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The Relationship Between Small Enterprises and Environmental Degradation in the Developing World (With Emphasis on Asia)

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Lawrence Kent

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7250 Woodmont Avenue, Suite 200, Bethesda, Maryland 20814

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Robert C. Young
Office of Small, Micro and Informal Enterprise
Bureau for Asia and Private Enterprise
U.S. Agency for International Development
Room 3214, N.S.
Washington, D.C. 20523-0021

or

Donald R. Snodgrass
EEPA Project Coordinator
Harvard Institute for International Development
1 Eliot St.
Cambridge, MA 02138

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LIST OF ABBREVIATIONS

ADB	Asian Development Bank
A.I.D.	Agency for International Development
BOD	Bio-oxygen demand (a measure of organic water pollution)
CO	Carbon monoxide
COD	Chemical oxygen demand (a measure of chemical water pollution)
HC	Hydro-carbon
HIID	Harvard Institute for International Development
IEPA	Industrial Efficiency and Pollution Abatement Project
ILO	International Labor Office
ITDG	Intermediate Technology Development Group
LSE	Large-scale enterprise
MIEP	Metropolitan Environmental Improvement Program
NGO	Nongovernmental organization
NOx	Nitrogen oxide
SO_2	Sulphur dioxide
SSE	Small-scale enterprise
SMI	Small- and medium-sized industries
TSP	Total suspended particulates
UNCHS	United Nations Center for Human Settlements
UNDP	United Nations Development Program
WEC	World Environment Center

EXECUTIVE SUMMARY

1. **Literature describing the relationship between small-scale enterprises (SSEs) and the environment is rare.** Most literature on SSEs emphasizes issues of efficiency and employment, ignoring environmental concerns. Most literature on the environment in developing countries does not differentiate between large and small enterprises when describing industrial pollution. The literature that treats our topic directly is very recent — most of it has been produced under World Bank and U.N. projects. The most prominent piece, by Ahmed Hamza, concludes that SSEs are serious environmental polluters.

2. **Two schools of thought have emerged on the issue.** The first asserts that small firms are less prone to environmental degradation than large firms, because small firms are more dispersed, and the people who work in these firms also live near them, creating an incentive to keep them "cleaner." The second school of thought states that SSEs are worse polluters than large firms, because SSEs are less technically efficient, harder to monitor, and less likely to adopt abatement technologies. Also, the noxious effects of SSEs are more likely to engender health problems because the firms are tightly integrated with residential areas. Neither school musters hard statistics to support its claims; however, the second school of thought is more prevalent in the literature and among analysts interviewed for this research.

3. **It is difficult to accurately assess the overall impact of SSEs on the environment because of the complexity of the question, the diversity of SSE activities, and the lack of data.** We attempted to estimate impact by looking at three parameters: (1) the types of activities in which SSEs are involved, (2) the level of output of SSEs in relation to large firms, and (3) the pollution *per unit of output* of small firms versus large firms. Diversity makes generalization dangerous, however, it appears that:

- Most SSEs are not involved in activities with high environmental impact;
- The SSEs that are involved in activities that have environmental impact are usually not the major polluters in the offending industry category, because they typically account for only a small percentage of total output;
- Analytical and limited empirical evidence suggest that SSEs pollute more *per unit of output* than large firms operating in the same sectors; and
- Industry, including small-scale firms, is not directly responsible for the bulk of urban air pollution (motorized vehicles are) nor the bulk of organic water pollution (which consists mainly of household wastes).

4. **SSEs contribute to water and land pollution through their liquid effluents and solid wastes.** Organic wastes such as those produced by food processing are harmful; however, they are minor when compared to overall levels of organic wastes being discharged into rivers in urban areas (most of which is household wastes). The toxic wastes produced by certain types

of SSEs are of greater concern, because these wastes pose a greater threat to human health. The wastes are discharged into rivers or deposited in the form of sludge on open-access lands. In certain Asian countries, SSEs contribute a significant portion of the toxic wastes of the leather tanning, electroplating, and wet-end textile processing industries.

5. **Many small enterprises contribute to air pollution** — small foundries, mills, bakeries, brickmaking operations, smelters, and so forth. Usually these emissions are a local problem, confined to the immediate area around the enterprise. Overall, motor vehicles are responsible for a greater portion of most forms of air pollution. Industry also contributes to air pollution, but the data are not available to indicate what percentage of industrial pollution can be attributed to SSEs. Most observers feel that SSEs, when compared to their large-scale brethren, contribute smaller loads of air pollutants. Certain categories of small-scale air polluters, however, deserve special attention because of the high toxicity of their fumes — namely small lead smelters.

6. **Certain SSEs contribute to resource depletion, particularly deforestation.** Their participation may occur at the level of harvesting wood, marketing wood, or consuming wood. SSEs, however, are not the major causes of deforestation in most Asian countries — commercial logging and agricultural encroachment are much more serious threats. The fundamental causes of inappropriate forest depletion are failures in land tenure arrangements — failures that are more closely linked to government land policies and forest management than to any SSE-related issues. Reducing wood consumption by SSEs is worthwhile, but it does not address the source of the problem.

7. **SSEs may contribute to environmental preservation through two channels.** The first channel is by creating off-farm employment that is likely to attract labor out of marginal and fragile lands and thus reduce pressure on natural resources. The second is by participating in specific activities that have direct positive impacts, such as the production of energy-efficient cookstoves, the tuning-up of motorized vehicles, and the recycling of waste products.

8. **Agriculture, SSEs, and environmental degradation are linked in complicated ways.** SSEs provide inputs to agriculture, and agriculture provides inputs to small-scale agro-processing activities. Prosperity in agriculture expands markets for SSE-produced products. Environmental pollution caused by SSEs may harm agriculture. Agriculture may lead to encroachment on forest lands, which may increase firewood scarcity for small enterprises that use it as an input. SSEs create off-farm employment that may serve as an alternative to farming marginal lands or exploiting natural resources. Many other linkages exist.

9. **Both policy approaches and technical approaches are available to those seeking to improve the relationship between SSEs and the environment.** Policy approaches may employ command and control regulatory regimes or economic instruments (such as effluent charges). Both command and control and direct economic instruments depend heavily on effective monitoring and enforcement mechanisms — mechanisms that are just developing in Asia and that are not yet capable of enforcing regulations on most SSEs. Indirect economic policy instruments (such as taxing fuels and chemical inputs) hold out greater promise; however, further research is necessary. Direct government investment in municipal sewerage systems is an appropriate

means to address pollution problems. Technical approaches, such as promoting "cleaner" production technologies, are only likely to work if they are privately profitable for individual entrepreneurs, or if they are coupled with enforcement measures that make nonadoption more costly than adoption. Technical assistance to government environmental agencies is an appropriate means to strengthen these institution's abilities to enforce environmental regulations.

SUMMARY OF RECOMMENDATIONS TO A.I.D.

In Regard to A.I.D.'s Small Enterprise Support:

1. A.I.D. should avoid generalizations and exaggerations about SSEs and environmental degradation — the relative importance of SSEs in pollution is low in certain sectors in certain countries, and high in others.

2. A.I.D. should distinguish between the goals of its environmental policy dialogue and those of its small enterprise support. A.I.D.'s environmental policy dialogue should concentrate on addressing the most significant sources of environmental degradation in specific countries, giving no more attention to SSEs than that which they deserve. A.I.D.'s assistance to small enterprises should not ignore issues of environmental concern; however, support to SSEs should not be expected to significantly modify their behavior towards the environment — this behavior is mostly a function of the environmental policy environment.

3. A.I.D. should avoid financing the start-up or expansion of SSEs that are particularly damaging to the environment. This should be accomplished without requiring intermediate financial organizations to carry out costly loan-by-loan environmental impact assessments by establishing a limited list of activities to be simply barred from financing.

4. Just as A.I.D. should avoid financing SSEs that are particularly harmful to the environment, the Agency should increase its support to SSEs that contribute to environmental preservation by serving as alternative sources of employment to people who would otherwise encroach on fragile lands or destructively exploit natural resources.

5. A.I.D. should take environmental concerns into account when considering the question of the registration of small-scale enterprises and their "formalization."

In Regard to the Relationship between A.I.D.'S Environmental Interventions and SSEs:

1. A.I.D. Missions considering interventions in pollution control should gather the data necessary to prioritize interventions, and focus on areas where impact is likely to be greatest. The "worst first" principle should be applied when deciding where to focus scarce resources, and SSEs should receive special attention only when they are identified as the "worst" polluters.

2. A.I.D. should support government efforts to relocate the most heavily polluting SSEs away from residential areas and to group them together on industrial estates where common wastewater treatment is feasible.

3. SSEs that discharge large quantities of organic wastewater should be considered separately from SSEs discharging toxic wastes. To deal with the organic wastewater problem, priority should be placed on improving municipal sewerage systems.

4. A.I.D. should continue to work to strengthen the monitoring and enforcement capabilities of environmental agencies through training, technical, and financial assistance.

5. Until a credible regulatory environment is established, A.I.D. should invest in the development and promotion of "cleaner" technologies only if the technologies promise to be relatively more profitable than traditional techniques; otherwise, the technology dissemination effort is likely to fail.

6. Policy dialogue on the land tenure problems that are the fundamental cause of deforestation should be of higher priority than discussions of the activities of SSEs in fuelwood gathering, trading, and consumption.

7. Given a situation where forest products are undervalued and A.I.D. feels that it cannot focus more resources on the fundamental land tenure problems, the Agency should consider both policy and technical approaches to reduce the overconsumption that undervaluation engenders.

INTRODUCTION

For over a decade A.I.D. and other donor organizations have recognized the important role of small-scale enterprises (SSEs) in the economies of developing countries. For most poor nations, small-scale enterprises are the most important source of employment and income after agriculture. Because they create jobs without requiring heavy capital investment or government subsidies, SSEs generally are viewed favorably by donors and local governments alike. A.I.D. has supported the development of small enterprises in many countries through credit programs, institutional support, training and technical assistance, and policy dialogue to improve the business climate for entrepreneurship. In fiscal year 1990, A.I.D. provided $85 million in support for small enterprise development worldwide, with $7.3 million going to Asia.[1]

At the same time that A.I.D. is concerned with promoting SSEs, the Agency is also concerned with environmental issues in developing countries. This concern dates back a number of years, but it has intensified recently as environmental awareness has increased in the United States and the developing world. In 1990, A.I.D. launched its "Initiative on the Environment" — a framework document that identifies three areas of intervention where A.I.D. resources will be focused on environmental matters. The areas are (1) Environmental Policy and Economics, (2) Strengthening Environmental Institutions, and (3) Priority Problem Areas specific to A.I.D.'s geographical regions. For Asia and the Near East, priority areas are water and soil resources, energy efficiency, urban and industrial pollution, and tropical forests and biological diversity.

Because A.I.D. is concerned with both small enterprise development and environmental issues, the Agency has commissioned this study to examine the relationship between small enterprises and environmental degradation in the developing world. Because the initiative for this study came from the Bureau for Asia and Private Enterprise the scope of work asks the contractor to draw most examples from the Asia region.

The paper is organized as follows. The first two chapters review the relevant literature and present the two major schools of thought on the relationship between SSEs and environmental degradation. The next chapter discusses the impact of SSEs on the environment, in particular in comparison with the environmental impact of large-scale firms. Chapters 4, 5, and 6 examine the relationship of SSEs with water and land pollution, air pollution, and resource depletion. Chapter 7 discusses how small enterprises may contribute to environmental conservation, and Chapter 8 analyses the relationship between agriculture, SSEs, and the environment. Chapter 9 examines approaches to solutions to the environmental problems of SSEs and the final chapter presents recommendations to A.I.D..

Before we turn to the subject at hand, let us be more precise about the meaning of "small-scale," "medium-size," and "large," because these terms appear throughout the paper.

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[1] *Second Annual Report to Congress on the Microenterprise Activities of the Agency for International Development*, A.I.D., April 30, 1991.

Usually, "small-scale" refers to businesses employing 20 workers or less, including microenterprises and cottage industries, which are even smaller. Occasionally, however, the available data preclude rigid adherence to this definition of small scale — in India small businesses are often defined as enterprises employing less than 50 workers. "Medium-size" firms usually refers to firms employing 20-100 workers, but in India the term is used for 50-100 worker shops. "Large" businesses are almost universally defined as those employing 100 or more workers.

Following convention, we do not consider farms or fishing operations as small enterprises in this paper. We also do not consider issues of occupational safety when we discuss environmental degradation, limiting ourselves to pollution and resource depletion issues.

CHAPTER ONE

LITERATURE REVIEW

The scope of work for this study calls for the contractor to review the literature on the impact of small enterprises on the environment and the causes of and solutions for such problems.

After conducting a concerted effort to identify this literature, we conclude that papers dedicated to this specific topic are extremely limited, consisting of a small number of articles in the journal *Industry and Environment* and targeted studies conducted under projects supported by international agencies. Overall, very little scholarly attention has been focussed on the relationship between small enterprises and the environment.

A significant amount of attention and literature, on the other hand, has been dedicated to looking at **the relationship between small enterprises and other economic and social issues.** This literature is both scholarly and practical. Scholarly pieces such as *Small Manufacturing Enterprises* (1987) by Little, Mazumdar and Page, and *Success in Small and Medium-Scale Enterprises* (1987) by Cortes, Berry, and Ishaq concentrate on issues of economic efficiency of SSEs and their relationships with capital, labor and product markets. These pieces test the economic theories that serve to justify special support to SSEs, namely, that market failures create differences between nominal and shadow prices for labor and capital inputs that in turn lead to suboptimal resource allocation in the production process. Meticulous attention is focussed on analyzing these alleged market failures, while absolutely no mention is made of another set of market failures — negative externalities in the form of environmental pollution. It is extraordinary how thoroughly environmental issues are ignored in even the most recent of these books and in scholarly pieces on SSEs in general.

