

CONTRADICTIONS OF ECOLOGICAL MODERNISATION: Pulp and Paper Manufacturing in South-East Asia*¹

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A growing literature suggests we have entered an era of paradigmatic institutional change permitting broad environmental transformation of society, including fundamental restructuring of manufacturing. To date, ecological modernisation theory has primarily examined advanced industrial societies. Few studies have taken into account its applicability in newly industrialising countries (NICs). This paper does so, drawing on the author's research on South-East Asian pulp and paper industries in the late 1980s and early 1990s. Those industries improved efficiencies, reduced waste, and progressed towards clean production. At the same time, they failed to meet an important criterion of ecological modernisation, the dematerialisation of production. Rather, 'supermaterialisation' of pulp and paper production in South-East Asia may be helping facilitate dematerialisation in the North. The paper concludes that dynamics of ecological modernisation may be present in large-scale, export-oriented modern sectors of NIC economies, while being more problematic in small and medium-sized enterprises (SMEs). Such dynamics present serious challenges for ecological modernisation theory.

Introduction

'Ecological modernisation' is a relatively new concept, coined in the early 1980s by German sociologist Joseph Huber [Spaargaren and Mol, 1992; Mol, 1995; Hajer, 1995]. In simple form, it might be thought of as industrial restructuring with a green twist. Poetically, Huber suggests that 'The dirty and ugly industrial caterpillar transforms into an ecological butterfly' [Huber, 1985, cited in Spaargaren and Mol, 1992: 334]. Hajer [1995] defines ecological modernisation theory as 'the discourse that recognises the structural character of the environmental problematique but ... assumes that existing institutions can internalise the care for the environment'.

As a theory of social change, ecological modernisation suggests we have entered a new industrial revolution, one of radical restructuring of production, consumption, state practices, and political discourses along ecological lines [Mol, 1995; Hajer, 1995; see also Mol and Spaargaren, in this volume]. As a 'normative theory' or 'political program' [Spaargaren and Mol, 1992; Mol, 1995], ecological modernisation advocates resolving environmental problems through 'harmonizing ecology and economy' [Simonis, 1989], and through 'superindustrialisation' rather than de-industrialisation [Spaargaren and Mol, 1992].

To date, ecological modernisation theory has been considered applicable primarily for advanced industrial countries, due to prerequisites for green industrial restructuring, 'e.g. the existence of a welfare state, advanced technological development ... a state regulated market economy ... and ... widespread environmental consciousness' [Mol, 1995: 54]. Ecological modernisation theory may also be 'increasingly relevant for Newly

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Industrialising Countries' [*Ibid.*: 55]. The first empirical studies addressing this question are only now beginning to show results [cf. Frijns et al., 1997; Mol and Frijns, 1999; Hengel, 1998].

Building on a study of Indonesian, Malaysian and Thai pulp and paper firms' adoption of environmental technologies in the early 1990s,² this paper aims to contribute to a discussion of the applicability of ecological modernisation theory to newly industrialising countries (NICs). Concerns are raised for scholarship on ecological modernisation especially in regard to dematerialisation, North-South equity, and the role of small- and medium-sized enterprises (SMEs).

Operationalisation

A first step in examining the applicability of ecological modernisation theory to NICs is to formally define and operationalize the concept of ecological modernisation. Various authors have made such an effort. Early scholars focused on actual improvements in environmental performance. Paulus [1986, cited in Simonis, 1989: 347], for example suggests that 'Ecological modernization focuses on prevention, on innovation and structural change towards ecologically sustainable development ... It relies on clean technology, recycling and renewable resources....'

Jänicke et al. [1989: 100] suggest an important premise of ecological modernisation: 'that a reduction in the resource input of production will lead to a reduction in the amount of emissions and waste and also the costs of production'. Hajer [1995: 25-6] suggests three basic concepts emerging out of early work on ecological modernisation:

- 'Make environmental degradation calculable' [especially monetarily];
- 'Environmental protection is ... a 'positive-sum game''; and
- 'Economic growth and the resolution of ecological problems can, in principle, be reconciled'.

