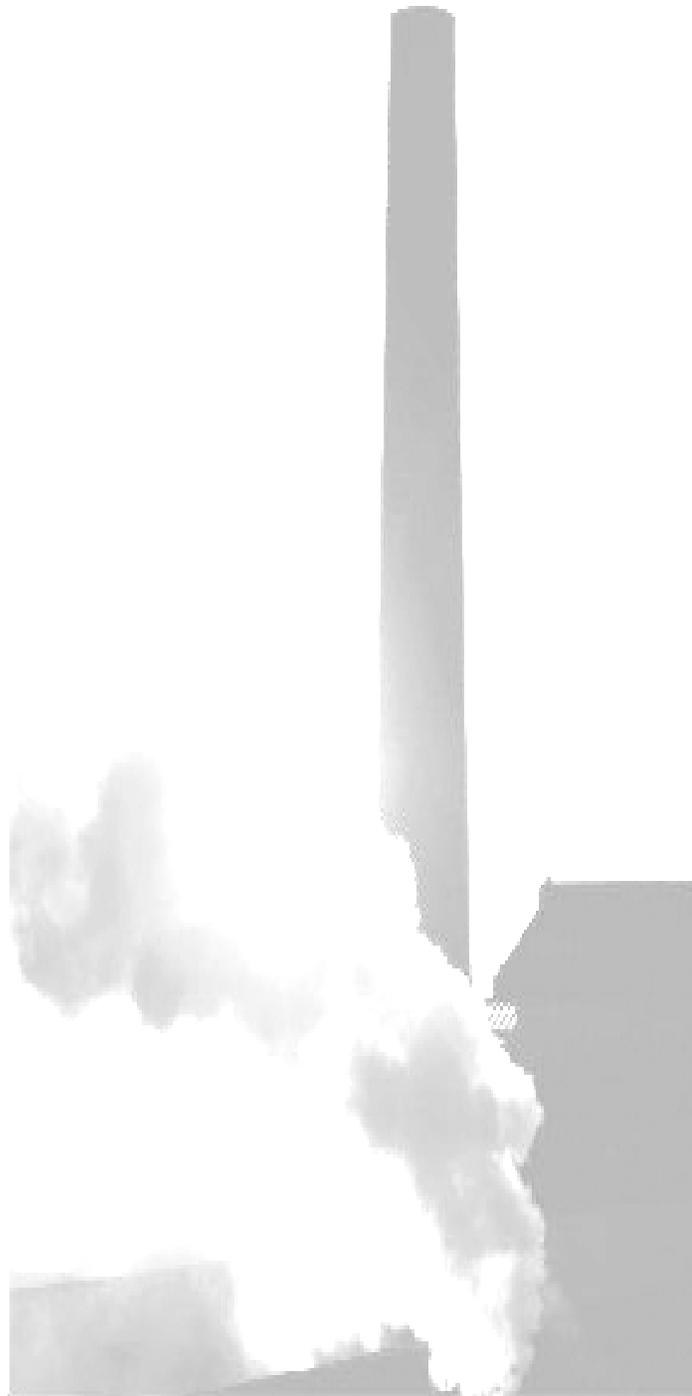


The Hidden Tragedy

Pollution in the
Developing
World

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INTRODUCTION

This paper aims to bring attention to the issue of environmental pollution in developing nations and to suggest a practical approach for combating this problem.

Until recently, the global environmental agenda has tended to focus on the impacts of *developed* countries on the environment. However, a growing number of studies are showing that environmental pollution in *developing* nations, especially in densely populated urban areas and their surrounding slums, contributes to the deaths and disabilities of millions of people annually.

Generally, these pollution problems are ones for which the developed world has already found solutions. However, missing all too often in developing countries are not only the resources to come up with practical solutions, but also the necessary political and legal infrastructure to support these solutions, and the community involvement required to make them sustainable at a social level.

Powerful results can be generated when there are local groups to spearhead their own solutions, with the appropriate mixture of involvement from governments and NGOs (non-governmental organizations). Blacksmith Institute's mission is to provide strategic, financial, and technical support to these local champions in their efforts to solve specific issues. The approach outlined in this document is based on this model, which we believe has the potential to raise the quality of life for hundreds of millions of people throughout the developing world.

THE PROBLEM

Twenty percent of the total burden of disease in the developing world is due to environmental pollution.

The main objective of environmental protection is the safeguarding of human health. Although the link between health and environmental factors – from neighborhood to global – has long been recognized, the true extent of health impacts resulting from exposure to environmental factors has not been properly quantified until recently.



Industrial pollution in a suburban waterway

Recent estimates, and these probably understate the true extent of the problem, indicate that *significant environmental health risks are responsible for as much as one-fifth of the total burden of disease in the developing world* – more than the combined impacts of malnutrition and all other preventable risk factors and groups of diseases.¹

Most at risk from environmental pollution are the 1.3 billion people in the developing countries of South East Asia and sub-Saharan Africa – almost one quarter of the world's population.