Largely descriptive books such as the Asian Development Bank's volume *The Role of Small and Medium-Scale Manufacturing Industries in Industrial Development* (1990) similarly neglect environmental concerns. The ADB book provides over 400 pages of description of SSEs in Bangladesh, India, Indonesia, and the Philippines, concluding with a series of policy and technical assistance recommendations, *but it does not dedicate one sentence to discussing the environmental implications of small-scale production.*

A substantial body of literature is also available on more practical small enterprise issues, frequently focusing on issues of credit and policy support. Good examples of this literature include the 16 papers on small enterprises assembled in the book *Microenterprises in Developing Countries* (Levitsky, ed., 1989). These papers address policy aspects of microenterprises (De Soto, Tokman, Tendler, Nowak), informal credit markets (Chadavarkar, Seibel), financial assistance (Meyer, Jackelen, Yunus), and technical services (Carr, Harper, Almond, Carvajal). All 16 papers, however, ignore environmental issues. Only occasionally does a piece of literature of this class touch upon environmental issues at all, and then only incidently. An example of this is Malcolm Harper's *Small Business in the Third World* (1984), a book of over

200 pages that mentions environmental issues in only two paragraphs, one of which is presented below:

> It is difficult enough to persuade or compel a large firm to conform to government policy, but almost impossible to monitor and control the operations of large numbers of smaller businesses. The same applies to environmental, safety or product standards; a large firm might require no more than one high level contact, backed by the veiled threat of sanctions, while ten or a hundred smaller firms providing the same output would need legislation, a force of inspectors and a schedule of penalties to ensure conformity (p. 18).

A second, sizable body of literature has developed around **environmental issues** in the developing world. We explored this literature and found that it treats several issues that are relevant to this study such as deforestation and industrial/urban pollution. However, the literature rarely addresses directly the relationship between the environment and small enterprises — when it treats enterprise issues at all it rarely differentiates between small-sector and large firms. An example of this is *Natural Resources and Environmental Management in Indonesia: An Overview* (Tarrant, 1987), which states that industrial process wastewater from Indonesia's manufacturing centers is a major environmental problem, but does not specify if small or large firms are responsible for most of this pollution (p. 38). Occasionally, the environmental literature does include short passages directly relevant to the topic of this study. An example of this is the *Thailand Natural Resources Profile)* (1987) prepared by the Thailand Development Research Institute, which reads:

> All private polluting factories have to install suitable wastewater treatment facilities in order to obtain their annual operating permits....Smaller factories typically do not have their own treatment facilities, due to a lack of space, a lack of funds, or both (p. 216)....It will be difficult for medium and smaller-sized factories to invest in treatment facilities, which suggests that one of three options might be adopted in such cases: (1) wastes can be tankered to nearby treatment plants, provided that they are organic and can be treated biologically; (2) if the waste is inorganic, chemical and/or toxic, it may be possible to transport it to a central treatment plant...and (3) if the Bangkok sewerage system is finally built, industrial effluents can be discharged to sewers for treatment at a central works, on payment of the relevant charges or effluent taxes (p. 233).

A second example of the environmental literature that mentions the role of SSEs is *The State of India's Environment 1984-85* (Centre for Science and Environment, 1985). The book implies that SSFs contribute to deforestation:

> Interviews with firewood stall owners reveal that apart from individuals purchasing firewood for domestic use, firewood is also consumed by roadside tea stalls, restaurants, bakeries, small-scale dyeing units, soap makers, and various cottage industries (p. 269).

A final example of the relevant environmental literature comes from a special issue of the journal *Business Asia* entitled "Pollution: The Dirt on the Dirt" (June 1991). This issue focuses on large industry's role in managing effluents, but mentions SSEs in two articles, the first on Thailand and the second on Malaysia:

> Moreover, small and medium-sized industries are Thailand's biggest polluters, normally discharging waste and effluent with no treatment whatsoever. Even if pollution regulations were enforced, waste treatment would be unfeasible for the individual factories; these plants, however, often are scattered so widely that it would be even less feasible to build common treatment plants (p. 198);

> The biggest polluters in Malaysia? Locally registered small and medium-sized industries, particularly palm oil mills, steel and iron works, saw mills and those firms making detergents and robber-based products. (p. 212)

As stated above, **literature that treats the issue of SSEs and environmental degradation head-on is rare** — the little of it that exists was produced recently under projects sponsored by international organizations. One of these projects is the "Urban Management and the Environment" program funded by the UNDP, and jointly executed by the World Bank's Urban Development Division and the United Nations Center for Human Settlements (UNCHS - Habitat). Launched in 1990, this program involves preliminary studies to help define broad environmental management strategies for dealing with critical urban problems in developing countries. One of the studies commissioned under this program is *Impacts of Industrial and Small-Scale Manufacturing Wastes on Urban Environment in Developing Countries*, by Ahmed Hamza (May 1991).

The Hamza report provides useful analysis and information; however, it frequently is ambiguous about the size of the industries that it is discussing and it provides little hard evidence to back up its assertions that "in most developing countries, the bulk of industrial pollution is still contributed by medium and small-scale industries which comprise [a] significant part of manufacturing production" (p. 23). The report consists mainly of anecdotes about polluting industries and generalizations about technical issues in waste management. According to Carl Bartone of the World Bank's Urban Development Division, the Hamza report highlighted how little literature and how little hard data are currently available on this issue. It was after reviewing the Hamza document that the Urban Management program decided that it would be necessary to collect its own data directly from the field. It commissioned four case studies to be completed by December 1991 and discussed at a seminar planned for early 1992. The studies will look at leather tanneries in Leone, Mexico; metal finishing in Peru; dyestuffs manufacture in Bombay, India; and several industries in Bangkok, Thailand.

Despite its weaknesses, the Hamza report is the most substantial document on the topic to be identified during the literature search for this paper. Its basic thesis is that "the widely-dispersed small-scale industries in the heart of urban settlements which discharge numerous pollutants and toxic residues impose immediate health risks and unbearable environmental nuisance to urban dwellers." To confront this problem, Hamza suggests employing low waste

technology, communal treatment of effluents, training of entrepreneurs in waste management, and improvements in institutional arrangements for the enforcement of regulations. The executive summary to his paper is found in Annex B.

A second internationally funded project that has contributed to the relevant literature is the Industrial Efficiency and Pollution Abatement (IEPA) Project financed by the World Bank in Indonesia. In preparation for this project the Bank commissioned the consulting firm COWIconsult to conduct a data collection study that was completed in March 1991. The bulk of this study discusses overall industrial pollution issues in Indonesia, but one chapter is dedicated to the effluent problems of small-scale industry clusters. The study points out that small-scale industrial establishments totalled almost 1.8 million units in 1988 and that close to 19 percent of the small-scale industries are located in clusters that benefit from government programs. According to COWIconsult, the most significant environmental pollution problems associated with SSEs are:

- Wastewater and solid waste containing heavy metals (chromium) and high BOD[2] from leather tanneries;
- Wastewater from electroplating containing heavy metals and dust from castings;
- Wastewater with very high BOD from tapioca, tempe and tofu production; and
- Wastewater containing dyes, inorganic chemicals from batik (p. 7.2).

COWIconsult recommends giving priority attention to providing technical assistance to tanneries and electroplating clusters of SSEs to improve the efficiency of their production processes and to establish common effluent treatment centers. COWIconsult's approach focuses more on the technical aspects of solutions than on the economic forces that motivate small-scale industrial polluters.

Another relevant document that emerged recently under the umbrella of an international project is a staff appraisal report (May 7, 1991) on an upcoming World Bank industrial pollution control project in India. This document addresses industrial policy and environmental protection in general, but it focuses at one point on the role of small-scale enterprises in a section entitled "Large Versus Small Scale Operations":

> As can be seen from the paragraphs above, pollution problems affect the chemical and related industries across the board; however, it seems to be most pervasive among small and medium size enterprises in particular in industries such as pulp and paper, sugar-distilleries, leather tanneries and pesticides. While most of the large size enterprises are believed to be capable of taking measures to reduce

[2] Bio-oxygen demand (BOD) is a measure of the oxygen required to break down solids and bacteria discharged into water. High BOD waste contributes to the reduction of oxygen, and life, in rivers and streams.

> pollution, many small and medium firms face many constraints [to abatement] (p. 9).

The report suggests that government support for the construction and operation of common waste water treatment facilities may be the most cost-effective way to alleviate the situation.

The World Bank also investigated SSE pollution issues as part of its Philippines Cottage Enterprises Project Mission to Manila in July 1990. Under a Bank contract, the consultant A.H. Somani prepared a short report entitled *Philippines Cottage Enterprises Project* (January 1991). The report describes waste problems of small tanneries, electroplating operations, and food processors, and concludes with a call for further environmental studies and education efforts.

A final UNDP-World Bank program must be mentioned in this section — the Metropolitan Environmental Improvement Program (MEIP) — which involves support for environmental management in Beijing, Bombay, Colombo, Jakarta, and Manila. This program has commissioned a number of environmental studies; however, the study it attempted to arrange on SSEs and the environment in India was never conducted due to contracting difficulties. According to a MEIP officer at the World Bank, the program sees common effluent treatment on industrial estates as the most promising approach to the small enterprise pollution problem.

Another international agency interested in the SSE-environment relationship is the nongovernmental organization (NGO) Intermediate Technology Development Group (ITDG) in England. ITDG is in the process of conducting "environmental audits" in five developing countries where it is supporting SSEs with appropriate technologies. It hopes to analyze the results of these audits and complete a paper on SSEs and the environment by early 1992. Representatives of ITDG state that little evidence is currently available on the issue; however, the organization has assembled a draft statement that asserts that "the impact of a number of small-scale industries on the environment will be more widely dispersed and easier to control than one or more larger establishments" ("ITDG's Contribution to the UNEP Addendum," mimeograph, 1991).

The journal *Industry and Environment* published by the United Nations Environmental Program dedicated an issue to "Environmental Management of Small and Medium-size Industries" in June 1987. A literature review would be incomplete if it failed to mention the contents of this issue. The opening article states that "the bulk of pollution throughout the world today is the result of the day to day activities of small and medium size industries which in some sectors comprise the major part of manufacturing production." This is followed by another article by Ahmed Hamza entitled "Environmental Management of Small and Medium Scale Industries in Western Asia." Hamza writes that "since small and medium size industries make up the largest portion of industry in Western Asia, and as small establishments such as tanneries, metal working, dyeing and printing are among the worst polluters, it is imperative that governments should provide adequate financial and technical assistance to enable them to incorporate clean technologies... ." The journal also contains technical articles on treating the effluents of small tanneries and electroplating enterprises.

Lastly, the work of the World Environment Center (WEC) is worthy of mention. The WEC holds a cooperative agreement with A.I.D. for a program called International Environment and Development Service. Under this program, WEC volunteers have performed economic assessments of several small industries in Asia. A report by D.W. Bannister entitled *The Dyestuffs and Dyestuff Intermediates Industry in India* (May 1990) describes the pollution problems of small firms, concluding that SSEs have insufficient space, technical knowledge, and financial resources to treat their effluent individually. Another WEC report, *Thailand Tannery Audits*, was prepared by Carl Huber and Gene Burch in 1989. This study analyzes the effluent treatment procedures and problems of two clusters of small tanneries on the outskirts of Bangkok.

In summary, the literature dealing directly with the relationship between small enterprise and the environment is underdeveloped. The few papers that address the topic directly are either highly region- and firm-specific (for example, *Thailand Tannery Audits*) or sweeping and unquantified (for example, the 1991 Hamza study). Almost all of the literature limits itself to questions about the environmental impact of small *manufacturing* enterprises, with little mention of the impact of small enterprises involved in services, trade, construction, or wood-harvesting. In the introduction to his book on small enterprises, Ian Little explains the lack of attention to nonmanufacturing enterprises by stating that information on their activities is very scarce:

> Outside manufacturing, there is very little information on the size structure of enterprises, although in most economies services are much greater employers than manufacturing, even excluding government and military service (p. 11).

This lack of information/literature on small nonmanufacturing enterprises makes it very difficult to assess their environmental impact in any precise fashion. Documents such as *The State of India's Environment* (Centre for Science and Development, 1985) provide a few anecdotes about the activities of small wood traders; however, these are of limited usefulness. The general scarcity of data on SSEs involved in trade and services results in these sectors receiving less attention than manufacturing firms. This paper is not an exception to that rule.

CHAPTER TWO

TWO SCHOOLS OF THOUGHT

Within the community of organizations that are interested in small-scale enterprises and the environment, two schools of thought appear to be emerging on the relationship between SSEs and environmental degradation. The first is best represented in the writings of the Intermediate Technology Development Group (ITDG) of London, while the second viewpoint is well represented in the documents commissioned under World Bank supervision.

ITDG asserts that small enterprises are less threatening to the environment than larger enterprises:

> Being small-scale, this type of industrial activity lends itself more easily to forms of organization which are less socially disruptive and, although it may pollute or otherwise affect the environment adversely, its dispersion, lesser need for massive infrastructure, and generally simpler processes are likely to result in less grave and more easily remedied environmental consequences (Carr, ITDG, 1987, p. 4).

ITDG sets forth the premise that local people operating small enterprises "are the best guardians of their immediate environments, if ever they are given the chance. Because they have a vested interest in maintaining the resource base and also live amongst the consequences of their actions, the impact of the [small-scale] technologies they use tends to be more carefully monitored and regulated than if it is left to the impersonal attention of regulatory agencies" (ITDG, "Decentralized Production and the Environment," 1991).

A draft of ITDG's contribution to a PVO working paper on the environment reads:

> The impact of a number of small-scale industries on the environment will be more widely dispersed and easier to control than one or more larger establishments. Where production and consumption occur in geographic proximity to each other, communities have a vested interest in protecting their future security. ("ITDG's Contribution to the UNEP Addendum," 1991, p. 2)

The second school of thought on this issue contrasts sharply with that of ITDG. This point of view is found throughout most writing on the subject, particularly in documents produced under World Bank supervision. It emphasizes several points:

- Small manufacturing enterprises are less efficient technically than larger enterprises and therefore likely to produce more pollution per unit of production;

- Small enterprises are difficult to monitor because of their abundance, dispersion, and informal status;

- Small enterprises are unlikely to adopt abatement measures because they cannot afford them, and are unable to exploit economies of scale in abatement technologies; and

- The noxious effects of small enterprises are more likely to engender health problems because the firms are often tightly integrated with residential areas.

A good example of this school of analysis is found in the lead article in the journal *Industry and Environment* (June 1987):

> Large scale manufacturers provide a relatively easy target for the authorities in terms of regulating and controlling emissions and discharges, whereas the same is not always true for the smaller manufacturer on account of the sheer numbers involved, the variety of manufacturing activities carried out and the lack of access to capital and research and development results. Indeed, proportional to turn-over, pollution-control within a small fabrication plant can cost considerably more than in a major industrial plant. As a result smaller industries tend to misuse the environment more than their bigger brethren....Also since most small firms are located within the heart of cities the pollution they cause is often acutely felt by the local population, both in terms of environmental degradation and human health (p. 1).