From these and other works, it might be suggested that ecological modernisation has three immediate and two ultimate technological/material objectives: in the short-term, *waste reduction and elimination, resource recovery and reuse*, and *dematerialisation*³; in the long-term, *resource conservation* and *clean production*.⁴

Later scholars have focused on mechanisms and broader social dynamics of ecological modernisation. Mol [1995: 39], for example, suggests that ecological modernisation's material objectives obtain both through '*economising the ecology*', using vehicles such as monetary valuation of natural resources, levying of environmental taxes, and establishment of market incentives; and '*ecologizing the economy*', via re-engineering production, improving industrial co-processing ('industrial ecology'), and boosting superindustrialisation⁵.

Mol goes on [1995: 58; see also Mol and Spaargaren, in this volume] to examine institutional and social dimensions of environmental transformation, arguing that in ecological modernisation: the state shifts from top-down regulatory intervention to negotiation with industry; non-governmental organisations play a key role, including

through direct interaction with industry; political and economic globalisation are supportive; and 'counterproductivity' ("small is beautiful", co-ops, etc.) policy approaches are eclipsed.

Together, such technological/material objectives, mechanisms and institutional dimensions of ecological modernisation provide a useful starting point for evaluating the applicability of the theory to particular cases, including NICs. This article addresses two questions: To what extent has pulp and paper manufacturing in Indonesia, Malaysia and Thailand been 'ecologically modernised' in recent years? How have these changes taken place?

Environmental Reform

One of the world's ten largest industries, pulp and paper manufacturing has received world-wide attention for environmental pollution for decades. In the 1970s, much public and regulatory attention focused on air quality, including the industry's 'rotten egg' (sulphur dioxide [SO₂]) smell. More recently, the industry has received attention for use of chlorine in pulping and bleaching, especially of wood. In the mid-1980s, chlorine used in paper production was positively identified as associated with the production of dioxin, a highly toxic chemical. Regulatory attention shifted to the presence of this chemical in wastewater streams and to water quality more generally. Beginning in the late 1980s, Greenpeace launched an international campaign for the elimination of chlorine in pulp and paper manufacturing.

In South-East Asia, prior to the late 1960s, most pulp and paper manufacturing was very small scale, producing printing and writing paper, newsprint, cigarette paper, and packaging materials, largely from agricultural wastes (bagasse, a residue of sugar cane processing; rice stalks) and recycled paper (especially old corrugated containers [OCC], often imported from East Asia and even North America) [see Sonnenfeld 1998c]. Pulp and paper manufacturing expanded substantially in South-East Asia beginning in the late 1960s, an integral part of early industrial development in the region. Pollution became a major concern only with large-scale expansion of pulp manufacturing in South-East Asia beginning in the mid-1980s.

Protests in South-East Asia over pulp industry expansion and pollution in the late 1980s and early 1990s [see Sonnenfeld, 1998a; 1998b] had a major impact however, leading to the establishment of new environment/technology regimes influencing adoption of newer, cleaner process technologies in the pulp and paper industry throughout the region [Sonnenfeld, 1996]. I focus here especially on adoption of advanced elementally chlorine-free (ECF) pulping and bleaching technologies. Such developments may be analysed in terms of the actual technological/material improvements, and the social dynamics forcing those improvements in each country.

Technological Improvements

Many environmental reforms in process and end-of-pipe technology were adopted by Indonesian, Malaysian and Thai pulp and paper firms, c. 1987-96, especially in the large-scale, export-oriented segments of the industry. During this period, new mills were built

and brought on-line in South-East Asia utilising some of the most advanced technologies in the world, and some older mills were modified. The most acute problems remain with the oldest, smallest facilities, some government owned.

Perhaps most dramatic was the construction of six new bleached kraft pulp mills using elementally chlorine-free (ECF) pulping and bleaching technologies in Indonesia and Thailand from 1992-6 (see Table 1). These mills operate more efficiently and with less pollution per unit of output than mills in many advanced countries [Sonnenfeld, 1998b]. During this period, no bleached kraft pulp mills were built without ECF technologies in these countries and Malaysia.

Place Table 1 about here.

Table 1. Correlates of environmental improvements at bleached pulp mills in Indonesia, Malaysia, and Thailand, c. 1987-96.⁶ Source: Sonnenfeld [1996].

