb for DDE) but also POPs such as HCB (up to 2.2 ppb), mirex (up to 2.2 ppb), dieldrin (up to 0.63 ppb), and PCBs (up to 54 ppb) (20).

In a 2001 study, dioxin and dioxin-like chemicals such as polychlorinated dioxins (PCDDs), polychlorinated dibenzo-furans (PCDFs), and PCBs were detected in 20 blood samples collected from residents of the Bien Hoa city. The concentrations ranged from 2.4 to 271 part per trillion (ppt) for dioxin, from 143 to 1,133 ppt for PCDDs, from 43.3 to 184 ppt for PCDFs, and from 31 to 156 ppt for PCBs (21).

In a 2002 study, POPs were detected in 16 food samples (fish, pork, beef, duck, and toad) also collected from the Bien Hoa city. The concentrations ranged from 0.025 to 331 parts per trillion (ppt) for dioxin (2,3,7,8-tetrachlorodibenzo-p-dioxin), from 17 to 8,216 ppt for PCB 118, from 8.6 to 919 ppt for HCHs, up to 1,391 ppt for HCB, from 46 to 44,722 ppt for DDT, and from 305 to 149,409 ppt for DDE. Polychlorinated dioxins (PCDDs) and polychlorinated dibenzo-furans (PCDFs) were also detected at lower levels (22).

Because of health and environmental problems from POPs in agriculture and industry, Vietnam was selected as one of nine case studies sponsored by the United Nations Environmental Program (UNEP) (23).

### **Air Pollution**

The most common air pollutant in Vietnam is dust. From 1995 to 1999, *“... most urban areas in Vietnam are polluted by dust, and some centers are polluted to an alarming degree... In residential areas next to factories or near large traffic roads, dust concentration is often higher 1.3 to threefold the acceptable level. The residential areas near brick and beer plants in Lao Cai town have dust concentration that is fivefold higher than the permitted standard. The places with highest levels of air pollution are residential areas near Hai*



Coping with air pollution in major cities

Phong cement plant, VICASA plant (Bien Hoa), Tan Binh industrial zone (Ho Chi Minh City), and Hon Gai coal select plant (Ha Long City)" (8). "According to the 1995 World Bank report, dust from cement factories coats much of Hai Phong, the third-largest city, exceeding government air standards by three to eight times." (3).



Air pollution from factories in urban areas

In general, daily average concentrations of CO and NO<sub>2</sub> are still below air quality standards in large cities such as Hanoi, Ho Chi Minh City, Da Nang, Hai Phong. The air quality standards, however, have been exceeded in some areas. "For example, in Dinh Tien Hoang-Dien Bien Phu cross-road ( Ho Chi Minh City), the daily average value (1999) of NO<sub>2</sub> content was 0.255 mg/m<sup>3</sup>, which was 2.55 times the permitted standard, and CO content was 15.46 mg/m<sup>3</sup>, which was more than three times the permitted standard. In Da Nang steel plant area, the daily average value (1999) of NO<sub>2</sub> content was 0.11 mg/m<sup>3</sup>, which is 1.1 times the permitted standard, and CO content was 12.2 mg/m<sup>3</sup>, which is 2.44 fold the permitted standard. In Thuong Dinh industrial zone (Ha Noi) in 1999, CO content was 7.2 mg/m<sup>3</sup> that is 1.4 times the permitted standard; in Hai Phong cement plant in 1999, CO concentration was 9.42 mg/m<sup>3</sup>, which is 1.88 times the permitted standard" (8).

Lead is another common air pollutant, especially in urban areas. "In Ho Chi Minh City in 1991, 750,000 motorcycles and 75,000 other vehicles, all burning leaded gasoline, contributed to an ambient lead level of 1-4 micrograms per cubic meter. In comparison, Chicago's airborne lead level in 1988 was less than 0.5 micrograms per cubic meter, according to research published in *Pediatrics* in 1994" (3). In Hanoi, the lead level in some areas exceeded 4 micrograms per cubic meter in 1998 (8).