Which of these two schools of thought is more accurate? At this point it is difficult to say, because neither side musters hard statistics to back up its claims. It is clear, however, that the second school is more prevalent in the literature and amongst those analysts interviewed during the course of this research. Our conclusion is that valuable insights can be identified in both schools, but the weight of the evidence supports the second viewpoint better than the first, especially when discussing small manufacturing enterprises. This is not to say that SSEs are responsible for most environmental degradation, but that *per unit of production* they probably are more severe polluters.[3]

The ITDG argument that SSEs "don't deliberately mess their own backyards" is convincing only in cases where the pollutants that they create are clearly affecting the property or livelihood of the owners of these SSEs. However when property rights are ill defined, such as ability to discharge into a flowing river, pollute the air, or cut trees in open access land, the incentives for SSEs to degrade the environment are similar to the incentives for large-scale enterprises (LSEs) to degrade the environment, namely capture gains for yourself and pass costs onto others as much as possible. And SSEs are better placed than LSEs to avoid government attempts to monitor and control any environmentally destructive activities that they engage in.

The two schools take contrasting positions on the significance of SSE location. The ITDG position is that the proximity of enterprises and their workers is positive, because it

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[3] This is dealt with at some length in Chapter Three.

reduces travel costs and creates incentives for "cleanness." The more mainstream position is that the proximity of small industry and residences increases health risks. A backyard lead smelter is more dangerous than one located in a peri-urban industrial estate.

It is difficult to talk about SSEs in general terms. Small enterprises are involved in such a wide variety of activities that they are bound to interact differently with the environment from industry to industry and from country to country. We will examine specific industries in which both SSEs and LSEs are operating to get a better picture of their relative impacts later in this paper.

CHAPTER THREE

ASSESSING THE IMPACT OF SSEs ON THE ENVIRONMENT

The terms of reference for this study ask the consultant to estimate the impact of small enterprises on the environment, especially in comparison with the impact of larger enterprises. Are small enterprises relatively benign when compared to large industries, or are they responsible for "the bulk of pollution throughout the world" as claimed by the U.N. journal *Industry and Environment?* To examine this issue, we have identified three relevant parameters:

- The types of economic activities in which small enterprises are involved (are most SSEs involved in high-pollution activities?);
- The level of output of small firms, especially in relation to large firms (are SSEs or LSEs responsible for most of a given industry's output and therefore most of its pollution?); and
- The level of environmental degradation that is associated with each unit of output of small enterprises, especially in relation to large firms (do SSEs pollute more than LSEs *per unit of output*?).

By identifying the major sectors in which SSEs operate, identifying their levels of output, and multiplying this figure by a per unit indicator of the level of pollution or environmental degradation associated with output, we can make rough estimates about the overall environmental impact of SSEs.[4]

THE TYPES OF ECONOMIC ACTIVITIES IN WHICH SMALL ENTERPRISES ARE INVOLVED

Small enterprises are involved in hundreds of different activities in the developing world ranging from cutting hair to retailing biscuits to manufacturing batteries. Some of these activities are undoubtedly more dangerous to the environment than others. Are most SSEs involved in environmentally hazardous or relatively benign activities?

To answer this question one needs to examine data on the number of SSEs operating in each sector of the economy. Unfortunately, such data are not available for the entire developing

[4] Another aspect to the question of impact is the absorbtive capacity of the environment in specific ambient zones. In so far as industries are dispersed, they are less likely to surpass the local environment's absorbtive capacity. We were unable to look at this aspect of the problem because of the unavailability of consistent data on the geographical locations of small and large firms.

world, nor for all of Asia — most countries only offer complete data on the *manufacturing* sector, with very little information available on the services and construction sectors. This is problematic, since most small enterprises, particularly microenterprises, operate in nonmanufacturing sectors. In Taiwan, for example, nonmanufacturing SSEs employ more than twice as many workers as do small manufacturing enterprises.[5]

One country for which good data are available is Indonesia. According to its Bureau of Statistics, nonmanufacturing SSEs are much more numerous than those involved in manufacturing. Small manufacturing enterprises employ 3.2 million workers, while nonmanufacturing SSEs employ over 8 million workers. These data are important, because in most people's minds, manufacturing processes are associated with pollution of the environment more than, say, retail trade activities. The Indonesian data corroborate the conclusion reached by Ian Little in his book on SSEs in India — "in most economies services are much greater employers than manufacturing."[6] The Indonesian data are presented below.

Table 1

DISTRIBUTION OF EMPLOYMENT IN NON-AGRICULTURAL SECTORS OF INDONESIAN ECONOMY

Sector	Total Employment ('000)	Employment in Small-scale Enterprises ('000)	SSE Share of Employment (%) In the Sector
Wholesale and retail trade, hotels and restaurants	6,611	6,280	95
Manufacturing	4,361	3,184	73
Transport and communication	1,468	940	64
Construction	1,573	928	59
Mining and quarrying	369	295	80

Source: Bureau of Statistics, Population Census 1980, and World Bank estimates (in ADB, 1990, p. 259)

[5] Little, p. 11.

[6] Ibid., p. 9.

In Indonesia, most small-scale enterprises are involved in wholesale and retail trade, hotels, and restaurants. Occasionally, these activities can have significant environmental consequences — for example, by repackaging pesticides for retail sale, or by consuming large quantities of fuelwood. For the most part, however, trade and hotel services are generally not considered to be the most serious environmental threats. Our impression, derived from these data and numerous interviews, is that most SSEs are not involved in manufacturing and are probably not involved in activities that seriously threaten the environment. According to small enterprise specialist Jim Boomgard of Development Alternatives, Inc., microenterprises (less than 10 employees) are even less likely to be involved in manufacturing activities than are larger SSEs (10-50 employees), although hard data corroborating this impression is unavailable.

Although most SSEs are not involved in manufacturing, many of them are, and environmental concerns should be focussed on this category of small enterprise, because almost all manufacturing processes create organic or inorganic wastes. What are the manufacturing industries in which the most SSEs are involved?

According to the Asian Development Bank publication *The Role of Small and Medium-Scale Manufacturing Industries in Industrial Development: The Experience of Selected Asian Countries* (ADB, 1990),

> Small manufacturing enterprises typically focus on the production of a fairly narrow range of light consumer goods. They are particularly important in food processing and beverages, textiles and apparel, and wood products. In many cases two-thirds or more of their production is concentrated in these industries (p. 12).

The variety of products that small manufacturers produce varies from country to country. In Bangladesh, 86 percent of all small manufacturers are involved in 11 major industry categories. The five most important categories are food transformation (mainly rice milling), basic metal working, saw mills and wooden furniture, printing, and bricks and tiles.[7] In Indonesia, there are numerous small firms in the food industry, the wearing apparel industry, the leather industry, and the production of wood products and building materials. In India, small firms predominate in drinks and tobacco, wood and furniture, leather, nonmetallic mineral products, and metal products.

Do these small-scale manufacturing processes contribute to environmental degradation?

Undoubtedly yes. Food transformation industries create large quantities of high BOD wastes that are dumped into streams and public drainage systems. Textile bleaching and dyeing create heavily polluted wastewaters that are poured directly into rivers or public canals that lead to rivers. Small leather tanneries release significant quantities of chromium that threatens to poison groundwater used for drinking. Small electroplating shops discharge similarly toxic

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[7] ADB, 1990, p. 74.

heavy metals. And brickmakers contribute to air pollution and the depletion of wood resources. Other examples abound.

Although most SSEs are probably not involved in activities that cause significant environmental degradation, many SSEs that are involved in *manufacturing* do threaten the environment with pollution. Of particular concern are activities in food processing, leather tanning, textile dyeing, metal working (electroplating), and lead smelting.

THE LEVEL OF OUTPUT OF SMALL FIRMS

Are SSEs the principal polluters among these industries? The answer varies across countries and across industries, but generally SSEs are not the principal polluters because they are not the principal producers. Although there are numerous small-scale firms in these industries, they rarely are responsible for most production, and it is production that usually is correlated with most environmental degradation. In Indonesia, there are 118 times more small industry firms than large firms, but small firms only contribute 18 percent of total manufacturing value added.[8] Small enterprises are particularly numerous in the food, wearing apparel, and machinery industries in Indonesia; however, they account for only about a quarter of output, as demonstrated in Table 2.

Table 2

	SMI Share (%) of Establishments	SMI Share of Value Added
Food industry	99	24
Wearing apparel	96	25
Machinery and components	91	26

Source: ADB, 1990, p.266.

Even in Indonesia's leather tanning industry, an industry that is frequently cited as an example of SSE pollution, small firms account for only 12 percent of the country's total output. In this light, it is doubtful that small tanneries are responsible for most of the industry's pollution. Nor is it probable that SSEs are responsible for most pollution associated with the food industry, wearing apparel industry, or machinery and components industry.

[8] COWIconsult, p. 7.1 and p. 3.3.

In Bangladesh and the Philippines, the situation is similar — SSEs are abundant, but they do not account for most manufacturing output. It seems unlikely, therefore, that they are responsible for the bulk of manufacturing pollution. In Bangladesh, the vast majority of manufacturing establishments are of the small and cottage types, and 80 percent of all manufacturing employment is in these small shops. Most manufacturing value-added, however, comes from medium- and large-scale firms. A 1983 census of manufacturing establishments in the Philippines showed that 90 percent of all enterprises employed 10 workers or less. These small enterprises, however, accounted for only 21 percent of total employment and 2 percent of manufacturing census value added.[9]

The situation is different in India. There are five manufacturing sectors in this country where small firms (less than 50 workers) are responsible for more than half of all output. This is indicated in Table 3.

Table 3

VALUE ADDED IN UNREGISTERED FIRMS (LESS THAN 50 WORKERS) IN 1982

Sector	Proportion of Total Manufacturing Value Added (%)
Drinks and tobacco	58.7
Wood and furniture	84.3
Leather and fur products	81.1
Nonmetallic mineral products	53.2
Metal products	55.5

Source: ADB, 1990, p. 163.

Two reasons that small firms appear to be unusually important in production in India are that (a) the Indian government has enacted fiscal and regulatory policies favoring small firms; and (b) the statistics for India classify "small" as up to 50 workers, while data for most other countries classify "small" as up to 20 workers. Nonetheless, it appears that small firms are probably more important in India than in other Asian countries and therefore they are responsible for a more significant portion of the pollution load. This is applicable, of course, only to the above-cited sectors. In other sectors, such as textiles, the Indian pattern is similar to that of the other countries — small Indian textile firms employ 56 percent of textile workers but produce

[9] ADB, p. 317.

only 13 percent of output.[10] Of all dyestuff manufacturers, 94 percent are small firms, but they produce only 25 percent of the industry's total output.[11]

The conclusion we draw from our review of these production data is that one must be careful with broad generalizations on this issue. In many economic activities and countries, SSEs are much more numerous than LSEs but produce less total output and presumably less total pollution (for example, tanneries in Indonesia). In other activities and countries, small enterprises produce the largest share of a limited number of industries' output and presumably the largest share of pollution related to those industries (for example, tanneries in India). One must be careful to specify the country and the industry before concluding that SSEs are, or are not, responsible for most environmental degradation related to that industry.

THE LEVEL OF ENVIRONMENTAL DEGRADATION ASSOCIATED WITH EACH UNIT OF OUTPUT OF SMALL ENTERPRISES, ESPECIALLY IN RELATION TO LARGE FIRMS

Determining level of impact on the environment is of course more complicated than determining the share of an industry's output that can be attributed to small enterprises. It is also important to determine if SSEs pollute more or less *per unit of output*.

There is very little hard evidence on this question; however, most observers agree that SSEs involved in manufacturing pollute more per unit of output than larger industries operating in the same sectors. According to a recent World Bank document on industrial pollution in India, pollution problems are much more pervasive among small- and medium-size enterprises than among LSEs.[12] Data from Indonesia indicate that small tanneries, for example, produce 65 percent more chromium waste per unit output than large tanneries.[13]

There are three analytical explanations for the apparent tendency of SSEs to pollute more per unit output: technical inefficiencies in production, technical inefficiencies in waste treatment, and the ability of SSEs to escape government regulation.

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[10] Ibid., p. 167.

[11] Bannister, p.1.

[12] World Bank, Staff Appraisal Report, India, May 1991, p. 9.

[13] COWIconsult, pp. 8.8-8.9.

Technical Inefficiencies in Production

The World Bank analysis of India's industrial pollution suggests that suboptimal scales of production can be blamed for technical inefficiencies that increase pollution per unit. Small enterprises are likely to produce output in batches, rather than continuously. Batch production requires more frequent starting and stopping of processes — starts and stops that often are associated with higher pollution levels. Examples include the air pollution associated with the frequent starts and stops of small rice mills, and the water pollution associated with flushing the machinery used for printing, tanning, and dyeing after each small batch.[14]

Ahmed Hamza is convinced that SSEs are less technically efficient than larger firms. He writes,

> Small-scale manufacturers tend to utilize non-automated and less expensive equipment. In some cases, they are allowed to buy secondhand production lines.... Such inferior equipment often results in the production of excessive wastes as well as considerable losses of raw materials, lubricating oils, energy, and processed products. Oils leaking from faulty machines, poor housekeeping, inadequate assembly of equipment in cramped areas, and ineffective process handling and control, are all common practices in little workshops and small manufacturing plants teeming in cities of the developing world" (Hamza, 1991, p. 23).

Financial Inefficiencies in Small-Scale Waste Treatment

Pollution abatement equipment is characterized by economies of scale that make per-unit costs for waste treatment much less for large-scale firms than for small firms. A small tannery, therefore, is much less likely to install a wastewater treatment plant than is a large firm, and a backyard lead smelter is less likely to install a scrubber than a larger-scale operation. According to the World Bank, adoption of a small production scale frequently increases the cost of treatment of effluent, making it difficult for companies to meet emission standards:

> While most of the large size enterprises are believed to be capable of taking measures to reduce pollution, small and medium firms face many constraints. Large firms have access to a variety of financing sources, international consultants and technologies. They can, therefore, take the required steps to protect the environment if monitoring and enforcement measures are implemented. On the other hand, considering their limited resources (including

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[14] "In most of the small factories, the campaign length for a single product is only two to five days to meet the ordered quantity of dyestuff. The campaign lengths can only be increased by carrying stocks of products. This is not acceptable because of carrying charges ant the danger that a further order will not be obtained. This means that the factories wash out their equipment frequently with consequent water usage, product loss, and waste discharge." (Bannister, p. 14)

> the lack of qualified operators, financial resources, and information on appropriate technologies), many of the small-scale industries cannot easily undertake the required pollution abatement measures" (Staff Appraisal Report, May 1991, p. 9).