During the same period, companies improved environmental performance at older pulp mills in South-East Asia as well, through changing raw materials, upgrading pre-processing, modifying process technology, and improving waste treatment. Highlights include:

- Older Indonesian pulp mills added pre-treatment processes, reduced use of elemental chlorine, and improved wastewater treatment.
- When it was built in the late 1980s, Malaysia's only bleached kraft mill incorporated world-class technology including oxygen-activated sludge treatment. The mill progressively decreased use of elemental chlorine through the early 1990s.
- Thailand's first large-scale export pulp mill added oxygen delignification and upgraded wastewater treatment facilities. The country's largest pulp and paper group installed advanced wastewater treatment systems, and experimented with enzymes and bacterial pre-treatment for reducing elemental chlorine use.

The worst environmental problems exist among the smallest and oldest pulp and paper mills in the region, some government-owned. Efficiencies as well as pollution would dictate the closing of many of these operations. However, employment issues in high-unemployment economies have proved even more acute [cf. Hanafi, 1994]. Even in this troubled segment, national and international research and assistance programs worked to make environmental improvements.

How did the new mills come to incorporate the latest technologies? What motivated some of the older mills to modify their process and end-of-pipe technologies?

Social Dynamics

Technological/material improvements in the manufacturing of pulp and paper in South-East Asia were the result of multiple social dynamics. At the local and country levels, community and environmental groups brought attention to companies' social and environmental practices; government agencies encouraged and sometimes forced companies to adopt cleaner production technologies; public and private sector research engineers creatively developed process modifications; and local environmental conditions came into play. These processes played out in both similar and dissimilar ways in each of the countries studied. In addition, global and regional dynamics contributed to the ecological modernisation of pulp production in South-East Asia.

Indonesia. As an important part of the country's export-oriented industrialisation strategy, Indonesia's pulp and paper industry grew rapidly in the late 1980s and early '90s. New greenfield⁷ mills were built on the 'outer' Indonesian islands of Sumatra and Borneo in locales with long traditions of subsistence agriculture. Pulpwood plantations, established by industrial timber estate concession holders as a precondition to government licensing of new mill projects, spread over hundreds of thousands of hectares, disrupted the lives of tens of thousands of people. Pulp mills piped their liquid wastes into rivers used for drinking, bathing, fishing, washing, irrigation, as well as by other industries. The adoption of environmental technologies in Indonesia's pulp industry was directly linked to popular protest against impacts of rural industrial development.

Minority residents in North Sumatra have been engaged in conflict for years with the Raja Garuda Mas (RGM) group, owners of PT Inti Indorayon Utama, Indonesia's first new export-oriented pulp mill, built with substantial government support. What began as an ethnically-charged local struggle over land and forest tenure became a conflict of national and international significance with the involvement of environmental groups and organisations, including the umbrella group, Indonesian Forum on the Environment (WALHI). A boiler explosion at Indorayon in November, 1993, led to demonstrations in Medan and elsewhere, and a government statement that henceforth all new pulp mills built in Indonesia would have to be 'ECF or better'.⁸

Under the Suharto government,⁹ while having limited success in getting RGM to improve operations at Indorayon, activists' campaigns against the company helped advance the adoption of green technology elsewhere in Indonesia, including RGM's next new pulp mill, PT Riau Andalan, built in the early 1990s in east central Sumatra. PT Riau Andalan was designed and built by the Jaakko Pöyry group, from Finland, and incorporated the latest pulping, bleaching and wastewater technologies.

The Sinar Mas group, Indonesia's leading pulp and paper producers,¹⁰ took advantage of cyclical downturn in the international economy & global pulp industry in the early 1990s to purchase advanced new technology at a substantial discount. Its subsidiary, PT Indah Kiat Pulp and Paper Co. (IKPP), also in east-central Sumatra, had been a target of community protest over land, forest, and water resources. IKPP, the Indonesia Legal Aid Society (YLBH), WALHI, and BAPEDAL signed an historic memorandum of understanding in 1992, wherein the company agreed to clean up its operations and to

assist development in surrounding communities [Sonnenfeld, 1996: Appendix E]. IKPP utilised in-house engineering expertise, consulting engineering services, and international aid to improve process technologies at its older mill. At the same time, it also adopted new, cleaner technologies at its new mill, in part to help gain access to green export markets.