"Impact of air pollution emission from several industries (for example: Cau Duong Brick enterprise, Hoang Thach Thermoelectric Plant etc) has caused damage to surrounding agricultural products. It has damaged the paddy fields and reduced productivity of rice by 20 to 50%. The ambient air of areas surrounding several industries (Hai Phong Cement Plant, Thuong Dinh industrial area etc) is heavily polluted by dust and SO<sub>2</sub> and directly affects human health e.g. increase in respiratory diseases by 1.5 - 2.5 times in comparison with other places, where the environment is non - polluted" (8)

Pollution from Lang Son Cement factory



Photo by Dinh Na (VNA)

## Solid Wastes



Trash scavengers

Municipal and industrial wastes are other contributing factors to environmental pollution in Vietnam. According to the State of the Environment in Vietnam 2001 (8), municipal wastes averaged approximately 16,200 tons/day in 1996, 19,300 tons/day in 1997, and increased to approximately 22,200 tons/day in 1998. These amounts did not include approximately 800 tons of cesspool sludge dumped into landfills everyday. Industrial wastes were estimated between 15 to 26 percent of municipal wastes, in which between 35 and 41 percent were hazardous. Hazardous wastes were estimated at approximately

2,200 tons/day in 1998 and 2,600 tons/day in 1999. Medical wastes were estimated between 50 to 75 tons/day. Most hazardous wastes including medical wastes were not treated or were treated inadequately and then dumped together with municipal wastes into open landfills. Approximately 13 and 20 percent of solid wastes were reused or recycled, mainly done by scavengers, who collect plastic, paper, metal and glass.

Lack of an adequate collection and disposal system has encouraged illegal dumping, especially into canals and rivers causing serious environmental and transportation problems for these waterways (24). In Ho Chi Minh City, approximately 100 tons of trash is dumped into 5 major canals every day, and the total amount of trash floating in these canals was estimated at 53,000 tons (25). At existing sanitary landfills such as Dong Thanh, Tam Tan, and Phuoc Hiep landfills in Ho Chi Minh City, *“... there is no liner in the bottom and on the walls, no leachate collection and control or gas system, and no cover layer and no fence on traditional landfills”* (8). As a result, these landfills have become sources of environmental pollution in their vicinities (26,27,28).



Floating trash in canals

## EFFECTS OF ENVIRONMENTAL POLLUTION ON DEVELOPMENT



Aquacultural fish killed by water pollution in Dong Nai River

The environmental pollution has already shown its impacts on the social and economic development in Vietnam. Water pollution has reduced availability of fresh water, killed aquacultural fish in rivers (29,30), and damaged crops and plants along polluted canals and rivers used as sources for irrigation water (31). *“The World Bank is soliciting bids for a \$150 million project to build new raw water mains, expand and update treatment plants, and lay distribution piping in four large cities”* (3). Because of the use of chloramphenicol and nitrofurans to cope with water pollution, *“... the Vietnam’s seafood industry has lost scores of US dollars recently”* (32). Costs for

remediation of water pollution are even higher. *“In the Red River delta alone, remediation of water pollution is estimated at approximately 4 billion \$US. Without remediation, costs of water pollution may reach 8 to 12 billion \$US”* (33). In the Saigon and Dong Nai river basins, the costs to protect water from pollution were estimated at approximately 130 million \$US (34).

Chemical pollution has threatened public health and safety and affected the quality of a variety of agricultural products such as meats, seafoods, fruits, and vegetables. The most common threat is food poisoning. In 1998 and 1999, 8,758 cases of pesticides poisoning were reported with 10,034 persons seriously affected and 198 deaths. The numbers increased to 6,962 cases, 7,613 affected persons, and 187 deaths in 2001 (35). Long-term health effects from chemical pollution including death, cancers, and birth defects have been observed and reported (17,36). A budget of approximately 30 million \$US was approved for food safety programs in 2003 (37).