Consider:

1.1 billion people lack adequate shelter

1.4 billion people lack access to safe water

2.9 billion people lack proper sanitation

2.8 million people die each year from exposure to indoor air pollution

1.8 million people die each year from exposure to urban air pollution

One in five children in the developing world do not live to see their fifth birthday

Lack of adequate water, sanitation, and hygiene causes seven percent of death and disease globally

The great majority of pollution-related deaths are avoidable. They are the result of problems that have already been eradicated, or are rapidly being solved, in the world's more affluent nations, and in many cases, elsewhere in the developing world.

The costs of such pollution to developing countries are enormous: destabilized economies, local (and even international) political instability, escalating public health costs, lost productivity, damage to ecosystems, and a legacy of problems passed down to future generations.

So why isn't more being done?

For many of the developing world's cash-strapped nations, many of which are in a constant cycle of rebuilding after wars, famines, or natural disasters, cleaning up the environment, let alone protecting it, is low on their list of priorities. Powerful vested interests often have a stake in maintaining the status quo of being able to pollute without regard for the community. Those most affected are the poor and disenfranchised, whose voices go unheard. Rarely is sound environmental management seen as a necessary *prerequisite* for a thriving, prosperous economy.



This local restaurant is next to an open sewer

The lack of attention given to this issue by governments and NGOs represents a striking failure to recognize pollution's full environmental and human impacts – and the significant opportunities for saving lives, reducing disease, generating income, and reviving local and national economies that tackling this problem would generate. Solutions do exist, as do those who are ready and willing to implement them. Often all they need to get started is encouragement and support.

It will take time, effort, and resources to solve these problems, and the issues involved are complex; but these are not excuses for inaction, nor are more studies and analyses needed. Solutions exist, and so do those who are ready and willing to implement them. Often all they need to get started is encouragement and support.

This report outlines the pollution-related environmental problems developing countries are facing and offers examples of practical solutions that local leaders are using to improve the quality of life in communities across the developing world. We hope you will find these stories as inspiring to read as we have. These are the stories that drive our work.

CASE STUDY 1: ENVIRONMENTAL RESTORATION OF MSIMBAZI RIVER AND ITS CATCHMENT – DAR ES SALAAM, TANZANIA

EnviPro is a group of environmental professionals from the University of Dar es Salaam who came together and formed an advocacy group with the support of the Blacksmith Institute. They Msimbazi River is the largest river running through the city. It is severely polluted by sewage runoff. EnviPro has been working on an outline of engineering design options and implementation costs for the environmental restoration of the Msimbazi River and its catchment in Dar es Salaam. They have also been holding meetings with the Municipal Council to discuss the proposed technical solution and how the Council will be involved in the implementation plan of Phase I, which concerns the management of liquid and solid wastes from the Vingunguti Abattoir. As of October, 2001, the Municipal Council has supported EnviPro's proposed solution, and has accepted the proposal report and agreed to contribute part of the implementation cost.

**for more information on the work of the Blacksmith Institute, please see Appendix 3, p. 15*

THE POVERTY–POLLUTION CONNECTION

*In developing countries, about one third of the population lives on less than one dollar per day.*²



City streets run with garbage and sewage

Environmental health risks are highest in regions housing the majority of the world's poor: Twenty seven percent of the total burden of disease in Africa, and 18% in Asia, is environmentally related.³

There is a clear link between poverty and pollution. Poverty determines the environmental risks individuals face: where they live, their access to clean water and proper sanitation, and their exposure to various kinds of environmental pollutants, while limiting their access to adequate resources for dealing with those risks. Unable to afford clean fuels, the poor depend on dirty fuels for cooking and heating, filling their dwellings with smoke; their dwellings are usually located near roadways, waste dumps, or industrial areas, subjecting them to a daily barrage of air pollution, noise, and the risks of toxic spills.

Any efforts to mitigate the effects of environmental pollution necessarily include issues of distribution of wealth. Without opportunities to achieve economic security, the world's poor will always bear an unfair burden of the health risks arising from the prosperity enjoyed by their more affluent neighbors.

BOX 1: ENVIRONMENTAL POLLUTION & HEALTH

Environmental threats to human health in the developing world fall into two broad categories:

Traditional hazards associated with poverty and underdevelopment:

Vector-borne diseases (e.g. malaria, yellow fever) and lack of access to essential environmental resources such as clean water, food, air, fuel, sanitary waste disposal, and adequate shelter.

Modern hazards resulting from rapid development without environmental safeguards:

Urban air pollution, contaminated water and soil, noise, and lack of proper sanitary disposal for increasing quantities of waste from household garbage to industrial and medical waste.

Until recently, most people suffering from “traditional” hazards have lived in rural areas of the developing world. With rapid, uncontrolled urbanization and the consequent unchecked growth of slums surrounding cities, these already severe threats are now combining with “modern” hazards to compound the risks to human health.