According to Ahmed Hamza, small-scale waste generators find it impracticable to treat their residues on site due to lack of space, experience, and financial resources (p. 26). Hamza writes that "based on unit production, pollution control within outdated small-scale plants is much more expensive than in modern large-scale plants" (p. 23). An environmental assessment of the dyestuff industry in India concludes that small firms cannot be expected to treat their effluents individually because of technical and financial constraints (Bannister, 1990).

The Ability of SSEs to Escape Government Regulation

The last explanation for why SSEs appear to pollute more than LSEs per unit of output is that SSEs are much more difficult to monitor and regulate. This is particularly true for informal, nonregistered enterprises that are beyond the control of government. According to the World Bank, the vast majority of small firms in India are in noncompliance with environmental regulations, and they are beyond the reach of the state pollution control boards. Ahmed Hamza writes:

> While large manufacturing concerns are prime targets of local authorities for emission control, smaller manufactures are, by and large, neglected on account of their sheer numbers and their comparatively lower levels of pollution. Consequently, small industries tend to misuse the environment by generating excessive wastes witch either are discharged as raw wastewaters to the overloaded municipal sewerage systems or are disposed of as sludges wherever convenient and accessible (p. 24).

For the above three analytical reasons, as well as empirical evidence that small-scale tanneries pollute more than larger ones in Indonesia, it is reasonable to conclude that **small-scale industries probably pollute more per unit of output than larger industries operating in the same sectors.**

CONCLUSIONS ON ASSESSING THE IMPACT OF SSEs ON THE ENVIRONMENT

At the beginning of this chapter we identified three questions that we felt were pertinent to this issue. The data are insufficient to answer any of these questions definitively; however, our review of the literature and our interviews have left us with informed impressions.

1) **Are most SSEs involved in high-pollution activities?** Most SSEs are not involved in manufacturing — they are involved in relatively neutral activities such as trade and services.

There is a minority group of SSEs, however, that is involved in highly polluting activities such as tanning, textile dyeing, metal working, and food processing.

2) **Are SSEs or LSEs responsible for most of a given industry's output?** For most industries, SSEs are only responsible for a small percentage of total output, and therefore it is unlikely that they are responsible for most of those industries' pollution. For five industry categories in India, however, SSEs are responsible for most production and therefore they probably are responsible for most pollution in these industries. These exceptions to the rule highlight the importance of specifying the country and industry before declaring whether or not SSEs account for most of a given industry's pollution load.

3) **Do SSEs pollute more than LSEs per unit of output?** Analytical and limited empirical data suggest that SSEs pollute more per unit of output.

These three sets of questions and answers leave the overall impression that SSEs only have an important environmental impact in a limited number of highly polluting manufacturing industries — industries in which SSEs produce a large percentage of total output. The identity of these industries will vary from country to country, but in several Asian countries the list will certainly include leather tanning, metal processing, wet-end textile processing, and food processing. We will look closer at each of these industries later in the paper.

THE ENVIRONMENTAL PROBLEMS OF SSEs IN PERSPECTIVE

It is useful to keep our understanding of SSE-related environmental impact in perspective. SSEs are responsible for a significant part of industrial pollution in only a limited number of industry categories. In industrial categories dominated by large firms (such as chemicals, petroleum, plastics, coal, and heavy engineering), SSEs contribute only a very minor part of pollution. It also must be pointed out that industry as a whole is not necessarily the major source of several forms of environmental pollution. **Domestic sewage** (household wastes) is the major source of water pollution in most Asian cities, and **motor vehicle exhaust** is the major source of urban air pollution.

In Bangkok, the total bio-oxygen demand imposed by discharges of domestic sewage and industrial wastes to the city's sewers, drains, and waterways is estimated at 365,000 kg per day. Of this total, 97 percent is from household wastes and 3 percent is from industry.[15] In Indonesia, domestic sewage is also considered to be the most important source of organic pollution in the nation's rivers. This is not to say that industrial water pollution is a trivial problem — it is a serious problem, because many industrial effluents are more toxic than domestic effluents. However, industry should not be the only target for those concerned about water pollution, particularly organic water pollution. In many Asian cities, improvements in

[15] Thailand Development Research Institute, p. 232.

municipal sewage systems should probably receive higher priority than controlling the effluents of small-scale enterprises.

In terms of air pollution, motor vehicle exhaust is a much more serious problem than the exhaust of small enterprises. In Sao Paulo Brazil, nearly three quarters of the air pollution is caused by cars.[16] In Thailand, motor vehicles represent the major emission source of CO (60 percent) and HC (46 percent), as well as NOx (23 percent).[17] Transportation is solely responsible for high ambient CO concentration along busy streets in major cities, and it is largely responsible for photochemical smog formation. In Jakarta, motor vehicles are the principal source of four of the five major air pollutants. Industry certainly contributes to air pollution, particularly sulphur dioxide, but when priorities are set in air pollution control, motor vehicles probably deserve more attention than small-scale manufacturers, which only cause a small part of all of industry's portion of air pollution.

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[16] Theodore Panayotou, *The Economics of Environmental Degradation: Problems, Causes, and Responses*, April 1990, p. 96.

[17] Thailand Develoment Research Institute, p. 194.

CHAPTER FOUR

WATER AND LAND POLLUTION

One of the most obvious environmental impacts of small enterprises is their contribution to water pollution. SSEs involved in industry, and occasionally services, cause water pollution by discharging effluents into streams, rivers, and public drainage systems that flow into rivers or oceans. Small manufacturing enterprises also create solid wastes and sludges, which frequently are disposed of improperly on public lands or in unlined landfills. Toxic elements of these solid wastes may eventually leach downward to contaminate groundwaters.

Dozens of different SSE activities contribute in some way to water and land pollution — even a hair dresser is likely to dump her empty shampoo bottles into an unofficial landfill. Four categories of SSEs, however, deserve special attention for two reasons: (a) they are involved in industries that create large quantities of pollutants or highly toxic wastes, and (b) they are involved in industries in which SSEs are responsible for a major part of total production.

In Indonesia, COWIconsult identifies four categories of SSEs that need special attention:

- Leather tanning operations;
- Wet-end textile operations (dyeing and finishing);
- Electroplating shops; and
- Food processing operations.

These same industries are of significant concern in other Asian countries. The literature identifies small **tanneries** to be of special concern in India (World Bank 1991, Center for Science and Environment 1982), Thailand (Huber, 1989), Malaysia (Singh, 1991), Hong Kong (Chiu, 1987), and the Philippines (Somani, 1990). Small **wet-end textile operations** are singled out for attention in India (Bannister, 1990, World Bank 1991), Western Asia (Hamza, 1987), Sri Lanka and Thailand (Hamza, 1991). Small **electroplating** shops are identified as significant polluters in the Philippines (Somani, 1990), Thailand (Hamza, 1991), and Malaysia (Singh, 1991). And small-scale **food processors** are identified in the literature as major problems in Thailand (Thailand Development Research Institute, 1987), Malaysia (Singh 1991) and the Philippines (Somani, 1990).[10]

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[10] Several other SSE activities might have been included in this list. Small battery manufacturers are mentioned as problematic in the Philippines, because of lead in their effluents; however, they are not mentioned in the literature on other countries and almost no data is available on their activities. Automotive service centers are also problematic, because they may discharge oil and fuels that foul water courses and groundwater. They are barely mentioned in the literature, however, and insufficient data are available to discuss their activities in an informed fashion. One can think of many other polluting SSE activities, but these are not considered to be of top priority

Because these four industries are identified in the literature as areas of special concern, we will examine each of them in more detail below. Possible technical solutions to these industries' environmental problems are also presented; discussion of economic and administrative solutions is delayed until Chapter Nine.

LEATHER TANNING

The transformation of hides into leather (tanning) is a multistep treatment process that pollutes the water it uses to wash and treat hides. The process involves softening and cleaning the hides with water, removal of hair by alkaline sulphide solutions, tanning the hides with chrome agents, and finally retanning in order to control the quality of finished leather. The polluted water is typically discharged as effluent into rivers or public drainage systems. In larger tanneries, the effluent may be treated before it is discharged, but in small-scale tanneries the wastewater is usually not treated properly if at all. Solid residues and sludges from tanning are routinely disposed of without treatment in uncontrolled landfills.

Tanning is conducted by large, medium, and small enterprises. In India, most tanning is done in small firms of less than 50 employees. In Indonesia, there are 70 large- and medium-size firms, and 470 small firms of less than 20 workers. Although small firms are more numerous in Indonesia, they account for only 12 percent of total leather output. Table 4 shows the industry breakdown.

TABLE 4

NUMBER OF UNITS AND PRODUCTION OF INDONESIAN TANNERIES

Size	Number of units and % of total	Number of employees and % of total	Production of finished leather in tons/year and % of total	Production in tons per employee per year
Small scale	470 (87%)	2,642 (26%)	5,881 (12%)	2.2
Medium and large scale	70 (13%)	7,427 (74%)	43,657 (88%)	5.9
Total	540	10,069	49,538	4.9

Source: COWIconsult, p. 8.1.

in the relevant literature.

Because small firms produce only 12 percent of Indonesia's leather output, it is unlikely that they are responsible for the majority of the industry's pollution, although they are undoubtedly significant polluters. In India, where small firms produce over 80 percent of all leather products, it is likely that SSEs are responsible for most tannery pollution.

The most important tannery pollutants are:

- Sodium chloride from salted hides and raw materials used;
- Soluble and suspended proteins from the hides;
- Heavily biodegradable matters like organic solvents, phenols, dyestuffs, detergents, and antiseptic agents; and
- Heavy metals like chromium from the tanning agents and chromium and copper from dyestuffs.

All of these pollutants contribute to water and land pollution, but the heavy metals are particularly hazardous because of their persistence, their tendency to be absorbed into the food chain, and their high toxicity to human beings.

CCWIconsult's estimates of the total pollution load from tannery wastewater in Indonesia is presented in Table 5.

This table indicates that small firms, responsible for 12 percent of leather output, are responsible for a corresponding amount of the industry's polluting effluents, except chromium. **Small firms cause a disproportionate share of chromium pollution**, discharging 65 percent more chromium per ton of leather processed than medium and large firms. Two explanations for this phenomenon are that (a) small-scale techniques are less efficient in chrome uptake, which results in more chrome being drained off in waste waters; and (b) small-scale firms are less likely to treat their effluents before discharge.

TABLE 5

Pollutant	Small-scale Tons per Year and % of Total	Medium and Large Scale Tons per Year	Total
Suspended solids	2200 (13%)	16,000	18,200
BOD	900 (12%)	6,500	7,400
COD	2600 (12%)	19,000	21,600
Sulphides	75 (12%)	550	625
Total Nitrogen	175 (12%)	1,300	1475
Sodium Chloride	4,000 (13%)	27,500	31,500
Chromium	120 (18%)	540	660

Source: COWIconsult, p. 8.9

During the course of this research, three industry experts were interviewed about the environmental impacts of small tanneries. Anil Somani, who studied tanneries in the Philippines for the World Bank, believes that small tanneries pollute more because of their tendency to process in batches, which requires frequent discharge of effluent. Gary Kilmer, an expert in Indonesian industry consulting to the World Bank, feels that small tanneries pollute more per unit than large firms because small firms are less sophisticated and less efficient in their measurement of chemical inputs. Fernando Fernandez of INSOTEC, an NGO currently undertaking a study of tanneries in Ecuador, believes that small firms pollute more because they are less likely than larger firms to treat their effluents in any way.

The damage that tanneries can cause to water resources is described in *The State of India's Environment 1986-85*, by the Centre for Science and Environment:

> Nearly 70 per cent of India's total exports of leather and leather products come from the 423 recognized tanneries in Tamil Nadu....Many tanneries have installed concrete storage tanks from which the effluents are evaporated. But their capacity is limited and the overflow is dumped either on fields or let into irrigation tanks and rivers. The King's Institute in Madras has declared Ambur's

> water supply to be unfit for human consumption....The Indian Express recently pointed out that the effluents from the tannery industry have resulted in 10.000 acres being severely affected and another 30,000 acres being moderately affected in [other towns]....What compounds the problem is that the effluents are released directly into or find their way to the Palar river and all wells on both banks and the river itself — the major source of water supply — have been severely polluted. Some 3,000 taps in Ambur now disgorge only polluted water (p. 36).

Two technical solutions have been put forward to confront the problem. The first is to **relocate small tanneries to industrial estates on the outskirts of town with common wastewater treatment facilities.** This approach is recommended throughout much of the literature on this topic. By grouping tanneries together, economies of scale can be gained in waste treatment. Such an approach requires government investment and the creation of incentives for small firms to relocate to such premises. Firms usually will not incur the expenses of operating these common wastewater plants unless penalties for pollution are enforced.

A second possible technical solution is proposed by COWIconsult engineers. Recognizing that in the conventional chrome tanning process about 33 percent of the added chromium is not used and is therefore discharged with the wastewater, COWIconsult recommends **changing the chemical input mix.** According to their engineers, tanneries using high-concentration chromium, lower pH values in the tanning solutions, and organic acids to mask the hydroxyl groups, should be able to reduce their loss of chromium to only 2 percent.[11] The new process, however, adds significantly to tanning costs. It seems unlikely that small firms will voluntarily agree to increase their costs, unless penalties for noncompliance are enforced.

WET-END TEXTILE OPERATIONS (DYEING AND FINISHING)

Textile production is an important industry throughout Asia, employing millions of workers. Spinning and weaving operations are not major causes of water pollution, but wet-end processes such as dyeing, printing, and finishing are important water polluters. These processes may be carried out by large mills in conjunction with other textile operations, or they may be carried out by small firms and cottage shops. Data is not available on the number of these small enterprises or their total output.

Small-scale, wet-end textile operations are identified as significant water polluters in Indonesia by the COWIconsult team, particularly cottage industries involved in batik. Ahmed Hamza identifies small-scale batik printing as a problem in Sri Lanka, where untreated effluents are being discharged into Colombo's canal systems, resulting in eutrophication and disappearance

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[11] COWIconsult, p. 8-4.

of aquatic organisms.[12] Singh also identifies small batik printers and cloth dyers as significant sources of water pollution in Malaysia. A water sample taken by Singh from a small dyeing operation revealed that the firm was exceeding pollution standards by 200 percent.[13] A study conducted by Bannister on the dyestuffs industry in India concludes that small firms pollute waterways because they are unable to treat their own wastes to meet regulatory standards.[14]

In Indonesia, a typical small batik enterprise employs six workers and discharges 500 to 2,000 liters of wastewater per day from the dying and dewaxing processes.[15] Of 42 such SSEs visited by the COWIconsult team in Indonesia, 41 did not treat their wastes. Wastewater contains dyes and inorganic chemicals such as salts and bases. Batik operations in urban areas frequently discharge their wastes into open ditches or municipal drainage canals.