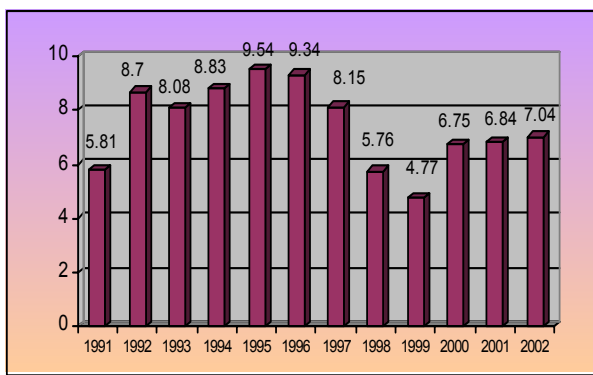


Birth defects caused by pesticides pollution

The tourist industry may have been affected because of environmental pollution at tourist attractions (38), but effects may not have been recognized.

Effects of environmental pollution on development, i.e. economic costs resulting from environmental pollution, are very difficult to quantify or estimate. According to studies conducted in China, *“...the annual economic cost of environmental degradation in China can be illustrated in terms of income loss as a result of deforestation, environmental pollution, and degradation of natural resources... The final outcome is quite stunning. On an annual basis, economic losses to China as a result of environmental degradation equal 382.61 billion yuan.*

*This figure represents 18.9 [percent] of China’s total national income (2022.3 billion yuan in 1992)”* (39).



Vietnam’s GDP growth rate

According to the Vietnam General Statistical Office, the gross domestic product (GDP) increased at an average rate of approximately 7.5 percent between 1991 and 2002 (40). But this increase did not appear to include “high environmental costs.” Even if the environmental costs are assumed to be only one-half of those in China, i.e. approximately 9.5 percent, the GDP actually decreased at a rate of approximately 2.0 percent.

## ENVIRONMENTAL PROTECTION MEASURES AND ACHIEVEMENT

*“Vietnam’s environmental policies date to 1985, with the development of a National Conservation Strategy that urged maintenance of ecological and life-support processes of the country’s various ecosystems and the preservation of its genetic diversity. In 1992, a national plan was developed to coordinate the development of regulations, information systems, and*



*strategic for sustainable development, and to promote the use of environmental impact assessments. This in turn led to the passage of the Environmental Protection Law in 1993, giving environmental authority to the Ministry of Science, Technology, and Environment” (3).*

In addition to the Environmental Protection Law, other laws and regulations were also passed. These include the Forest Protection and Development Law (1991), the People Health Protection Law (1989); the Land Use Law (1993), the Law of Oil and Petrol (1993), the Mineral Resources Law (1996), the Water Resources Law (1998), the Dykes Protection Ordinance (1989), the Criminal Affair Law (reform, 1999), the Ordinance of Resources Taxes (1989), the Ordinance of Aquatic Resource Protection (1989), the Ordinance of Radiation Safety and Control (1996), and the Ordinance of Vegetation Protection and Quarantine (1993) (8).

Although environmental protection has been strengthened during the last decade, the Vietnam environment continues to degrade. *“The socio-economic development process during the industrialisation period, together with urbanisation and rapid population growth exerts a high pressure on the environment and natural resources. The forest area continues to be degraded and destroyed. Mineral products are still exploited recklessly. Land and soil are being eroded and degraded. Both terrestrial and marine biodiversity have gradually been depleted. The surface water and ground water resources are more and more polluted and face the risk of depletion in some regions. Water pollution has also started to occur in coastal areas. The environment around many urban centres and industrial areas has been polluted by wastewater, emissions and solid wastes. Environmental sanitary conditions in rural areas are still very poor...” (8)*



US-Vietnam conference on dioxin in Hanoi

Vietnamese officials and some anti-war organizations claim that environmental degradation in Vietnam is caused by “consequences of the Vietnam War” and by “... a lack of appropriate environmental standards, coordination and consistency in the implementation of Vietnam's various legal provisions on the environment. This is due to a shortage of necessary facilities for monitoring environmental policy implementation and a shortage of human resources in environmental control units. There is a lack of public awareness for the need for environmental protection” (41).