A continuing problem area in Indonesia relates to older, smaller pulp and paper mills, many located in densely populated areas on the island of Java, home to the great majority of the country's 200 million people. In East Java, for example, the provincial government, working together with various international agencies in attempting to clean up heavily used and polluted waterways, sought to shut down a number of smaller (5,000 tons per year), older, relatively inefficient, polluting pulp and paper mills. It was unable to do so, however, at least in the present, due to very high levels of unemployment in the area, and the impact such mill closures would have on the local economy [Hanafi, 1994].

Environmental activists in Indonesia had a cooperative working relationship with Emil Salim, Indonesia's first Minister of Population and Environment, and first head of the Bureau of Environmental Impact Management (BAPEDAL). Activists' relations with BAPEDAL cooled in the mid-1990s, as the agency's second chief, Sarwono Kusumatmadja, steered the agency towards a more voluntary-compliance based relationship with industry.¹¹ Activists had a positive relationship with the staff of the government-run Institute for Research and Development of the Cellulose Industry (IRDCI), which works primarily with state-owned and smaller, older mills.

International consulting engineer and technology supply firms played an important role in the adoption of environmental technology in Indonesia's pulp and paper industry. The Jaakko Pöyry group has advised almost every new pulp mill project in Indonesia. Technology suppliers received strong backing from their home governments, and benefited from close working relationship with consultants. Some suppliers became joint venture partners with Indonesian producers.

At least a half-dozen bilateral aid programs also contributed to the adoption of environmental technologies in Indonesia's pulp and paper industry. Canadian and Australian agencies supported development of national environmental regulations and administration in Indonesia. Austraid (Australia) and other agencies contributed to PROKASIH, the Clean Rivers Project, under which the province of East Java developed perhaps the toughest local water environmental standards in Indonesia. The United States Agency for International Development (USAID) supported a clean technology assistance program, which included participation by Indonesia's pulp and paper industry. Swedish and Japanese aid agencies supported environmental research at IRDCI.¹²

Malaysia. Sabah Forest Industries (SFI) was Malaysia's sole greenfield pulp mill during the period studied. Located in north-west Borneo, SFI is one of the most studied pulp mills in South-East Asia, with extensive baseline and follow-up environmental impact assessments conducted in association with the United Nations Environment Programme's (UNEP) Network on Industrial Environmental Management (NIEM) project [cf. Murtedza and Landner, 1993]. Principle concerns articulated in those studies related to effects of the mill's effluent on fisheries in Brunei Bay. Even more consequential than

the mill's discharge, however, was heavy siltation in the Bay due to soil erosion from upland logging [*ibid.*]. It is not clear from Murtedza and Lander's study how much of that 'upland logging' was by SFI or its contractors.

During its start-up and initial years of operation, SFI was kept under strict environmental oversight by Malaysia's national government. SFI was required to conduct annual environmental audits and improve environmental performance. The close attention paid to SFI by Malaysia's national government may be partially explained by the mill's ownership by the state of Sabah. At the time, Sabah was one of only two states not led by the United Malays National Organisation (UMNO), Malaysia's ruling party.¹³ SFI was caught in tension between local and national authorities on matters such as the granting of tariff protection and building of infrastructure.¹⁴

SFI used in-house research facilities to improve environmental performance, including reducing use of elemental chlorine and improving waste water processing. Technology and engineering supply firms, university researchers and the NIEM supplemented SFI's in-house efforts. The Swedish International Development Agency (SIDA) funded and provided training in Sweden for SFI engineers and machine operators.

Although there were no integrated pulp and paper mills in West Malaysia at the time of my field work, there were a number of small and medium-sized paper mills utilising recycled paper as their primary raw material. Malaysia's weak environmental regulations governing the pulp and paper industry are meant at least in part to protect this small but economically important sector. In a recent white paper, for example, university researchers and government officials describe as 'valid' complaints from operators of small mills that they could not meet even existing weak environmental standards due to 'financial difficulty in installing efficient wastewater treatment plants as their production scales are too small' [Murtedza, et al., 1995: 12].