The hazards associated with these wastewaters depend on the types of dye employed. Certain types of dyes and color fixation agents contain chromium, which is considered highly toxic. According to COWIconsult, only a small percentage of dyeing operations employ this or other types of chemicals. Bannister's study of dyestuffs in India also concludes that only a small part of the dyes used in that nation's textile business contain chromium. According to Bannister, wastewater from dyeing operations contaminates rivers with both BOD and nonbiodegradable pollutants. Discolored water creates an aesthetic problem, but generally is not highly toxic to marine organisms.[16] It may, however, decrease light penetration and hence reduce photosynthetic oxygen production.[17]

Three technical solutions have been put forward to confront the problem. The first is to **relocate small dyeing operations to industrial estates with common wastewater treatment facilities.** This solution is attractive because it allows effluents to be treated sufficiently to meet environmental standards. This approach, however, involves the same cost and incentive problems that were described above for other common treatment facilities.

A second possible technical solution is to **ban the import, production, and use of dyes containing dangerous heavy metals** such as chromium. If effective, such a ban would eliminate the most toxic substances from the industry's effluent.

A third possible solution is to recognize that the wastewater from batik enterprises is of modest proportions compared to the domestic wastewater load being born by most Asian

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[12] Hamza, p.8.

[13] Gurmit Singh, et al., *Environmentally Sound Technology Search Among Malaysian SMIs*, 1991, p. 64.

[14] Bannister, p.2.

[15] COWIconsult, pp. 7, 9.

[16] Bannister, p. 23.

[17] Hamza, 1991, p. 17.

waterways, and to concentrate resources on improving urban sewerage systems rather than pursuing small batik operations. According to a specialist in Indonesian industrial pollution, it makes more sense to improve the cities' municipal sewage systems and allow batik operations to discharge into it, than to set up common treatment plants for small batik makers.

ELECTROPLATING

Electroplating is the coating of a metal or plastic substrate with metal for protective or decorative purposes. The process consists of immersing the object in a series of chemical baths to degrease, clean, and plate it. Small electroplating shops often are mentioned as particularly dangerous polluters because of the heavy metals found in their effluents. It has been estimated that 10 percent of all metal used in electroplating passes into the effluent.[18]

COWIconsult reports that most electroplating operations in Indonesia have inadequate or no wastewater treatment. They estimate that the total quantity of heavy metals discharged with the wastewater to be several thousands of tons per year, exceeding standards by 20 times.[19] Data is not available on the size composition of firms in the electroplating industry, but a large number of small firms are involved.

Somani's study in the Philippines identifies electroplating as one of the three small-scale industries of greatest concern in that country. According to Somani, electroplating effluents contain phosphates, acids, chlorides, and complexing agents, as well as heavy metals such as copper, nickel, chromium, zinc, lead, and tin. Small operations are located throughout Manila and other urban centers, and they usually discharge their effluent directly into the nearest ditch or public sewer without pretreatment. Such discharges may cause acute metal toxicity or changes in pH that poison the receiving water body. According to Somani, the dangerous solid wastes of electroplating (tank bottom sludges, filings) are disposed of untreated, leading to potential soil and groundwater contamination.[20]

Hamza also mentions electroplating as a source of major environmental concern in Thailand.[21] According to Hamza, significant buildups of heavy metals have been reported in almost all industrial urban areas of South East Asia, posing hazards to human health and aquatic organisms.[22]

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[18] Sarah Longhurst and Eric Turner, "Combined Treatment of Industrial Effluents," in *Industry and Environment*, Vol. 10, No. 2, June 1987, p. 13.

[19] COWIconsult, p. 4.29.

[20] Somani, p. 16.

[21] Hamza, p. 28.

[22] Ibid., p. 21.

Technical solutions to the environmental problems of SSEs involve treatment of effluents using a series of chemical treatment processes of oxidation, reduction, neutralization, and precipitation, followed by sedimentation, filtration, and sludge handling facilities. Through electrowinning and other processes, certain heavy metals can be recovered from the effluents for reuse. These procedures do not appear to be feasible for small electroplating firms, because the basic equipment is expensive, costing between $100,000 and $200,000 per unit for a medium-size operation[23]. However, the equipment may be more appropriate for common treatment facilities serving groups of electroplating enterprises located in industrial estates. Such common facilities have been successful in Japan, but economic or regulatory enforcement incentives must be well developed before small firms will become attracted to such schemes in poorer countries.[24]

Simpler procedures to reduce effluent volume may be possible on an individual shop basis, for example, through countercurrent washing and the saving of water through spray washing techniques.[25] Basic sedimentation tanks can also help to reduce pollution.[26] Firms will not have incentives to adopt these techniques, however, until free disposal of effluents is eliminated or more economically attractive methods are identified.

FOOD PROCESSING

Food processing is usually the first small industry to spring up in most developing countries. It can range from milling rice, to transforming soya into tofu, to making bottled fruit juices. There are thousands of food processing enterprises in Asian cities and rural areas, many of them household or cottage shops.

According to COWIconsult, one of the most significant environmental pollution problems associated with SSEs in Indonesia is "wastewater with very high BOD from tapioca, tempe, and tofu production."[27] According to the World Resources Institute, Indonesian officials cite the

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[23] COWIconsult, Annex 12, p. 18.

[24] The Japanese example is described in "Pollution Abatement and Control Technologies for Small and Medium Scale Metal Finishing Industry," by M. Okazaki in *Industry and Environment*, Vol. 10, No. 2, June 1987, p. 23.

[25] Ibid., p. 26.

[26] COWIconsult estimates that a small tank and sedimentation basin at a small electroplating shop costs $2,000 to install, plus recurrent costs for precipitating chemicals, p. 7.8; these will reduce, but not eliminate, the chromium pollution problem.

[27] COWIconsult, p. 7.2.

numerous, small tapioca producers in urban areas as significant contributors to river pollution.[28] These small producers typically dump their untreated wastewaters directly into open ditches and city drainage canals. In Thailand, BOD imposed by organic effluents is the main problem in most of the nation's rivers, according to the Thailand Development Research Institute.[29] A significant part of these effluents originates in tapioca and sugar processing operations, although data on the size structure of these industries is not available.

Somani, writing on the Philippines, cites food processing as one of the major small-scale enterprise activities contributing to water and land pollution. According to Somani, the majority of small food processing firms in the Philippines are involved in the production of fruit juices, furit cocktails, and fried snacks. Large volumes of wastewaters are produced from the washing, cooking, sterilization, and general housekeeping and equipment cleaning. The wastewaters are normally high in BOD, total suspended solids, and pH. Fecal coliforms may also be present. Where city sewers are available, the wastewaters are discharged into the sewers; otherwise, they are either discharged to the nearest water course or allowed to soak into the soil.[30]

The Singh report on small enterprises in Malaysia also mentions the pollution problems of small food processors, particularly noodle and tapioca producers which discharge high BOD wastewater into water courses.

Solutions to the environmental problems of small food processing plants are technically simple. A small wastewater treatment center can be constructed at each production unit in Indonesia for about $800, or dispersed enterprises can be encouraged to group together around a common wastewater treatment plant. The by-products of certain processes such as rice hulls can be formed into fuel briquets or incorporated into building materials. Other wastes can be incorporated into animal foods. These solutions, however, are frequently not profitable for the enterprise-owners, and, in the absence of economic or effective regulation, it is unlikely that they will be adopted on a wide scale.

Recognizing that the amount of organic waste originating from industrial food processing operations is much smaller than the amount originating from domestic sources (untreated sanitary wastewater) in urban areas, COWIconsult recommends that the problems of small food processors be resolved in connection with the installation of municipal sewerage systems and treatment plants. Once proper sewerage systems are operational, food processing wastes can flow through the same system as domestic sewage. Ahmed Hamza mentions a similar solution

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[28] World Resources Institute (Center for International Development and Environment), *Toward an Environmental and Natural Resources Management Strategy for ANE Countries in the 1990s*, ANE/USAID, January, 1990, p.37.

[29] *Thailand Natural Resources Profile*, p. 217.

[30] Somani, p. 17.

in his paper, pointing out that combined domestic/SSE treatment can be more cost-effective and simpler to administer than individual on-site treatment for small firms.[31]

[31] Hamza, p. 25.

CHAPTER FIVE

AIR POLLUTION

Many small-scale enterprises create smoke and fumes, thus contributing to the severe air pollution problems that exist in most large Asian cities. Small foundries, rice mills, bakeries, restaurants, food processors, brick making operations, and lead smelters burn fossil fuels that create emissions. Usually these emissions are a local problem, confined to the immediate area around the enterprise.

The literature on SSEs and environmental degradation indicates less concern about air pollution than water pollution. Air polluting enterprises are not mentioned in the lists of SSEs deserving special environmental attention compiled by COWIconsult in Indonesia and A.H. Somani in the Philippines. Ahmed Hamza expresses limited concern about air pollution and SSEs. He writes:

> Compared to their large-scale brethren, small-scale industries contribute smaller loads of air pollutants. Nevertheless their effect are sometimes more pronounced due to the cumulative impact of concentrations of small polluting establishments located within a residential area (p. 20).

One reason that SSE-generated air pollution receives less attention is that the air pollution generated by small manufacturing enterprises is relatively minor, when compared to the major sources of urban air pollution: motor vehicles, large industry, households, and burning garbage. This is demonstrated in Table 6 below — a source inventory for Jakarta. This data does not differentiate between large and small enterprises; however, observers believe that large firms such as power plants and paper mills create the bulk of the worst industrial pollutant — sulphur dioxide.

In Jakarta, nonindustrial sources are responsible for the majority of four of the five major air pollutants, with transportation being the largest culprit. Air pollution data from Bangkok are similar. Transportation represents the major emission source of CO (60 percent) and HC (46 percent), as well as NOx (23 percent). Transportation is solely responsible for high ambient CO concentrations along busy streets in major cities and it is largely responsible for photochemical smog formation.[32] In Bombay, India, transport is responsible for twice as much particulate matter and carbon monoxide as industry, although industry (mostly large industry) creates more sulphur dioxide and hydro-carbons.[33]

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[32] Thailand Development Research Institute, p. 194.

[33] Centre for Science and Environment, 1982, p. 79.

TABLE 6

AIR POLLUTION SOURCE INVENTORY FOR JAKARTA

Pollutants	Total emissions t/year	Industry %	Households %	Burning garbage %	Motor vehicles %
TSP	71	14.6	33.0	8.4	44.1
SO_2	24710	62.7	10.7	0.2	26.5
NO_x	20465	15.9	9.6	1.1	73.4
HC	14593	1.2	2.2	7.7	88.9
CO	325578	0.1	0.1	1.0	98.8

source: COWIconsult, p. 3.11. TSP=total suspended particulates; SO_2=sulphur dioxide, NO_x=nitrogen oxide; HC=hydro-carbons; CO=carbon monoxide.

These data indicate that transport is a larger air polluter than small industries. If one considers independent taxis and other motorized vehicle services as small enterprises, one must also consider them to be part of the urban air pollution problem. In Lima, Peru, Hernando de Soto claims that 95 percent of all public transport is small scale and informal.[34] We were not able to locate data on what percentage of traffic in Asian cities is composed of small entrepreneurs on wheels.

In so far as independently operated vehicles are older and less well maintained than other cars, they may be responsible for a disproportionate share of air pollution. Small entrepreneurs who tune up older vehicles contribute to reductions in air pollution. Small entrepreneurs who "jerry rig" old, heavily-polluting vehicles, thus keeping them on the road, contribute to increased air pollution.

As mentioned above, small, air-polluting industrial enterprises generally create local problems, confined to the area around the business. One type of enterprise that deserves special mention in this regard is small lead-scrap smelters, because of the high toxicity of their fumes. COWIconsult cannot specify the number of small-scale smelters operating in Jakarta, but does cite cases of uncontrolled and very serious pollution with lead dust coming from small firms. Considering the dangers of lead poisoning, COWIconsult recommends that this industry group be the subject of further study. Ahmed Hamza also cites smelters as being particularly noxious. Gary Kilmer of the World Bank's Industrial Efficiency and Pollution Abatement Project in

[34] Hernando de Soto, "Structural Adjustment and the Informal Sector," p. 4, in *Microenterprises in Developing Countries*, edited by Jacob Levitsky, Intermediate Technology Publications, 1989.

Indonesia believes that small lead-scrap smelters are beyond reform and may have to be simply shut down.

Good ideas for reducing air pollution from small-scale industry are rare — abatement equipment is neither technically nor economically adapted to the needs of small firms. COWIconsult estimates the typical cost of installing filters on a lead smelter to be $200,000 per factory.[35] Common treatment of gaseous emissions is much less feasible than it is with liquid emissions.

Good ideas for reducing air pollution from motor vehicles, on the other hand, are commonplace. These include fiscal measures to support sales of reformulated, lesser-polluting vehicle fuels, taxes on heavily polluting fuels to reduce their consumption, and improved vehicle inspection procedures. Such measures are not specific to SSE-operated vehicles; they will affect all motorized transportation.

[35] COWIconsult, Annex 12, p. 18.

CHAPTER SIX

SSEs AND RESOURCE DEPLETION

The scope of work for this study reads: "It is expected that some of the small enterprise sectors will be heavy net consumers of natural resources e.g., brick and charcoal producers, as heavy users of wood." In this section we look at the role of SSEs in resource depletion, particularly deforestation. For reasons of clarity, we put aside the issue of air pollution associated with burning woodfuels (treated in Chapter Five) to focus exclusively on the depletion issue.

Six significant findings on resource depletion are outlined in this chapter:

- Forest depletion is occurring at an alarming rate in Asia;
- Most deforestation in Asia does not involve SSEs;
- SSEs are involved in deforestation in two ways: directly through directly harvesting wood, and indirectly through consuming wood as an input;
- The source of the deforestation problem lies fundamentally with policy failures relating to the harvest of wood, not in its consumption;
- To address the fundamental cause of deforestation, it is necessary to address policy failures in land tenure and insecurity of forest ownership;
- Steps to reduce consumption of wood by SSEs are worthwhile; however, they treat the symptom of inappropriate resource depletion (overconsumption due to low wood prices) and not the cause (insecure tenure of forest lands).