RISING POPULATION FUELS URBAN GROWTH

By 2025, the world's urban population is projected to double to more than five billion; two-thirds of the world's population will be living in towns and cities by then, and 90% of this projected increase will have occurred in developing countries.⁴

Some of the fastest population and urbanization growth rates are taking place in the world's least developed countries. At five percent per year, Africa has the highest urban growth rate in the world; the emerging economies of the Asia-Pacific region are not far behind, with average annual growth rates of around four percent.⁵

Rapid, uncontrolled urbanization magnifies the impacts of existing environmental problems, placing slum dwellers – sometimes up to one half of urban populations – under the double jeopardy of traditional diseases associated with unsanitary conditions and pollutants resulting from unchecked industrialization. Drinking water becomes contaminated both by feces and industrial chemicals. Air is polluted from households burning dirty fuels and unregulated industrial use of fossil fuels. Overcrowded, poorly



A city's waste dump leaches directly into a river

drained, lacking clean drinking water, basic sanitation, and health care services, urban slums become breeding grounds for insects, rodents, and a variety of biological pathogens, their dwellers exposed to high levels of air pollution, noise, and the greatly increased potential for industrial accidents and toxic spills.

The trend is clear and disturbing: the developing world's urban poor – already weakened by poverty and inadequate nutrition – are becoming increasingly subject to the burdens of both traditional environmental health problems and the emerging problems of industrial pollution.

INDUSTRIALIZATION – TOO MUCH TOO SOON?

In the world's most rapidly developing nations, industrialization is occurring at triple the speed that the Industrial Revolution took place in the West.

Properly regulated industrialization is key to the economic and social prosperity of developing nations. However, this prosperity is being undermined by serious damage to the environment and human health occurring as the result of rapid, uncontrolled industrial expansion – annual growth rates of up to eighteen percent are common in some developing countries, far outstripping those of the developed world.⁶

In most of these countries, the legislative and regulatory structures that exist in the developed world are not yet in place, and toxic pollutants are released unchecked into the environment with little knowledge of or concern for their effects. Furthermore, substances having known risks to human health are still widely available, and though banned in developed countries, many are still being produced for export to developed nations.



Industrial waste in Zambia from copper mining

The greatest threats to human health from industrialization are injuries resulting from workplace accidents, acute chemical poisoning in the workplace or in surrounding areas, and long-term exposure to chemicals released into the general environment. The health impacts of these first two threats are well documented, and even though the impacts of long-term exposures are not yet fully understood, caution is appropriate. Many chemicals such as asbestos and PCBs, once considered safe, are now banned in the developed world.

Industries in some developing countries have reduced the impacts of these pollutants on their populations by implementing cleaner production or “eco-efficiency” initiatives. Encouraging similar approaches in the world's newest industrializing nations will be vital to their future prosperity if they are to avoid the devastation that has already occurred in many parts of the developing world as a result of industrialization undertaken without regard for environmental consequences.

CHILDREN ARE ESPECIALLY AT RISK

One in five children in the developing world do not live to see their fifth birthday; two-thirds of preventable diseases occurring worldwide from environmental causes occur among children.⁷

Many of the developing world's children face daily exposure not only to hazards resulting from lack of access to essential environmental resources, but also to a barrage of toxic chemicals and other pollutants stemming from unchecked development. These pollutants include agricultural chemicals,

heavy metals such as arsenic and lead, industrial chemicals, and a variety of air pollutants, which have all been linked with birth defects, cancer, and weakening of the human immune system.



Town square laid waste by SO₂ emissions

Children are much more susceptible to these hazards than adults. Exposure to toxic agents can occur before conception if the mother is exposed to pollutants such as lead and mercury that cross the placenta, and there are wide ranges of chemicals that can be transferred through breast milk. Many children work in fields that have been sprayed with pesticides, and their parents may carry home chemical residues on their clothing. Having higher metabolic rates than adults, children breathe air from closer to the ground, and ingest higher concentrations of pollutants; inhaling them more deeply into their lungs than do adults, they retain these pollutants and absorb them into their metabolisms more readily.

It is often said that a nation's children are its greatest resource. Any accurate reckoning of the global costs of environmental related deaths and injuries must take into account the huge wasted human and economic potential of environmental pollution's impact on children.

BOX 2: CHEMICAL HEALTH HAZARDS IN THE ENVIRONMENT

Chemicals found in food and water:

- lead (in food and drinking water, especially where there is a combination of lead pipes and acidic water)
- aflatoxins and other natural food toxicants
- nitrates in drinking water (and their conversion into nitrites in the body)
- trace pollutants in water supplies, many from agrochemicals
- aluminum (food and drinking water)
- arsenic and mercury

Chemicals commonly found in the indoor environment (home/workplace):

- carbon monoxide from incomplete combustion of fossil fuels
- lead paint (ingested by children)
- asbestos from roofing insulation or air conditioning ducts
- smoke from combustion of coal and wood (or other biomass fuel)
- tobacco smoke
- potentially dangerous chemicals used without adequate safeguards
- formaldehyde (mostly from insulation, also in some wood preservatives and adhesives)

Chemicals found outdoors in urban areas in the air (ambient):