Thailand. The pulp and paper industry in Thailand, too, has been at the centre of longstanding controversy. Small farmers, supported by NGOs, academics, urban professionals and the media, protested establishment of pulp plantations, industrial pollution, and loss of rural livelihood in Thailand. Two firms in the north-east region of the country received the greatest attention; one was perceived as foreign-owned, the other as minority-owned.

An industrial accident involving one of those firms had an important catalytic effect in public and governmental scrutiny of the industry. A massive fish kill in a nearby river was blamed on a mill operated by the Phoenix Pulp and Paper Co., joint venture of the 'European Overseas Development Corporation' (EODC)¹⁵ and Ballarpur Industries (India). With an important election drawing near, the government responded to public demands for action, taking the unprecedented action of shutting down the Phoenix mill until it could upgrade its wastewater treatment system.

Phoenix management air-lifted a wastewater treatment system from Finland, got it operational in 30 days, and resumed operations. The company proceeded to add a second pulp line, supported with an interest-free Finnish loan. The new pulp mill incorporates the latest pulping and bleaching technology from Nordic supply firms. The construction

project included upgraded pre-processing for the original mill.

With north-east Thailand beset by an extended drought, government agencies further required Phoenix to phase out all discharges into the nearby river. In response, the company developed a program to use treated wastewater to irrigate pulpwood plantations in the vicinity of the mill. Optimistically, the company hoped to ‘turn necessity into a virtue’, by marketing its products to green markets internationally.¹⁶

The government’s shutdown of the Phoenix mill rippled through the Thai pulp and paper industry. The Federation of Thai Industries’ Pulp and Paper Club became involved in the USAID-sponsored Industrial Environmental Management (IEM) program within weeks of the shut-down. Club members actively exchanged information about environmental technology, conducted environmental audits of each others’ manufacturing facilities, and visited environmental technology suppliers in the USA.

The Soon Hua Seng group, a Sino-Thai business which had previously run into trouble establishing eucalyptus plantations, created a new subsidiary, Advance Agro Ltd., to develop a pulp mill, also in north-east Thailand. It hired Presko, a Thai-Finnish public relations firm, to actively monitor popular concern about the pulp industry in Thailand; and Jaakko Pöyry as designer and general contractor for new mill. The mill, which began operations in 1995, was designed with ECF pulping and bleaching processes and advanced wastewater treatment facilities.¹⁷ In building a ‘green’ mill, Soon Hua Seng hoped to forestall getting into political trouble as it had before.

The Siam Pulp and Paper group, division of partially crown-owned Siam Cement, was less frequently the target of public and political pressure to environmentally improve its operations. Nevertheless, the group took strong environmental leadership in its operations and in the Thai Pulp and Paper Industry Association. The group upgraded wastewater treatment facilities at its largest pulp and paper production site, and experimented with using enzyme and bacterial pre-processing to reduce chemical use at its pulp mills.¹⁸

In contrast to the experience of the new, large scale pulp producers, pollution by smaller, older mills often ‘slips through cracks’ of regulatory enforcement in Thailand. An official of the Pollution Control Department told me, for example, that smaller pulp and paper facilities were not a high enforcement priority for his office, because there were relatively few such producers, and he had to deal with many far more pressing problems.

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In both Indonesia and Thailand, one pulp mill’s troubled beginnings set the tone for the environmental reform of an entire industry. While having different immediate outcomes, the cases set in motion similar country-level dynamics. These might be portrayed graphically as in Figure 1. Essentially, these dynamics entail a combination of social movement (NGO), state regulation, and business factors driving the innovation process at the national level.

Place Figure 1 about here.

Figure 1. Dynamics of adoption of environmental technologies in pulp and paper manufacturing in Indonesia and Thailand, c. 1987-94.¹⁹ Source: Sonnenfeld [1996].

The core dynamics of adoption of environmental technologies as depicted in Figure 1 include the original, ‘landmark’ conflict; the establishment of new standards/levels of expectation for industry environmental performance; the encouragement of both firm and supplier innovation; and implementation/adoption of the new, cleaner production technologies. Key participants in these processes are local community groups, domestic and international business interests, non-governmental organisations, regulatory agencies, bi- and multi-lateral aid agencies, and ‘green’ consumers. Particular local environmental conditions (such as the poor character of Phoenix’s site) also are a factor.