FOREST DEPLETION IS OCCURRING AT AN ALARMING RATE

Forests are being depleted at a shocking pace throughout the developing world. In Asia the depletion is particularly severe, as seen in the table below.

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TABLE 7

DEFORESTATION IN ASIAN COUNTRIES

Country	Area of forest cleared annually (hectares)	Per cent of forest cleared annually
India	1,500,000	4.1
Indonesia	900,000	0.8
Myanmar	677,000	2.1
Thailand	397,000	2.5
Vietnam	173,000	2.0
Philippines	143,000	1.5

Source: World Resources Institute, cited in *The Economist*, August 10, 1991.

MOST DEFORESTATION IN ASIA DOES NOT INVOLVE SSEs

Large-scale commercial logging and clearing land for agricultural purposes are by far the two most important causes of deforestation in Asia. (World Resources Institute 1986, *The Economist*, Aug 10, 1991) These two activities do not involve SSEs and therefore they are not discussed in this study. The collection of firewood is a less important source of deforestation. This activity is carried out by individuals for home consumption and by small- and medium-scale entrepreneurs for sale in urban markets. According to the World Resources Institute, "fuelwood users are not so much the cause of deforestation as the victims of it."[36]

SSEs ARE INVOLVED IN DEFORESTATION IN TWO WAYS

There are two distinct ways in which small enterprises contribute to the deforestation problem: **directly, by cutting trees** or gathering fuelwood from open access or public lands; and **indirectly, by consuming wood** in a production process, usually as a fuel.

Very little is known and very little has been written about the role of SSEs in **direct deforestation** in Asia. Two possible reasons for this lack of knowledge are that much of the business is illegal and difficult to study, and secondly it is not considered the major cause of deforestation in Asia, which may allow it to escape attention. In the countryside, most rural

[36] World Resources Institute, *World Resources 1986*, Basic Books, Inc. New York, 1986, p. 112.

families gather or cut their own wood for household needs — they do not buy wood. This can also be said about other rural users of fuelwood, such as brickmakers. However, urban consumers of wood usually buy their supplies in the market. Entrepreneurs supply urban consumers by collecting wood in rural areas by cutting or gathering it on either private lands or, more frequently, open-access public lands (including unguarded government reserves). Truck owners may also cut wood in open-access rural areas to haul into the cities. In India, the government harvests wood directly in state-managed forests and sells it to entrepreneurs. According to the *State of India's Environment*, the wood is usually purchased by large timber contractors who transport it via railway or truck to cities for sale. In sum, the entrepreneurs involved in direct deforestation range from individuals trying to supplement a meager agricultural income by selling a few sticks of firewood, to small-scale truckers cutting wood on open-access lands, to government forestry departments that harvest wood directly.

Once wood has been collected and delivered to the cities, it is sold to intermediary wholesalers who then pass it on to retail depots before selling it to individuals for domestic use, cremations, and small enterprises such as bakeries, restaurants, soapmakers, and brickmakers. These wood-consuming small enterprises contribute **indirectly** to the deforestation problem. Good data are not available on what percentage of wood brought into urban areas is consumed by SSEs. However, most observers note that household consumption exceeds small enterprise consumption in most Asian cities. According to a 1988 article in *World Development* entitled "Dynamics of Fuelwood Prices in India: Policy Implications," large quantities of fuelwood are used primarily by the lowest-income population of urban centers.[37] *The State of India's Environment* reports that 80 percent of fuelwood entering Bangalore serves domestic cooking and heating needs.[38] It appears that SSEs consume an important but minority share of the fuelwood traded in Asian cities.

THE SOURCE OF THE PROBLEM: POLICY FAILURES RELATING TO THE HARVEST OF WOOD

Deforestation occurs when forest lands are mismanaged and trees are felled in an unsustainable manner. This type of land mismanagement occurs where land tenure is insecure. Insecurity of tenure increases incentives to harvest trees quickly and to avoid longer-term investments in forest management and replanting. When land tenure is fully secure, land management improves and land-owners do not tend to rapidly deplete their resources.

Deforestation in Asia generally occurs in areas where land tenure problems exist. This includes areas where government-negotiated concessions to large logging enterprises do not offer secure tenure and therefore do not provide incentives for sustainable forestland management. It also includes areas of open-access public lands — land which no well-defined individual or

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[37] Bowonder, p. 1214.

[38] Centre for Science and Environment, 1985, p. 271.

group owns and therefore no one has a direct incentive to manage correctly. It also includes government-owned forest areas which become de facto open-access lands because the government is unable to keep private woodcutters out.

Small-scale commercial woodcutters and collectors generally operate on open-access public lands and in government-owned forest areas. Because they don't own these lands, their incentives are to harvest as much as possible, not to manage or maintain the forests. Given current land tenure arrangements, the behavior of these small entrepreneurs is understandable.

To change the behavior of small entrepreneurs vis-a-vis forest lands, and more importantly to change the behavior of encroaching farmers and large-scale loggers, flawed land tenure arrangements must be corrected. Open-access lands must be converted into well-defined communal or individual ownership arrangements, and government-controlled lands must be better managed or reduced in size until their integrity can be fully protected from illegal incursions. Logging concession agreements must be redesigned to build in incentives for sustainable forest management. To address the issue of SSE involvement in direct deforestation, the fundamental policy/political problem of land tenure must be addressed.[39]

STEPS TO REDUCE THE CONSUMPTION OF WOOD BY SMALL ENTERPRISES

Overconsumption of wood in urban areas is not a direct cause of deforestation in Asia — rather, it is a symptom of the fundamental land tenure problem described above, which causes wood to be overharvested and undervalued. This undervaluation leads to overconsumption. Thus, approaches to forest depletion that focus on consumption issues are not addressing the basic cause.

That said, steps to reduce the consumption of wood by small enterprises are still worthwhile, until the basic land tenure/wood undervaluation problem can be resolved. Two methods can be employed to reduce wood consumption by enterprises. The first is technological — adapt and disseminate more efficient stoves, ovens, kilns, and furnaces for use by SSEs. The second method is economic — raise the relative price of wood to encourage conservation and conversion to kerosene, gas, or electricity. The first method can be employed by NGOs, donors, or governments; however, experience has shown that energy-efficient devices are likely to catch on only if they decrease small enterprise costs substantially.

The second method to reduce wood consumption involves government policy changes. These changes may involve increased taxation of fuelwood, removal of subsidies on fuelwood transport, decreased taxation of alternative fuels, or subsidies for alternative fuels. These

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[39] According to Panayotou, 1990, insecurity of land ownership is the single most severe market/policy failure in developing countries. Untitled or insecurely-held land is common in the Philippines, Thailand, Indonesia, Burma, and Nepal. Panayotou lays out policy recommendations to address the land tenure problems that cause deforestation on pages 74 - 77.

changes are clearly second-best solutions to the problems of undervalued wood resources — a first-best solution would deal directly with the fundamental problem of land tenure.

CHAPTER SEVEN

THE CONTRIBUTIONS OF SSEs TO ENVIRONMENTAL SUSTAINABILITY

To this point in the paper we have focused on the negative impact of SSEs on the environment. In this chapter we examine how small enterprises can have a positive impact on the environment through two channels: (1) by engaging in activities such as recycling that serve to improve the environment; and (2) by creating millions of jobs that may attract labor off of marginal and fragile areas and thus reduce the pressure on natural resources.

Small entrepreneurs engage in several activities that may be considered beneficial to the environment. These activities include the production of improved fuel-efficient stoves and the production of push-carts and other forms of nonmotorized transport that may reduce air pollution. In some cases, SSEs may substitute manpower for motorized power, thus reducing air pollution (for example, hand looms versus motorized looms in India). These examples are not representative of most SSE activities, but they demonstrate that SSEs can have positive impacts.

Small enterprises also may have a positive impact through their involvement in recycling. This point is highlighted in an International Labor Office document on the urban informal sector:

> One of the virtues of the informal sector is its ability to recycle waste materials into productive use. Given the paucity of initial capital, premises and skills, it is not surprising that informal sector enterprises in many cities are engaged in the collection of waste materials such as scrap metals, used bottles, waste paper, spent batteries, and the like. Some of these materials such as waste paper find their way through to large manufacturing enterprises while most of the rest are transformed into commodities for daily use within the informal sector.[1]

According to this ILO document, recycling of wastes is not a dominant feature of the informal sector; however, it is important in several activities, such as the use of scrap metals by small blacksmiths and foundries. The document makes the point that such recycling activities not only reduce urban litter problems, but also reduce pressures on natural resources that serve as inputs.[2] The World Resources Institute makes a similar point in its annual publication *World Resources 1990-91*.[3]

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[1] S.V. Sethuraman, *The Urban Informal Sector in Developing Countries, International Labor Office*, Geneva, 1981, p.181.

[2] Ibid., p. 183.

[3] World Resources Institute, *World Resources 1990-91*, Oxford University Press, New York, 1990, p. 77.

The second, and probably more important, means by which small enterprises impact positively on the environment is by creating alternative sources of employment for poor people who might otherwise engage in destructive environmental practices such as slash-and-burn agriculture or woodcutting on marginal lands. Marilyn Carr makes this point in a document prepared for the Intermediate Technology Development Group:

> Further, the very act of creating millions of off-farm income-earning opportunities helps to achieve environmental objectives by taking some of the pressure off the land.[4]

Harvard resource economist Theodore Panayotou supports this proposition in his paper *The Economics of Environmental Degradation: Problems, Causes, and Responses* (1990). He writes,

> Labor-intensive industry if combined with appropriate location and educational policy is likely to attract labor out of the marginal and fragile areas and thus reduce the pressure on natural resources. (p. 54)

These arguments are convincing and they justify special government or donor support to labor-intensive small enterprises that create alternative employment in environmentally fragile zones.

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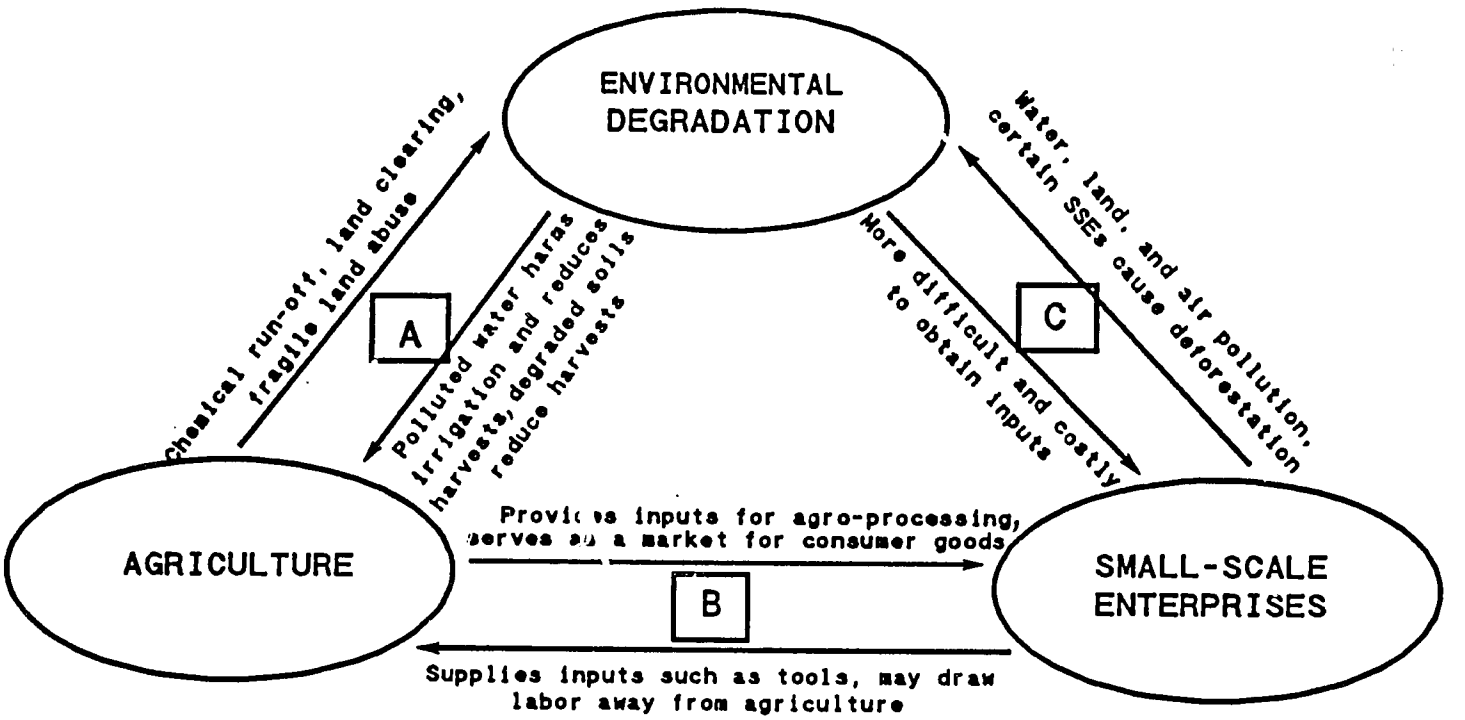
[4] Marilyn Carr of ITDG, "Industry and Appropriate Technology: Mass Production or Production by the Masses," paper presented at the International Institute for Environment and Development's Conference on Sustainable Development, London, England, April 1987.

CHAPTER EIGHT

AGRICULTURE, SMALL ENTERPRISE, AND ENVIRONMENTAL DEGRADATION

The scope of work for this study calls on the contractor to examine agriculture and its close links with small business and the environment. The relationship is a complex one that we diagram below.

FIGURE 1 : Relationships Between SSEs, Agriculture and Environmental Degradation



DIRECT RELATIONSHIPS

The relationship between agriculture and the environment (relationship "A") has received increased attention in recent years as the concept of "sustainable agriculture" has gained wider and wider acceptance. Particular attention has been focused on the ill effects that pesticides and chemical fertilizers can have on the environment, and on the erosion and deforestation that occur

as farmers are forced to cultivate increasingly marginal lands. Attention also has been focused on the ill effects that environmental degradation has on agricultural yields. As soil is eroded, salinized, or waterlogged, crop yields drop dramatically and ultimately the land becomes untenable for agricultural production. Similarly, as air and water resources are contaminated by industrial effluents, fish populations decline and irrigated agricultural production is reduced. The interdependence of agriculture and the environment means that each has a substantial and continuing impact on the other.