- lead (exhausts of vehicles using leaded gasoline, from external paint, some industrial emissions)
- sulphur dioxide, sulphates, and smoke/suspended particles (mainly from coal or heavy oil combustion by industries, power stations, and households)
- oxides of nitrogen (in most cities, mostly from motor vehicle emissions; also some industries)
- hydrocarbons (motor vehicles, petrol stations, some industries)
- ozone (secondary pollutant formed by reaction of nitrogen dioxide and hydrocarbons in sunlight)
- carbon monoxide (incomplete combustion of fossil fuels, mostly by motor vehicles)
- volatile organic compounds (VOCs) (a considerable range of such compounds are or may be hazardous)

Chemicals that may contaminate land sites:

- cadmium and mercury compounds and other heavy metal compounds (industrial wastes)
- dioxins, PCBs, arsenic, organochlorine pesticides (industrial wastes)

Also in both indoor and outdoor settings:

- micropollutants
- mixtures of each at trace level (with possible additive effects)

Source: World Resources Institute in collaboration with United Nations Environment Program, the United Nations Development Program, and the World Bank, *World Resources Report 1998-99* (Oxford University Press, New York, 2000), p.29

THE KEY ISSUES

Water Supplies & Sanitation

In many of the developing world's cities and towns, sewage systems are either non-existent, limited to only affluent parts of town, and/or not functioning properly. Untreated human waste often flows directly into water supplies that are used for drinking, cooking, and bathing. Even where sewage systems do exist, overflows during rainy periods are common, leading to outbreaks of disease, the most prevalent of these being diarrhea, which claims the lives of over 2.5 million people per year. Most of these deaths are children aged less than five years old.



Raw sewage empties into an open pond

Worldwide, 1.4 billion people do not have access to safe drinking water, and 2.9 billion lack access to adequate sanitation. Inadequate supplies and poor water quality are responsible for an estimated seven percent of all deaths and disease globally.^{8,9}

Improvements to water supplies and sanitation services would greatly reduce the incidence of water-borne disease and improve the quality of life for millions throughout the developing world. Low-cost, simple solutions like that described below in Case Study 2 could greatly reduce the incidence of diarrhea, ascariasis, guinea worm, schistosomiasis, and other prevalent water-borne diseases.¹⁰

Such improvements would also benefit communities by alleviating the need to spend several hours per day collecting water. Individuals would be freed up to pursue other productive activities – education, employment, and community projects – potentially releasing a vast reservoir of untapped human and economic potential.

CASE STUDY 2: COMMUNITY-BASED WATER & SANITATION PROJECT – RUFISQUE, SENEGAL

Nine low-income communities worked in partnership with an international NGO and local authorities to set up a revolving community fund that helped to finance initial sanitation and sewage connections. Grants from international agencies provided seed money for the fund and covered setup expenses, and now the bulk of the \$US50,000 fund consists of small monthly contributions from community members.

Using narrower pipes than would be needed in cold climates to withstand freezing reduced installation costs to five percent of that of conventional systems, increasing the number of families that could afford to be connected to the system. Since the project's inception in 1990, there has been a notable decrease in illnesses related to local environmental conditions.

Source: Malick Gaye and Fode Diallo, "Community Participation in the Management of Urban Environment in Rufisque (Senegal)", *Environment and Urbanization*, Vol. 9, No. 1 (April 1997), pp. 9-30.

Urban Waste Management

Many countries do not have even basic regulations for the safe management of waste, let alone the infrastructure or enforcement mechanisms for ensuring proper waste collection and disposal. Even in countries where municipal authorities provide collection services, these are often limited to certain (usually more affluent) suburbs, leaving large areas unserved. It is estimated that between one third and one half of solid wastes generated in cities in developing countries are not collected;¹¹ in the world's poorest communities, most of which are in sub-Saharan Africa, 80-90% of waste is not regularly collected or disposed of safely.



Waste dumped indiscriminately causes health problems

Refuse accumulating in poorly drained streets, open spaces, and wastelands creates ideal breeding conditions for mosquitoes, rodents, and other disease-bearing organisms. Malaria and dengue fever, formerly confined to rural areas, are fast becoming urban problems as scarce municipal resources are becoming stretched to the breaking point by ever-expanding populations – most of them living in urban slums without access to health care facilities.¹² Leaching of waste materials from unlined dumpsites into soil and drinking water supplies, combined with scavenging and generally poor landfill management, further increase the potential for the spread of infectious diseases.

The developing world's governments and municipalities generally lack the financial resources and technical expertise to provide their citizens with effective waste management services. Although there has been a trend recently towards public-private sector partnerships, these in themselves will not improve matters if an effective strategic waste management policy is not in place at the local level. Developing such policies represents an important challenge for governments, and there is much still to be done in this regard; in the meantime, entrepreneurial micro-enterprises of the kind described below (Case Study 3) can be highly effective in addressing local urban waste management issues.

CASE STUDY 3: SOLID WASTE MICRO-ENTERPRISE – QUEZON CITY, PHILIPPINES

In 1993, a group of urban waste scavengers presented the Quezon City government with a set of demands for provision of basic needs including community-controlled buying stations for recyclables, a health center to address scavenging related accidents and illnesses, training centers to enhance vocational and organizational skills, alternative livelihoods, and security of land tenure.