But the true cause appears to be the deficiency of the existing system for environmental protection, especially in the areas of management and remediation strategies. According to Dr. Judith Ladinsky, a professor of the University of Wisconsin-Madison and chair of the U.S. Committee for Scientific Cooperation with Vietnam, Vietnam officials should insist “... on real, not paper, environmental protection...” (3). Strategies to remediate environmental pollution such as blame on the consequences of the Vietnam War (42), the relocation of documented polluters from urban to suburban or rural areas (43), and the diversion of water from polluted canals in Ho Chi Minh City into the Vam Co and Saigon Rivers (44,45) do not appear to be appropriate. These remediation strategies do not likely solve pollution problems. On the contrary, they spread the pollution into clean or less-polluted areas and may make the pollution problems

worse. In fact, "... numerous relocated factories in new industrial areas continue to pollute the environment" (43).

## **CONCLUSIONS AND RECOMMENDATIONS**

Since the renovation policy (doi moi) was initiated in 1986, Vietnam has experienced a relatively rapid economic growth at an average rate of 7.5 percent of the GDP during the last 12 years. This economic growth, however, has come with the expense of the environment. Vietnam now is facing with serious environmental problems.

Available data shows that the area of forests destroyed after 1975 has trebled the impacts of wars between 1945 and 1975, and deforestation still continues at an alarming rate. The forest systems in Vietnam have also faced with a new threat: destruction of mangroves for shrimp aquaculture. There are practically no wastewater treatment facilities. Untreated wastewater from municipal and industrial areas has been discharged directly into rice fields and water bodies and caused serious water pollution in major cities and river basins. In rural areas, environmental conditions are not better. Surface water has been polluted with nutrients, coliforms, and possibly pesticides from agricultural activities and human and animal wastes. Improper use of large amounts of chemicals and pesticides for agricultural and industrial production and for fighting disease (DDT) has resulted in serious chemical pollution across the country. Toxic chemicals including POPs have been found in the environment, foods, breast milk, and blood. Several toxic chemicals have elevated concentrations much higher than those for dioxin. Most of urban areas are polluted with dust and smoke, especially in the areas adjacent to industrial areas, thermo power plants, and cement plants. Lack of an adequate system for collection and disposal of solid wastes has encouraged illegal dumping, especially into canals and rivers. Municipal, medical, and industrial wastes have been dumped in open landfills. These landfills were not properly designed and have become sources of environmental pollution in their vicinities.

The environmental pollution has already shown its impacts on the social and economic development in Vietnam. Water pollution has reduced availability of fresh water, killed aquacultural fish in the rivers, and damaged crops and plants along polluted canals and rivers. Chemical pollution has threatened public health and safety and affected the quality of agricultural products. Both short-term and long-term effects including food poisoning, cancers, birth defects, and death have been observed and reported. It is difficult to quantify or estimate the economic costs from environmental pollution, especially in Vietnam, but the economic losses due to environmental pollution may exceed 9.5 percent of the GDP based on a study conducted in China.

Although environmental protection has been strengthened during the last decade, the Vietnam environment continues to degrade at an alarming rate. Vietnamese officials and some anti-war organizations claim that environmental degradation in Vietnam is caused by "consequences of the Vietnam War" and by a lack of environmental standards, technical tools, and public awareness. But the true cause appears to be the deficiency of the existing system for environmental protection, especially in the areas of management and remediation strategies.