The relationship between agriculture and small enterprises (relationship "B") is less studied than relationship "A." However, the linkages are important and have been well documented in Haggblade, Hazel and Brown, "Farm-Nonfarm Linkages in Rural Sub-Saharan Africa", *World Development*.[5] The relationship exists in three areas:

- Agricultural input markets. SSEs produce hand tools and provide repair service for machinery used in agriculture. Chemical fertilizers and pesticides are rarely produced by SSEs, but often small traders play a role in repackaging and distributing these inputs;

- Agro-processing. SSEs frequently process agricultural products, milling grains, processing soya into tofu and tempe, making fruit juices, tanning hides, and so forth. Rice milling alone accounts for over half of all employment in Bangladeshi small industries (excluding handlooms).[6] Ian Little proposes that rapid agricultural growth in the Punjab explains the plethora of small-scale, agro-related industries in that state;[7] and

- Demand for consumer goods. Demand for SSE outputs is heavily influenced by the prosperity of agriculture. Prosperous small farmers make substantial demands for the types of consumer goods produced by small businesses.

The relationship between SSEs and environmental degradation (relationship "C") is the subject of the present study. It involves the issues of resource depletion, air, water, and land pollution discussed in earlier chapters.

TWO-STEP RELATIONSHIPS

Besides the direct relationships labeled "A," "B," and "C" in Figure 1, interesting two-step relationships also exist among the environment, agriculture, and SSEs. For example, SSEs

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[5] Vol, 17, No. 8, 1989.

[6] ADB, 1990 p. 76.

[7] Little, p. 303.

may degrade the environment, which may in turn harm agricultural output. We briefly discuss three of these relationships below.

How do the effects that SSEs have on the environment in turn affect agriculture? When SSEs cause environmental degradation, they harm the resource base upon which farmers, and fisherfolk, depend for their livelihood. Statistical evidence on the extent of this impact is not available, but several relevant examples can be cited. In Indonesia, small tanneries in Magetan currently discharge untreated effluents that pollute the local water course. Because this water is used to irrigate rice fields, it is suspected that the high levels of salinity caused by the tanneries have led to reduced crop yields.[8] Gary Kilmer of the World Bank's IEPA project in Indonesia cites examples where the effluents of small textile dyeing operations pollute small streams, which in turn flow into fish ponds and fields, killing fish and crops. *The State of India's Environment 1982* describes a situation in Tamil Nadu where small tanneries pollute a river used for irrigation. Because of the pollution, sugarcane yields in the area are only one-third of what they normally should be.[9]

How do the effects that agriculture has on the environment in turn affect SSEs? These effects are not documented, but two impact channels are possible. First, the run-off of agricultural chemicals may foul water courses that are used by industry as sources for input water. Industries such as textile-dyeing that rely on clean water as an input may be harmed by agricultural run-off. Second, agricultural encroachment is a major cause of deforestation in Asia. This deforestation may cause products such as firewood and rattan, which are used as inputs by many SSEs, to become more difficult to obtain and more expensive.

How do the effects of SSEs on agriculture in turn affect the environment? Small-scale enterprise creates employment opportunities that may draw labor away from agriculture in marginal areas and fragile lands. Reduced agricultural activity in these areas can serve to preserve the environment. This important point, which was developed in Chapter Seven, is perhaps the most significant of the two-step relationships.

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[8] COWIconsult, p. 14-7.

[9] Centre for Science and Environment, 1982, p. 35.

CHAPTER NINE

APPROACHES TO SOLUTIONS

Two broad approaches should be considered to improve the impact of small-scale enterprises on the environment. The first is a policy approach emphasizing regulations and fiscal measures to mitigate environmental degradation. The second is a technical assistance approach emphasizing training, technology transfer, and technology development. We will discuss the advantages and disadvantages of these approaches with respect to pollution control first, and treat the issue of resource depletion separately.

POLICY APPROACHES TO POLLUTION

Policy approaches to mitigating environmental degradation can be divided into three broad categories of policy instruments. The first is command and control, the second is economic instruments or market-based incentives, and the third is government production.

Command and Control

A command and control approach to pollution involves the imposition of regulations on polluting processes. These regulations can set source-specific limits on waste emissions into the air, water, or land, or they can directly dictate what industrial processes are permissible or what abatement equipment is required.

In the developing countries of Asia, command and control regulations on industry are common. Extensive legislature has been passed to establish standards for air and water effluents and solid waste disposal. In Indonesia, government standards are similar to the standards recommended by the World Bank. In India, the legal framework is in place to achieve significant progress in environmental protection. According to Ramesh Ramankutty of the World Bank-UNDP Metropolitan Environmental Improvement Program, the environmental regulations are adequate in most Asian countries.

The problem with these command and control regulations is the lack of enforcement. Government agencies do not have the resources or the power to police all of industry. In India, many of the industries that are in noncompliance with environmental standards are tolerated as the result of the immense workload of the Pollution Control Boards and the insufficiencies caused by lack of staff, equipment, and facilities. In general, government agencies have great difficulty enforcing effluent standards.

This is not to say that standards are not enforced at all. The World Bank examined chemical and associated industries in India (including dyes, fertilizers, tanneries,

pharmaceuticals, pesticides, pulp and paper, and petrochemicals) and estimated overall compliance of the sector with the environmental regulations as 50 percent (p.7). In India and Indonesia, the government is improving its enforcement capabilities.

Among small-scale industries, enforcement of command and control regulations is much more difficult, because these firms are so widely dispersed and so numerous, and because so many are not officially registered. Compliance with environmental regulations by SSEs is low. Small tanneries in Indonesia release five times more BOD than the amount allowed under national regulations, seven times more COD, and 53 times more Chromium.[10] According to a World Bank appraisal, small firms are less likely to be in compliance than larger units, which are financially stronger and more responsive to environmental concerns. Sectors dominated by large firms (fertilizers, petrochemicals) comply much more closely to regulations than do sectors dominated by small firms (dyes, tanneries). "Small and medium industries is where enforcement is most difficult and noncompliance more pervasive."[11]

More vigorous monitoring and enforcement are often prescribed as solutions to the problem of noncompliance. According to the World Bank, top priority in India should be given to improving the monitoring and enforcement capabilities of the State Pollution Control Boards. Improved monitoring and enforcement, however, is liable to be focused first upon larger, more visible firms. It will take substantial progress in enforcement capabilities before government environmental agencies will be strong enough to regulate smaller firms, and it may never be cost-effective to reach household and microenterprises. Public awareness campaigns, support to environmental NGOs, and negotiations with trade associations are complementary measures to increase pressure on polluting firms to conform to environmental standards.

The idea of enforcing government regulations on SSEs runs counter to the spirit of the movement to support small enterprises in developing countries. Most supporters of small enterprise wish to see SSEs as free as possible from cumbersome, ill-adapted government regulation and easily corrupted regulating agents. However, until environmental regulations are enforced in small firms, they will have little incentive to internalize the social costs of their environmental pollution. The trade-offs between regulation and nonregulation (and registration and nonregistration) must be considered carefully on a country-by-country, industry-by-industry basis.

Economic Policy Instruments

Economic policy instruments are policies that use market-based incentives to achieve pollution controls objectives. Examples of *direct* economic policy instruments are effluent charges and tradeable pollution permits. Examples of *indirect* economic policy instruments are input taxes and subsidies to abatement equipment. In developed countries, economic policy

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[10] COWIconsult, table 6.1.

[11] World Bank, Staff Appraisal Report, p. 14.

instruments have increased in popularity in recent years because they present several advantages in economic efficiency. They may reduce the economic costs of pollution control and create incentives for firms to develop less-polluting technologies.

In developing countries, direct economic policy instruments are difficult to apply successfully for the same reason that command and control instruments present difficulties — they require strong monitoring and enforcement capabilities that do not exist in most nations. To put a charge on effluent, for example, a government must have the capacity to continuously monitor effluent and collect charges. For a pollution tradeable permit to have value, the government must be able to enforce pollution restrictions on firms that do not hold permits. A small capitalist will not purchase a subsidized abatement device if he can get away with no abatement at all. According to a World Bank paper *Alternative Approaches to Pollution Control and Waste Management: Regulatory and Economic Instruments* (Bernstein, 1991),

> Economic instruments cannot be successfully implemented without pre-existing appropriate standards and effective capacities in monitoring and enforcement. (p. 3)

For this reason, direct economic instruments cannot be considered appropriate for the control of pollution from small-scale enterprises — the most difficult of all enterprises to monitor and regulate.

Indirect economic instruments, on the other hand, hold more promise as effective tools for controlling the pollution of SSEs. In particular, instruments that tax or subsidize industrial inputs are promising, since fuel and chemical inputs originate from a much more limited number of sources and are therefore easier to tax. Just as a fuel tax might be employed to reduce auto emissions in the United States, a tax on chemicals containing heavy metals might reduce harmful effluents coming from small-scale tanneries and electroplating operations in Asian countries. Further study would be necessary before recommending such a strategy. The possible emergence of illegal chemical markets or more harmful production processes would be of concern.

Another type of economic instrument that deserves closer study and consideration is the use of a deposit-refund system for containers of toxic chemicals and pesticides. Large-scale manufacturers of these products could be required to buy back empty containers at high enough prices to ensure their return to these companies for safe disposal. A similar system is not necessary for nontoxic containers in most Asian countries, because economic incentive already exist for their recycling (they can be sold).

Direct Government Expenditures on Pollution Control

Another option to control the pollution of SSEs is direct government expenditure on developing industrial estates containing common effluent treatment centers. In recognition of the fact that small-scale industries tend to be in a financially and technically weak position to comply with environmental standards, governments sometimes provide a range of special

initiatives, such as the construction and operation of common waste water treatment plants. This is already being done in Indonesia through support to small-scale clusters. According to a World Bank document, government-supported actions in India, including grants for the construction and operation of common waste water treatment facilities, may be the most cost-effective way to alleviate the substantial social costs posed by pollution from small- and medium-sized firms.[12]

The problem with such schemes, however, is devising ways to motivate the small firms to pay the operating costs of wastewater treatment or to use the facility at all. Effective enforcement incentives are necessary before firms will incur these costs. Small industrial estates in Indonesia and Thailand have run into substantial difficulties along these lines.

A more promising type of public expenditure on pollution control is the construction of municipal sewage systems. As mentioned earlier, household wastewater creates most organic water pollution in Asian cities. Most of this wastewater flows untreated through ditches and canals to water courses. Public investment in sewage infrastructure will allow for the treatment of both domestic wastewater and effluents from small enterprises such as food processors.

TECHNICAL APPROACHES TO POLLUTION PROBLEMS

Technical assistance can also play an important role in pollution control. Three types of technical assistance are appropriate.

First, technical assistance to state environmental agencies can enhance their ability to monitor and enforce environmental regulations. This assistance should involve training in environmental analysis, monitoring, and abatement, and the provision of technical monitoring equipment. Institution-building measures are necessary to improve enforcement capabilities. Similar assistance can be provided to environmental NGOs that assist in enforcement by monitoring enterprises and pressuring authorities to implement regulations.

Second, technical assistance can be provided directly to enterprises to help them to adopt cleaner production and abatement measures. When designing this type of technical assistance, careful attention must be focussed on the question of incentives. Small firms are only likely to adopt new cleaner technologies if they are more profitable than traditional techniques, of if non-adoption will result in punitive fines or other negative consequences to the firm.

Third, technical assistance can involve research and development of new, cleaner production processes and abatement technologies that meet the important profitability criterion mentioned above. Such technologies may be adopted by small enterprises even in the absence of enforcement of environmental regulations.

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[12] World Bank, Staff Appraisal Report, p. 12.

APPROACHES TO SOLVING THE PROBLEMS OF SSEs AND RESOURCE DEPLETION

The same framework applied to the pollution problem can be applied to the question of resource depletion, particularly deforestation.

If one focuses on the fundamental problem of inappropriate land tenure arrangements, policy solutions must be considered. A commarid and control approach would involve regulating the harvesting of wood and enforcing regulations through government outlays on forest guards. This approach has been ineffective in most of Asia, because enforcement is difficult on large government reserves. An economic instrument approach would involve changing land tenure arrangements to create private incentives for good management, rather than quick exploitation, of forest lands. Harvard Economist Theodore Panayotou lays out a number of valuable suggestions on how to improve land tenure arrangements in his paper *The Economics of Environmental Degradation: Problems, Causes and Responses.*[13] These were described briefly in Chapter Six.

If one focusses on the symptoms of inappropriate land tenure arrangements — undervaluation and over-consumption of natural resources such as firewood — one may consider a command and control approach (rationing fuel consumption or regulating technology choices), an economic instruments approach (tax or subsidize firewood or its substitutes), or a technical assistance approach (development and promotion of fuel-efficient stoves and kilns). These approaches also were described in Chapter Six.

The most important and promising approaches to solving the deforestation problem are not specifically related to small-scale enterprises. In fact, the only approach mentioned above that relates directly to SSEs is technical assistance in transferring energy-efficient technologies such as kilns and improved stoves. This approach is likely to have only a minor impact on slowing deforestation, because it treats only part of the symptom of the problem, not the fundamental source of the problem.

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[13] Panayotou, 1990, p.74.

CHAPTER TEN

RECOMMENDATIONS TO A.I.D.

The scope of work requires the contractor to recommend to A.I.D. appropriate steps for modifying the policies of host countries and the Agency to ameliorate negative or enhance positive environmental impacts of SSEs.

IN REGARD TO A.I.D.'S SMALL ENTERPRISE SUPPORT:

1. **A.I.D. should avoid generalizations and exaggerations about SSEs and environmental degradation — the relative importance of SSEs in pollution is low in certain sectors in certain countries, and high in others.** Most SSEs are not involved in activities that have significant environmental impact, and the SSEs that are involved in such activities are usually not the major offenders in the industry category, because they typically account for only a small part of total output.

2. **A.I.D. should distinguish between the goals of its environmental policy dialogue and those of its small enterprise support.**

A.I.D.'s **environmental policy dialogue** should concentrate on addressing the most significant sources of environmental degradation in specific countries. It should not target SSEs for special attention, but should deal with SSEs when they are identified as significant sources of environmental degradation in priority areas of concern, whether these areas are defined by geography, pollutant, or industrial category. Detailed country-specific studies are necessary to identify these priority areas.

A.I.D.'s **assistance to small enterprises** should not ignore issues of environmental concern; however, support to SSEs should not be expected to significantly modify their behavior towards the environment — this behavior is mostly a function of the environmental policy environment. An A.I.D.-supported financing organization should not have to impose on its clients pollution control standards that are not enforced under national environmental policies. Such a requirement would impose higher costs on the client than those faced by her or his competitors, and it would impose additional costs on intermediary financial institutions, when the sustainability of such institutions requires reducing, not increasing, costs. A.I.D.-supported small lending operations should not be expected to solve environmental problems on a micro level. These problems need to be addressed through improvements in national-level government policies and enforcement procedures.