As a result of these demands, a local NGO advocating for environmental and urban poverty issues assisted these urban scavengers in setting up the Payatas Environmental Development Program – an alternative waste management system to open dumping. It involved setting up a community-based materials recovery center, harnessing the waste picking and recycling skills of scavengers and micro-entrepreneurs, and further supplementing these skills with environmentally friendly technology for solid waste processing and composting.

In the absence of any alternative waste management plan on the part of the government, this plan was recognized as a possible alternative to the Payatas dump site and a possible response to the city's garbage problem, and was approved in principle by the Department of the Environment and Natural Resources and other government agencies.

Source: Vincentian Missionaries, "The Patayas Environmental Development Program: Micro-Enterprise Promotion and Involvement in Solid Waste Management in Quezon City", *Environment and Urbanization*, Vol. 10, No. 2 (October 1998), pp. 55-68.

Industrial & Medical Waste

Uncontrolled dumping of hazardous waste is common in the developing world, with many urban slums located next to industrial zones or dumping grounds. Many workers handle these materials daily, unaware that they are dealing with potentially dangerous chemicals; procedures for properly managing spills and uncontrolled discharges are non-existent or disregarded. Materials long since banned in the developed world are either taken to unlined dumpsites, or just left out in the open for their contents to leak into air, soil, and water.

Medical waste treatment is generally non-existent, and even where there are facilities such as incinerators, equipment is usually antiquated and ineffective at destroying pathogens. Without adequate

supervision and regulation, the financial pressure to cut corners is strong. Often, to save costs, medical waste is simply taken to open dumps along with other refuse.

Intensification of agriculture, driven by increasing population, results in increased use of pesticides such as DDT and subsequent contamination of water supplies. Even large freshwater lakes such as Africa's Lake Tanganyika and Cambodia's Tonle Sap, which provide drinking water and fishing resources to hundreds of thousands of people, are now at risk from pesticide run-off from neighboring farmlands. Careful regulation of pesticide use, and alternative pest management techniques such as companion planting and development of pest-resistant crop strains will become increasingly important if developing nations are to maintain high crop yields without creating toxic side effects.



Industrial waste and sewage mix in a local waterway

Clean production programs like the one outlined below in Case Study 4 can reduce pollution discharges significantly while providing financial savings to industry – acting as an incentive to implement such measures when fines or threats of plant closures may be insufficient.

CASE STUDY 4: COLLECTIVE ACTION FOR CLEANER PRODUCTION – SURAT, INDIA

Surat is one of the largest industrial cities in the western Indian state of Gujarat, and a major producer of synthetic textiles, with over 200 factories and dyestuff manufacturers consuming 10 million gallons of water daily and releasing more than 7 million gallons of effluents into local waterways. Most of these plants are small or medium enterprises with limited wastewater treatment facilities.

As a result of excessive extraction of groundwater, the local water table has fallen from 60 feet to 180 feet. The poor state of Surat's environment aggravated the effects of a plague, which struck the city in 1994, after which authorities came under pressure to enforce strict pollution control standards.

This increased enforcement, along with the pressures of dwindling natural resources and cost considerations, prompted Surat's textile industry to take voluntary action. In 1994, a waste management group (WMG) was set up to promote the benefits of pollution prevention and minimize waste and chemical usage through re-use, recycling, and substitution. The WMG distributed information on the benefits of waste minimization, prepared safety data sheets for chemicals and dyes used by local manufacturers, conducted environmental impact studies, prepared energy and water conservation manuals, and launched waste minimization pilot projects.

These initiatives brought both financial and environmental savings. One textile mill installed an effluent reuse system, and now reuses up to 80 per cent of effluent discharge, as well as using recycled water for cooling machinery. A dye manufacturer saves over 1 million litres of water every month through automation of equipment and water re-use, reducing pollution by 90 per cent, energy consumption by 40 per cent, and chemical use by 85 per cent.

Source: Nick Robins and Ritu Kumar, "Producing, Providing, Trading: Manufacturing Industry and Sustainable Cities", Environment and Urbanization, Vol. 11, No. 2 (October 1999), pp. 75-93.

Legal Issues

Legal structures for safeguarding the environment and human health are inadequate in most of the developing world, if they exist at all. Even in countries where such laws do exist, the mechanisms for enforcing them are usually lacking, and enforcement officials are often, at best, underpaid and at worst, corrupt. It is common for even the worst polluters to use political connections or bribery to avoid prosecution; in the rare cases where pollution-related cases do come to trial, they can afford to hire the country's best lawyers, and actual prosecutions are a rarity.

On the other side of the equation are the poor and exploited who are usually pollution's first victims. As noted earlier, the link between poverty and exposure to pollution is well documented, especially in the developing world, and also within more affluent nations as well.

Exacerbating this problem is the increasingly wide gap in developing countries between the richest and poorest strata of society, where basic human needs like clean water, sanitation, health care, and legal representation are, increasingly, becoming affordable to only the privileged few. More and more, the burdens of pollution and disease fall on those least equipped to fight back.