In order to maintain sustainable development, Vietnam should have a sustainable environment. Extensive changes should be made, as soon as possible, to improve the existing system for environmental protection including capacity building, technical training and education, and proper and effective environmental laws and regulations. Policies should focus on (1) improving

capability in management and environmental know-how, (2) improving environmental education and training in schools and universities, (3) improving capability of responsible agencies, (4) prioritizing remediation objectives to optimize effectiveness, (5) improving public awareness on environmental issues, (6) controlling and encouraging the safe use of the pesticides and chemicals for agricultural and industrial production (7) seeking international assistance to eliminate POPs, (8) cooperating with international communities and facilitating their cooperation, and (9) preparing and implementing appropriate measures to effectively control the disposal of wastes (solid, liquid, and gas) from industrial and municipal areas.

## REFERENCES

- (1) Harashima, Yohei. July 2000. "Effects of Economic Growth on Environmental Policies in Northeast Asia." <http://www.findarticles.com>
- (2) Faversham House Group Ltd. 2002. "Thai economic growth has been at the expense of the environment." <http://www.edie.com>
- (3) Tenenbaum, David. December 1996. "The Value of Vietnam." *Environmental Health Perspectives*, Volume 104, Number 12. <http://ehpnet1.niehs.nih.gov>
- (4) De Koninck, Rodolphe. 1999. *Deforestation in Vietnam*. International Development Research Center, Ottawa, Canada. [www.idrc.ca](http://www.idrc.ca)
- (5) Collins, M., ed. 1990. *The Last Rain Forests. A World Conservation Atlas*. Oxford University Press, New York, New York.
- (6) K.B. Dinh. August 8, 2002. "Daklak mat 1.000 ha rung." *Nguoi Lao Dong Newspaper* (in Vietnamese), Hanoi, Vietnam. [www.nld.com.vn](http://www.nld.com.vn)
- (7) Environmental Justice Foundation. 2003. *Risky Business: Vietnamese Shrimp Aquaculture – Impacts and Improvements*. Environmental Justice Foundation, London, UK. [www.ejfoundation.org](http://www.ejfoundation.org)
- (8) Ministry of Science, Technology and Environment of Vietnam. June 2002. "State of the Environment in Vietnam 2001." <http://www.rrcap.unep.org/reports>
- (9) Nguyen, Kim Oanh T., Bengtsson, B-E, Reutergårdh, L-B, Bergqvist, P A, Hynning, P-C and Remberger, M. 1995. "Levels of contaminants in effluent, sediment, and biota from bai bang, a bleached kraft pulp and paper mill in Vietnam." *Arch Environ Contam Toxicol* 29: 506-516.
- (10) Mai, Nhuan T. et al. April 2002. "Primary Research on the Application of Molecular Markers in Investigation of Environmental Organic Geochemistry in the Vietnamese Coastal Zone." Presented at Symposium on Tracing Pollutants from Agrochemical Use: Focus on EDC Pollution, 15-16 April 2002, Hanoi, Vietnam.
- (11) Nhan Dan Newspaper. November 14, 2002. "Tinh trang o nhiem moi truong nuoc hien nay" (in Vietnamese). Hanoi, Vietnam. [www.nhandan.org.vn](http://www.nhandan.org.vn)