At the same time that A.I.D. should not use its SSE-support tool to do a job that its policy dialogue tool is designed for, the Agency should avoid financing the start-up or expansion of SSEs that cause excessive environmental degradation. One way to avoid supporting such SSEs, without requiring intermediate financial organizations to carry out costly loan-by-loan

environmental impact assessments, is to draw up a list of activities to be simply barred from financing. Such a list might include SSE activities like lead smelting, electroplating, and chromium-based leather tanning, but detailed studies of these and similar SSE activities must be conducted before a list can be defined. Use of such a list will allow A.I.D. to avoid financing particularly harmful SSEs without imposing significant costs on intermediate organizations. The list will not solve the environmental problems of small-scale polluting industries, but this is not the task of SSE support operations — it is the task of government environmental policy and enforcement mechanisms.

3. Just as A.I.D. should avoid financing SSEs that are particularly harmful to the environment, **the Agency should increase its support to SSEs that contribute to environmental preservation by serving as alternative sources of employment to people who would otherwise encroach on fragile lands or destructively exploit natural resources.** In this context, rural, labor-intensive industries deserve special support, and A.I.D. should consider supporting intermediary organizations that lend to or otherwise assist such enterprises.

4. **A.I.D. should take environmental concerns into account when considering the question of the registration of small-scale enterprises and their "formalization."** One of the strengths of small informal enterprise has always been its freedom from unnecessary regulation — this freedom has allowed SSEs to start up, hire employees, and expand operations at a quick pace. Informal status, however, facilitates the avoidance of environmental regulations — regulations that may not be "unnecessary." If the environmental degradation of small, informal firms is to be controlled, they eventually will need to be registered with the government.

IN REGARD TO THE RELATIONSHIP BETWEEN A.I.D.'S ENVIRONMENTAL INTERVENTIONS AND SSEs:

Water, Land, and Air Pollution:

1. **A.I.D. Missions considering interventions in pollution control should gather the data necessary to prioritize interventions, and focus on areas where impact is likely to be greatest.** This data includes information on which sources create most pollution (household, industrial, agricultural runoff), which effluents are the most harmful, which industries cause the highest level of pollution, what is the size structure of the offending industries, and how does size structure correlate with pollution levels. **The "worst first" principle should be applied when deciding where to focus scarce resources, and SSEs should receive special attention only when they are identified as the "worst" polluters.** This reasoning applies to both identifying areas for A.I.D. investment and identifying points for policy dialogue.

In many cases, SSEs will not be of top priority. For example, industry is only responsible for 2 percent of BOD pollution in Bangkok while household wastes account for 98 percent; thus, improving municipal sewerage systems is of higher priority than controlling the activities of small tapioca processors. Also, motor vehicles are responsible for 99 percent of

carbon monoxide pollution in Jakarta — changing vehicle inspection procedures is of higher priority than controlling the emissions of small grain millers. Small tanneries, on the other hand, are responsible for 81 percent of leather output in India and an even higher percentage of chromium pollution. Efforts to improve the treatment of their effluents should receive high priority, especially if larger tanneries are already treating their own effluents satisfactorily.

Because the variables affecting definition of high-priority areas of intervention vary considerably from country to country, individual country or city source inventories will be necessary to identify the categories of polluters that need the most attention. SSEs deserve special attention only when they are identified to be high-priority polluters.

2. In certain industries, SSEs appear to be high-priority polluters, accounting for a large part of toxic waste output. These industries include leather tanning (which discharges chromium), electroplating (which discharges a variety of heavy metals), textile wet-end processing (which may involve toxic bleaches and dyes), and lead smelting (which emits toxic fumes). **A.I.D. should support government efforts to relocate these heavily polluting SSEs away from residential areas and to group them together on industrial estates where common wastewater treatment is feasible.** Common wastewater treatment infrastructure can initially be subsidized by government or donor agencies, but sustainable mechanisms must be identified to cover operating costs and ensure that treatment occurs. Such schemes are only likely to work if penalties can be imposed for non-use or improper use of treatment facilities. If paying the costs of effluent treatment eliminates the profitability of these small firms, they should be encouraged to go out of business. A.I.D. should avoid financing the start-up or expansion of SSEs in these toxic-producing industries, unless full assurances of proper effluent treatment systems are provided for.

3. **SSEs that discharge large quantities of BOD should be considered separately from SSEs discharging toxic wastes.** Small-scale food processors (particularly producers of tapioca, tofu, and tempe), cloth dyers (batik), and restaurants discharge important quantities of BOD into Asian rivers. Generally, however, these quantities are dwarfed by the quantities of BOD produced by untreated sewage and household wastes. **Priority should be on improving municipal sewerage systems first.** Then steps should be taken to link SSEs producing BOD to these sewage systems on a variable fee basis. Through policy dialogue and financial support coordinated with other donors, A.I.D. should encourage investment in improving municipal sewerage systems.

4. Proper incentive structures are necessary to motivate polluting firms to internalize the costs of their pollution. Firms of any size will continue to pollute as long as it is profitable for them to do so. To affect behavior, government or technology transfers must make pollution relatively unprofitable. This can be done by **improving enforcement** of fines and charges for pollution. This is easier said than done — enforcement of regulations is difficult with large firms and even more difficult with small firms. Nonetheless, the effort cannot be abandoned; **A.I.D. should continue to work to strengthen the monitoring and enforcement capabilities of environmental agencies through training, and technical and financial assistance.** The

agencies should be encouraged to enforce regulations on the basis of "worst first." Amongst SSEs, the "worst" are likely to be the toxic-producing industries mentioned above.

5. In manufacturing, technical alterations in production processes can reduce waste output. In leather tanning, for example, a Danish chemical treatment technique can reduce the quantity of chromium in tanning effluent. "Greener" techniques such as this, however, will only be adopted by SSEs if they are more directly profitable than traditional techniques, or if they are coupled with the enforcement of charges or fines that make nonadoption more expensive than adoption. **A.I.D. should invest in the development and promotion of "cleaner" technologies only if these profitability conditions are met**; otherwise, the technology dissemination effort is likely to fail.

Resource Depletion, Particularly Forests:

1. A.I.D. should recognize, and encourage local governments to recognize, that inappropriate land tenure arrangements are the most important causes of over-exploitation of natural resources. **Policy dialogue on the fundamental land tenure problems and investments designed to confront these problems should be of higher priority than discussions of the activities of SSEs in fuelwood gathering, trading, and consumption.** In most of Asia, agricultural encroachment and commercial logging are more serious threats to forest resources than are small-scale fuelwood-related activities.

2. **Given a situation where forest products are undervalued and A.I.D. feels that it cannot focus more resources on the fundamental land tenure problems, the Agency should consider both policy and technical approaches to reduce the overconsumption that undervaluation engenders.** Raising the relative price of firewood through fiscal measures is one policy approach to be considered, either by removing taxes on alternate fuels, subsidizing alternate fuels, or taxing fuelwood sales. A.I.D. should study these options and incorporate them into policy dialogue. A.I.D. should also consider support for the dissemination of technologies that reduce fuelwood consumption. If fuelwood consumption studies indicate that SSEs are major users of wood in the geographical area of concern, then programs should be considered which introduce more efficient technologies, such as improved kilns for brickmakers and improved stoves for restaurants. A.I.D.'s efforts in these areas, however, should not be allowed to distract the Agency from addressing the more fundamental problems of land tenure.

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ANNEX A

LIST OF PERSONS CONTACTED

Helen Appleton	Intermediate Technology Development Group, England
Carl Bartone	Urban Management Program, World Bank
Roger Batstone	Environmental Analyst, World Bank
Elliot Berg	Economist, DAI
James Boomgard	Project Director, GEMINI, DAI
Random DuBois	Environmental Analyst, DAI
Fernando Fernandez	Small Enterprise Specialist, INSOTEC, Ecuador
Mathew Gamser	Deputy Project Director, GEMINI, DAI
Max Goldenson	Small Enterprise Analyst, Sri Lanka, DAI
Don Henry	Energy Technologies Specialist, DAI
Richard Hooley	Small Enterprise Specialist, Independent Consultant
Devesh Kapur	Small Enterprise Specialist, Consultant
Gary Kilmer	Industrial Efficiency and Pollution Abatement Proj., World Bank
Molly McCaully	Environmental Analyst, Resources for the Future
Karen McKay	Natural Resources Specialist, DAI
John Melvin	Project Assistant, GEMINI, DAI
Richard Newell	Environmental Analyst, ICF, Inc.
Ramesh Ramankutty	Metropolitan Environmental Improvement Program, World Bank
Scott Simons	Economist, DAI
A.H. Somani	Environmental Analyst, World Bank
Ann Thrup	Agricultural Specialist, World Resources Institute
Holly Welles	Environmental Analyst, USAID

ANNEX B

EXCERPT FROM THE AHMED HAMZA PAPER, UNCHS, URBAN MANANGEMENT PROGRAM, 1991

EXECUTIVE SUMMARY

This report presents the rationale for industrial environmental management in developing countries with particular reference to the impacts of waste arisings from small-scale manufacturing on city environment and public amenities.

The first section reviews the status of industrialization and spatial distribution of manufacturing enterprises in the different categories of developing countries. Industry tends to concentrate in cities which causes environmental degradation, overcrowding, poor hygiene and overloading of public services. The widely dispersed small-scale industries in the heart of urban settlements which discharge numerous pollutants and toxic residues impose immediate health risks and unbearable environmental nuisance to urban dwellers. Urban pollution is further aggrevated due to the scarcity of financial resources and technical expertise available to these settlements.

The newly industrialized countries have implemented measures to alleviate the problem. However, most developing countries are still trying to deter industrial pollution without noticeable success. Practices and constraints of handling conventional pollutants and hazardous residues generated from industrial and small-scale manufacturing enterprises are briefly discussed. A profile of innercity industries and their pollution arisings is presented for different regions of the third world .

Health and environmental impacts of industrial hazardous residues are examined in the following section. The assumption that pollution is less pressing in developing world cities because of lower levels of industrialization is void, as hundreds of such cities constitute pockets of intensive industrialization and considerable pollution emissions. The ensuing environmental deterioration causes unbearable impacts on the livelihood and health of city inhabitants. Many slums and shanties crowd in the deserted areas around hazardous industries; a fact attested by the higher fatality rates of industrial accidents among dwellers of third world cities.

Generation of hazardous residues from small-scale industries and their discharge into the air, water and on or into the soil causes severe environmental degradation. The short and long-term effects are far more serious than those caused by municipal wastes. While the latter is more readily biodegradable, many synthesized industrial residues are toxic, persistent, biomagnifiable and tend to accumulate in the receiving environments. The prevailing malnutrition, inferior socio-economic standards and hypersensitivity of city dwellers in developing countries lessen the tolerance exposure limits of most toxic substances; a grim fact which adds to the misery of urban poors inhabiting these cities.

Industrial pollution also, adversely affects the beneficial uses of water resources, impairs soil and air qualities and poses serious impacts on the environment and public amenities. These problems will loom larger in the future as continued urban-industrial growth will

place more pressure on the environment, and limits its capacity to assimilate wastes.

The report then assesses alternatives for combatting pollution from small-scale industries. Minimization of waste generation through employing low waste technology, should receive priority . However outdated equipment and obsolete technologies still dominate in small-scale enterprises and so results in excessive generation of pollutants. On-site treatment of effluents is neither economically affordable nor technically feasible for small waste generators. Centralized treatment or communal facilities offer economies of scale, and flexibility, hence suit the needs of small manufacturers. A perspective on practices of handling hazardous residues is given with brief description of case studies for co-operative handling of residues from small-scale manufacturing establishments in some cities of developing countries.

Focusing on industrial employment and environment, the report noted the persistent tendency to concentrate labor-intensive industries in urban settlements, which contributes to the problems of congestion and the consequent repercussions on urban environment.These industries are typically less productive and more polluting. Lately however, capital to labour ratio has been rising, despite the stagnating effect on employment. Such trend is bound to improve productivity and reduce losses with subsequent enhancement of environmental quality.

Proceeding to the issue of training, the report highlights the need to use unconventional methodologies to reach the hesitant managers and the illiterate operators. On-the-job demonstrations, show-how tours, and on-site group discussions represent practical training approaches. Such training is bound to create environmental awarness, enhance responsiveness to pollution control initiatives, and develop local cadre for management of waste control programmes. Small manufactures need information on opportunities for waste exchange, better operational practices, appropriate waste treatment technologies, and sources for financial and technical assistance. This can help incorporating cleaner technologies and environmental management into work patterns.

The following sections review the legal and institutional mechanisms for control of pollution emanating from industrial and small-scale manufacturing. In many countries legislation rarely considers factors such as cost and level of technology, or the relation between emission loads and the assimilative capacity of the receiving environment. Enacting standards in some instances is a mere procedural formality. Legislation should be drawn up and enforced in such a way that if violations occur, effective sanctions should be imposed. Institutional organization suffers from absence of clear working directives, overlapping and irresponsiveness. In some countries independent entities have been set up for management of industrial pollution in metropolitan centres. Such autonomous agencies are crucial for implementing indigenous measures to reduce pollution and conserve resources, and to create conditions for productive co-existence between industry and the environment.

Technical options for waste minimization in small-scale industries have been presented next with reference to selected practices of sources segregation, process modifications, product substitution, and recycling of inputs. Such prudent measures increase industrial productivity and profitability, and results in considerable improvement of environmental quality.

To internalize costs of pollution externalities a range of measures is discussed including incentives in the form of loans and tax waivers, and disincentives such as taxing inputs and imposing charges for non-compliance with regulations. The challenge is to enforce standards sufficiently high to ensure coercion while devising feasible economic means to cushion the impact on small-scale industry.

The following chapter draws upon opportunities for environmentally-sound industrial development. Experience and potentials for recovery of secondary materials are detailed. Industrial environmental impact assessment ensures environmental compatibility of new industries; constraints and shortcomings of applying assessment procedures are briefly presented.

The experience of some countries in achieving balanced industrial development is discussed with reference to the cases of China, South Korea and Malysia which brought about notable harmony between industrial and agricultural development and hence narrowed rural-urban disparities.

Finally, the report points out to knowledge gaps of pollution control options for small-scale industries, institutional mechanisms, and linkages between health, environment and society; and sets forth research priorities within the context of the urban management programme.