Non-Government Organizations (NGOs)

Most NGOs working in the developing tend to focus more on "traditional" issues of development or on conservation, with correspondingly less emphasis placed on urban pollution problems. Given the rapidly growing scale of these problems, much more needs to be done to address the environmental and health threats resulting from rapid urbanization and industrialization.

Local NGOs, their direct stakeholders, and their communities have much to gain from tackling these problems: a cleaner environment, healthier population, and a prosperous economy, amongst other benefits.

Attaining these ends requires NGOs to work closely with local communities and governments if their work is to have lasting impact. Not only must managers have the necessary technical expertise, but their projects must also be designed to survive when support from aid agencies and development institutions runs out. Unfortunately, many projects are not designed with these principles of sustainability in mind, and often do not survive beyond the initial round of funding. From our observation, projects of an entrepreneurial nature providing direct economic incentives and benefits to participants stand a much greater chance of long-term success than those substantially dependent on outside aid.

Locating such organizations and providing them with the right assistance at the right time can mean the difference between the success and failure of their enterprises – literally a matter of life and death for those whose health and livelihood depends on them.

Supporting and strengthening environmental leadership in the developing world. This is the challenge at the core of Blacksmith Institute's ongoing work.

WHO'S WHO

Other organizations actively involved in pollution-related issues globally are:

United Nations Development Program (UNDP)

United Nations Environment Program (UNEP)

The World Bank and its International Development Program (IDA)

World Health Organization (WHO)

World Resources Institute (WRI)

United States Agency for International Development (USAID)

UN Commission on Sustainable Development (CSD) and the Inter-Agency Environment Coordination Group (an advisory and consultative body to the UNEP)

The WHO, in particular, strongly supports the incorporation of health concerns into development projects, and actively encourages interaction between the above organizations.

Most of the materials reviewed in researching this paper were research publications linking a specific sector of the environment to health in developing countries. The World Bank and WHO, especially, have published many technical reports on these topics. However, it is difficult to find examples of these organizations, or indeed any groups, implementing specific projects in developing countries to directly address pollution and health concerns.

Appendix 1: References

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12. *Op. cit.* 1, p.5

Appendix 2: Tables

TABLE 1: ENVIRONMENTAL IMPACTS OF SELECTED INDUSTRIES

SECTOR	AIR	WATER	SOIL & LAND
<i>Chemicals (industrial inorganic & organic compounds, excluding petroleum products)</i>	Various emissions depending on processes used & chemicals manufactured Emissions of particulate matter, SO ₂ , NO ₂ , CO, CFCs, VOCs and other organic chemicals, odors Risk of explosions & fires	Use of process water & cooling water Emissions of organic chemicals, heavy metals (cadmium, mercury), suspended solids, organic matter, PCBs Risk of spills	Problems with disposal of chemical process waste Problems with sludges from air & water pollution treatment
<i>Paper & Pulp</i>	Emissions of SO ₂ , NOX, CH ₄ , CO ₂ , CO, hydrogen sulphide, mercaptans, chlorine compounds, dioxins	Use of process water Emissions of suspended solids, organic matter, chlorinated organic substances, dioxins	
<i>Cement, Glass, Ceramics</i>	Cement emissions of dust, NOX, CO ₂ , CO, chromium, lead Glass emissions of lead, arsenic, SO ₂ , CO, vanadium, hydrofluoric acid, soda ash, potash, chromium Ceramics emissions of silica, SO ₂ , NOX, fluorine compounds	Emissions of process water contaminated by oils & heavy metals	Extraction of raw materials Soil contamination with metals & problems with waste disposal
<i>Mining Of Metals & Minerals</i>	Emissions of dust from extraction, storage, & transport of ore & concentrate Emissions of metals (e.g. mercury) from drying of ore concentrate	Contamination of surface water & groundwater by highly acidic mine water containing toxic metals (e.g. arsenic, lead, cadmium) Contamination by chemicals used in metal extraction (e.g. cyanide)	Major surface disturbance & erosion Land degradation by large slag heaps
<i>Iron & Steel</i>	Emissions of SO ₂ , NOX, PAHs, hydrogen sulphide, lead, arsenic, cadmium, chromium, copper, mercury, nickel, selenium, zinc, dust, organic compounds, PCDDs/PCDFs, PCBs, particulate matter, hydrocarbons, acid mists Exposure to ultraviolet & infrared radiation, ionizing radiation Risk of explosions & fires	Use of process water Emissions of organic matter, tars & oil, suspended solids, metals, benzene, phenols, acids, sulphates, sulphides, ammonia, cyanides, thiocyanates, thiosulphates, fluorides, lead, zinc	Slag, sludges, oil and grease residues, hydrocarbons, salts, sulphur compounds, heavy metals, soil contamination & waste disposal problems
<i>Nonferrous Metals</i>	Emissions of particulate matter, SO ₂ , NOX, CO, hydrogen sulphide, hydrogen chloride, hydrogen fluoride, chlorine, aluminum, arsenic, cadmium, chromium, copper, zinc, mercury, nickel, lead, magnesium, PAHs, fluorides, silica, manganese, carbon black, hydrocarbons, aerosols	Scrubber water containing metals Gas-scrubber effluents containing solids, fluorine, hydrocarbons	Sludges from effluent treatment, coatings from electrolysis cells (containing carbon & fluorine), soil contamination & waste disposal problems