- (12) Quang Ha. March 6, 2002. "Thach tin trong nuoc ngam: Nguy co co that" (in Vietnamese). *Lao Dong Newspaper*, Hanoi, Vietnam. [www.laodong.com.vn](http://www.laodong.com.vn)
- (13) Mai, Truyet T. and Nguyen D. Son. November 18, 2000. "Arsenic Contamination and Potential Health Effects in Mekong Delta" Presented at the VAST-Mekong Forum conference on The Mekong River: Development Conflicts and Calamity, Santa Ana, California, USA.
- (14) GINC Vietnam. "Classification of use of chemicals." Hanoi, Vietnam. <http://www.vnnews.com/coci/ginc/index.htm>
- (15) Nguyen, Luong A. and Dang Quoc Nam. 1999. "An important approach to the protection of human health and sustainable development in Vietnam." *Asian-Pacific Newsletter*.
- (16) Ha Phuong. April 20, 2002. "Chua kiem soat duoc viec su dung thuoc bao ve thuc vat." *Nguoi Lao Dong Newspaper*, Hanoi, Vietnam. [www.nld.com.vn](http://www.nld.com.vn)
- (17) Nguyen, Sinh N. et al. March 1999. "The Persistent Organic Pollutants and Their Management in Vietnam." *Proceedings of the Regional Workshop on the Management of Persistent Organic Pollutants (POPs)*, Hanoi, Vietnam, 16-19 March, 1999.
- (18) Nguyen, Hien V. "Malaria and Its Control in Vietnam." Ministry of Health, Hanoi, Vietnam.
- (19) GINC Vietnam. "Brief Report on Contamination of Pesticide Influence to Environment and People's Health in Hoa Son Subdistrict, Do Luong District, Nghe An Province." Hanoi, Vietnam. <http://www.vnnews.com/coci/ginc/index.htm>
- (20) Hatfield Consultants Ltd. and 10-80 Committee. April 2001. *Development of Impact Mitigation Strategies Related to the Use of Agent Orange Herbicide in the Aluoi Valley, Vietnam*. West Vancouver, Canada.
- (21) Schechter, Arnold et al. May 2001. "Recent Dioxin Contamination From Agent Orange in Residents of a Southern Vietnam City." *Journal of Occupational and Environmental Medicine*, Volume 45, Number 5:435-443.
- (22) Schechter, Arnold et al. 2003. "Food as a Source of Dioxin Exposure in the Residents of Bien Hoa City, Vietnam." *Journal of Occupational and Environmental Medicine*, Volume 45, Number 8:781-788.
- (23) UNEP. "POPs Related Case Studies." *Proceedings of the Regional Workshop on the Management of Persistent Organic Pollutants (POPs)*, Hanoi, Vietnam, 16-19 March, 1999.
- (24) T. Mai and N. Hau. May 24, 2002. "76 km kenh rach dang can dan vi rac" (in Vietnamese). *Nguoi Lao Dong Newspaper*, Hanoi, Vietnam. [www.nld.com.vn](http://www.nld.com.vn)
- (25) Lao Dong Newspaper. September 7, 2003. "Hoa Binh – Ha Tay – Ha Noi – Ninh Binh – Nam Dinh: Chung song o nhiem" (in Vietnamese). *Lao Dong Newspaper*, Hanoi, Vietnam. [www.laodong.com.vn](http://www.laodong.com.vn)