**TABLE 1:
ENVIRONMENTAL IMPACTS OF SELECTED INDUSTRIES (continued)**

SECTOR	AIR	WATER	SOIL/LAND
<i>Coal Mining & Production</i>	Emissions of dust from extraction Emissions of CO & SO ₂ from burning slag heaps CH ₄ emissions from underground formations Risk of explosions & fires	Contamination of surface water & groundwater by highly saline or acidic mine water	Major surface disturbance & erosion Subsidence of ground above mines Land degradation by large slag heaps
<i>Refineries, Petroleum Products</i>	Emissions of SO ₂ , NOX, CO, CO ₂ , HCs, hydrogen sulphide, benzene, particulate matter, PAHs, toxic organic compounds, mercaptans, odors Risk of explosions & fires	Use of cooling water Emissions of HCs, mercaptans, caustics, oil, phenols, chromium, effluent from gas scrubbers	Hazardous waste, sludges from effluent treatment, spent catalysts, tars
<i>Leather & Tanning</i>	Emissions including leather dust, hydrogen sulphide, CO ₂ , chromium compounds	Use of process water Effluents from toxic solutions containing suspended solids, sulphates, chromium	Chromium sludges

Source: Adapted from World Health Organization (WHO), *Health & Environment in Sustainable Development: Five Years After the Earth Summit* (WHO, Geneva, 1997), Table 3.10, p.64

**TABLE 2:
TYPES OF ENVIRONMENTAL POLLUTION - HEALTH IMPACTS & INTERVENTIONS**

PROBLEMS & MAJOR SOURCES	PRIMARY HEALTH IMPACTS	INTERVENTIONS	EFFECTIVENESS MEASURED BY
Indoor Air Pollution <i>(Burning dirty fuels indoors for cooking & heating)</i>	Chronic lung disease (COPD) Acute respiratory infections (ARI) Lung cancer Asthma Low birth weight Blindness Heart disease	Cleaner fuels Improved stoves Improved ventilation	Decreases in child deaths Decreases in cases of COPD, ARI, lung cancer, asthma No. of households using clean fuels and/or improved stoves
Outdoor Air Pollution <i>(Burning fossil fuels in energy production & vehicle use)</i>	COPD ARI IQ impairment from lead	Cleaner energy production Cleaner vehicle fuels Emissions controls Alternative transportation	Decreases in child deaths Decreases in cases of COPD, ARI Decreases in lead blood levels in children
Vector-Borne Diseases <i>(Poor drainage, unsanitary conditions, overcrowding)</i>	Malaria Dengue fever Yellow fever Schistosomiasis	Infrastructure (drainage) Health (vector control) Irrigation Reforestation	Decreases in deaths due to malaria Decreases in cases of malaria
Inadequate Water Supply & Sanitation <i>(Lack of clean drinking water; poor/non-existent sewage systems)</i>	Diarrhea Ascariasis Guinea worm Schistosomiasis	Infrastructure (improved access to clean drinking water, connection to sewage systems) Water treatment programs Community health education programs Oral re-hydration therapy (ORT)	No. of households with access to clean water No. of households connected to sewage systems Decreases in incidence of water-related disease Community cost-sharing & maintenance
Pesticide Residues & Other Toxic Substances <i>(Unregulated discharges from agriculture & industry)</i>	Acute poisoning Cancers Birth defects IQ impairment from lead Damage to immune, nervous, & reproductive systems	Alternative/reduced pesticide use Improved storage & handling	Decreases in poisoning cases, cancers, birth defects
Unsanitary Waste Management Practices <i>(Improper storage, collection, & disposal of household, industrial, medical, & toxic wastes)</i>	Occurring in combination with many other factors	Sanitary waste disposal Treatment of medical & toxic wastes Clean production Recycling	Waste management regulations Decrease in uncontrolled dumping Land zoning regulations

Source: Adapted from World Bank draft report, *Health and Environment* (World Bank, 2000), table 3, p.8

Appendix 3: THE BLACKSMITH INSTITUTE

The Blacksmith Institute's mission is to ensure that we provide a clean and hospitable planet to future generations. Our focus is on pollution-related problems in developing countries. In particular, we provide strategic, technical and financial support to local champions and organizations as they strive to solve specific, pollution-related environmental issues. Currently we are supporting projects in Tanzania, Zambia, Thailand, and Cambodia.

Blacksmith's strategy is to strengthen developing countries' capacities for addressing pollution and health issues by the following means:

Strategic Assistance – Assisting groups in both their start-up phase and those re-examining their strategies with visioning, mission statements, and management support.

Networking Capabilities – Identifying networking and collaboration opportunities for Blacksmith Institute partners and connecting them appropriately.

Technical Research – Providing the necessary resources for partners to research a problem, often working with scientific and advocacy groups in the U.S. with expertise in relevant areas.

Financial Support – Supporting new and already-established organizations with both seed money and continuing support, and providing long-term core funding to projects demonstrating measurable success.

PROJECTS CURRENTLY SUPPORTED BY BLACKSMITH INSTITUTE

In conducting research for this paper, we found remarkably few case studies showing actions being undertaken to reduce environmental pollution in developing countries. This adds weight to our contention that not nearly enough emphasis is being placed on this problem by governments, donor organizations, NGOs, and the international community in general. It is our hope that by bringing this issue to wider attention, this situation will change.

Some pollution-related initiatives that are currently being supported, or considered for support by the Blacksmith Institute, are outlined below. The common thread linking all these projects is that they are locally managed, outcome-focused, low-cost, and designed to be sustainable (i.e. not reliant on continual injections of funding from donor organizations).

<p>Country: Zambia Organization: ARE – Advocacy for Environmental Restoration Project: Environmental Restoration of Msimbazi River and Its Catchment - Dar es Salaam Project: Sustainability of the Kafue River Basin Background: ARE is committed to cleaning the Kafue River in Zambia, the largest river in that country, and currently polluted from industrial and other wastes.</p>

<p>Country: Zambia Organization: TBD Project: Lead Smelter Situation in Kabwe Background: The city of Kabwe is suffering lead pollution from the local smelter that was closed in 1994. The remains of lead have affected a community of about 250,000 for decades. Blacksmith Institute has been working with the World Bank on this issue and is in the process of creating a watchdog group to oversee the problem, the plans, and the solutions.</p>

Country: Tanzania
Organization: EnviPro – Environmental Professionals' Organization
Project: Environmental Restoration of Msimbazi River and Its Catchment - Dar es Salaam

Background: EnviPro has been working on an outline of engineering design options and implementation costs for the environmental restoration of the Msimbazi River and its catchment in Dar es Salaam. They have also been holding meetings with the Municipal Council to discuss the proposed technical solution and how the Council will be involved in the implementation plan of Phase I, which concerns the management of liquid and solid wastes from the Vingunguti Abattoir. As of October, 2001, the Municipal Council has supported EnviPro's proposed solution, and has accepted the proposal report and agreed to contribute part of the implementation cost.

Country: Tanzania
Organization: JET – Journalists' for the Environment of Tanzania
Project: Raising public awareness of environmental threats through media

Background: JET is working to raise public awareness around the sustainable management of natural resources. They publish two monthly newspapers, one in English and the other in Kishwahili. JET also manages an environmental resource library where the NGO and CBO communities and other journalists are invited to gather and share information.

Country: Tanzania
Organization: LEAT – Lawyers' Environmental Action Team
Project: Opening of office in Mwanza

Background: LEAT is a membership organization whose mission is to stand for environmental stewardship through the use of law and policy and also promote the establishment of an enabling policy environment for civil society including civil liberties and human rights. They are engaged in policy research, advocacy and some public interest litigation. Blacksmith's funding is to set up a branch office in the city of Mwanza (close to Lake Victoria where pollution from factory discharges and local residents poses health threats, as does the local mining activities) to continue tracking and strengthening Tanzania's weak pollution control laws.

Country: Tanzania
Organization: Clean Mikocheni Society
Project: Sanitation Reform

Background: Clean Mikocheni is dedicated to implementing sewage management systems in Dar es Salaam, a city with almost no sewage management. Their focus is on one neighborhood in Dar, with the intention of expanding any successes throughout the city.

Country: Cambodia
Organization: Ministry of the Environment
Project: Medical Waste Project

Background: Blacksmith Institute's Regional Representative has spent the last few months conducting a survey of the medical waste disposal situation in Phnom Penh, including an investigation of the various aspects of putting in place a medical waste incineration system for the city. A detailed report will be presented to the Cambodian Ministers for the Environment and Health in November 2001.

Country: Cambodia
Organization: Ministry of the Environment
Project: Toxics Importation Laws

Background: Blacksmith Institute has been working with the Ministry for the Environment to draft legislation controlling the importation and management of hazardous materials in Cambodia. With assistance from mentors at the NRDC (Natural Resources Defence Council) we are drafting legislation to be reviewed by the Minister.

Country: Thailand
Organization: EnLaw – Environmental Litigation and Advocacy for the Wants
Project: Various environmental litigation projects

Background: EnLaw is a new independent advocacy project working on public interest environmental law, created with funding assistance from Blacksmith Institute. EnLaw's goal is to practice effective environmental advocacy and litigation and promote environmental protection by way of stronger environmental laws. They are pursuing several environmental issues that could serve as their test cases, for example:

- Lead contamination by mining at Kliti Lang Village, Kanchanaburi province
- Pollution of the Nam Pong River, Khon Kaen province
- Industrial waste from pulp and paper factories, Kanchanaburi province

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