- (26) Tuoi Tre Newspaper. December 20, 2002. “Bai rac Dong Thanh o nhiem mui hoi trong pham vi 5.000 m” (in Vietnamese). Ho Chi Minh City, Vietnam. [www.vnexpress.com](http://www.vnexpress.com)
- (27) Thu Mai and Doan Phu. January 17, 2003. “Do rac ve Tam Tan, hau qua kho luong” (in Vietnamese). *Nguoi Lao Dong Newspaper*. Hanoi, Vietnam. [www.nld.com.vn](http://www.nld.com.vn)
- (28) Doan Phu. May 9, 2002. “Bai rac Phuoc Hiep, huyen Cu Chi: Vua hoat dong da gay o nhiem” (in Vietnamese). *Nguoi Lao Dong Newspaper*. Hanoi, Vietnam. [www.nld.com.vn](http://www.nld.com.vn)
- (29) Phan, Cong T. Jan 21, 2003. “Ve vu ca chet o Dong Nai: Dan lang be dang can cuu tro, boi thuong” (in Vietnamese). *Lao Dong Newspaper*, Hanoi, Vietnam. [www.laodong.com.vn](http://www.laodong.com.vn)
- (30) Tuoi Tre Newspaper. February 6, 2003. “Ca chet hang loat tren song Vam Co Dong” (in Vietnamese). Ho Chi Minh City, Vietnam. [www.vnexpress.com](http://www.vnexpress.com)
- (31) Tuoi Tre Newspaper. May 17, 2002. “TP HCM: O nhiem nghiem trong o Kenh Thay Cai” (in Vietnamese). Ho Chi Minh City, Vietnam. [www.vnexpress.com](http://www.vnexpress.com)
- (32) Thanh Nien Newspaper. September 12, 2002. “Nhiều thực phẩm nhập từ EU và Mỹ có độ lượng kháng sinh”, Hanoi, Vietnam. [www.vnexpress.com](http://www.vnexpress.com)
- (33) Pham, Xa. August 28, 2003. “O nhiem nuoc – Bai toan kho giai” (in Vietnamese) *Sai Gon Giai Phong Newspaper*, Ho Chi Minh City, Vietnam. [www.sggp.org.vn](http://www.sggp.org.vn)
- (34) Lao Dong Newspaper. September 12, 2003. “Can hon 2 nghin ti dong bao ve moi truong nuoc song Gai Gon – Dong Nai” (in Vietnamese). *Lao Dong Newspaper*, Hanoi, Vietnam. [www.laodong.com.vn](http://www.laodong.com.vn)
- (35) Nhan Dan Newspaper. March 13, 2002. “Nam 2001, hon 500 nguoi chet va tai nan lao dong va nhiem doc.” (in Vietnamese). *Nhan Dan Newspaper*, Hanoi, Vietnam. [www.nhandan.org.vn](http://www.nhandan.org.vn)
- (36) Phan, Phiet T. June 15, 2001. “Nguoi ca o Hop Thanh” (in Vietnamese). *Lao Dong Newspaper*, Hanoi, Vietnam. [www.laodong.com.vn](http://www.laodong.com.vn)
- (37) Nhan Dan Newspaper. December 6, 2002. “40 ty dong cho cong tac bao dam an toan ve sinh thuc pham” (in Vietnamese). *Nhan Dan Newspaper*, Hanoi, Vietnam. [www.nhandan.org.vn](http://www.nhandan.org.vn)
- (38) Manh Hung. September 14, 2003. “Khu du lich Tam Dao – bon be rac thai” (in Vietnamese). *Lao Dong Newspaper*, Hanoi, Vietnam. [www.laodong.com.vn](http://www.laodong.com.vn)
- (39) Mao, Yu-Shi. “The Economic Cost of Environmental Degradation in China – A Summary.” [www.library.utoronto.ca/pccs/state/chinaeco/summary.htm](http://www.library.utoronto.ca/pccs/state/chinaeco/summary.htm)
- (40) Vietnam Trade Office. “Economic Performance” [www.vietnam-ustrade.org](http://www.vietnam-ustrade.org)

- (41) Nhan Dan Newspaper. November 14, 2002. "Status of water pollution in Vietnam (report of the Congressional Committee on Science, Technology, and Environment)" (in Vietnamese). *Nhan Dan Newspaper*, Hanoi, Vietnam. [www.nhandan.org.vn](http://www.nhandan.org.vn)
- (42) Environmental Conference on Cambodia, Laos and Vietnam. July 28, 2002. "Declaration on the long-term consequences of war in Cambodia, Laos and Vietnam." Stockholm, Sweden. [www.nnn.se/vietnam](http://www.nnn.se/vietnam)
- (43) Huu Thai. August 11, 2003. "Thieu he thong xu ly nuoc thai: Cac KCN dang thanh 'o' o nhien!" (in Vietnamese). *Sai Gon Giai Phong Newspaper*, Ho Chi Minh City, Vietnam. [www.sggp.org.vn](http://www.sggp.org.vn)
- (44) Nong, Y K. January 13, 2003. "32 doanh nghiep bien song Sai Gon thanh song den" (in Vietnamese). *Nguoi Lao Dong Newspaper*, Hanoi, Vietnam. [www.nld.com.vn](http://www.nld.com.vn)
- (45) T.H.T. September 5, 2003. "TP. Ho Chi Minh: Khoi cong xay dung tram bom chong ngap cho 1,2 trieu dan" (in Vietnamese). *Lao Dong Newspaper*, Hanoi, Vietnam. [www.laodong.com.vn](http://www.laodong.com.vn)