In all three countries, there were markedly different dynamics in the large-scale, often export-oriented pulp industry segment as compared to the segment of smaller, older producers. Although the former received great public and regulatory attention, the latter often ‘slipped through the cracks’ of both popular and regulatory oversight. Even when identified as causing serious pollution to public waterways, small and medium-sized pulp and paper mills typically were allowed to continue operating. In contrast, popular and government pressure was much greater on the larger, newer mills.

Global and Regional Dynamics. Global and regional institutions also contributed to environmental reform of (at least the large-scale, export oriented segment of) South-East Asian pulp manufacturing. Global market, finance, and technology considerations exerted influence on adoption of environmental technologies in the export-oriented, and financially dependent South-East Asia industries. International aid agencies and social movements played important roles as well.

On the one hand, various global factors motivated South-East Asian pulp producers to adopt the new, more environmental technologies. Environmental risk is factored in to the costs firms have to pay (in ‘points’ and interest) in world financial markets to issue corporate bonds. Maintaining access to global consumer markets also is important to export-oriented South-East Asian pulp producers. They pay attention to international eco-labelling efforts and aim to obtain eco-certification where possible. Phoenix, in Thailand, for example, was considering going after green markets in Japan and elsewhere with its non-wood (bamboo, kenaf), ‘environmentally friendly’ pulp.

On the other hand, global technology firms were highly motivated to sell their new technologies under favourable terms. When the new, ECF technologies were coming on the market in the early 1990s, Finland and Sweden were undergoing their worst economic (and political) crises in half a century; Europe and North America were in the midst of a major economic slump; and South-East Asia was one of the few regions of the world rapidly expanding. Technology supply firms and Nordic governments offered

price discounts, trade credits, interest-free loans, and joint-venture partnerships to South-East Asian pulp producers to encourage them to adopt the new technologies.

Foreign consulting engineering firms played an active role in promoting adoption of environmental technology in Thailand's pulp and paper industry. Both new ECF mills in north-east Thailand were designed by Jaakko Pöyry and incorporate advanced, Nordic-sourced technology. H.A. Simons, a Canadian consulting engineering firm, was the major contractor for upgrading wastewater treatment facilities at the Siam Pulp and Paper group's mills.

International aid agencies, also, played an important role in the adoption of environmental technology in Thailand's pulp and paper industry. As noted above, the Finnish Agency for International Development (Finnaid) provided aid and trade credits for purchase of pulp manufacturing equipment, including at Phoenix Pulp and Paper in Thailand. USAID supported training in environmental management and waste minimisation in both Indonesia and Thailand.

Swedish assistance has been critical in carrying out the United Nations Environment Programme's Network on Industrial Environmental Management (NIEM). For more than seven years, the NIEM has conducted training, documentation, conferences, and workshops aimed at helping pulp industries in participating countries (China, India, Indonesia, Malaysia, the Philippines, Sri Lanka, Thailand, and Viet Nam) develop expertise and exchange information on environmental problems.²⁰

International social movements played an indispensable role in the adoption of environmental technologies in South-East Asian pulp industries. The new, ECF technologies were developed in Sweden and Finland in response to European social movements' efforts to tighten environmental regulations and increase demand for green products. Transnational social movements helped disseminate environmental information to South-East Asian governmental, academic, and citizens' groups. Greenpeace, in particular, played a critical role in gathering information on the pulp industry and the environment, and making it available around the world. It consulted with pulp manufacturers, industry, governmental and university research institutes, regulatory agencies, and NGOs; and developed a good relationship with suppliers of environmental technology for the pulp industry, especially in Western Europe.

Expressed graphically, the global flow of environmental innovation in South-East Asian pulp manufacturing might look like Figure 2. While having important country-level characteristics due to unique cultural, political, economic, and environmental factors; there is also an essential global dimension of the diffusion of technologies, regulatory standards, and social movement influence in the pulp and paper industry. South-East Asia, as a late industrialising region, was affected by and able to take advantage of these dynamics [see Sonnenfeld, 1998b].

Place Figure 2 about here.

Figure 2. Global flow of innovation in environmental pulping and bleaching technologies, c. 1985-94.²¹ Source: Sonnenfeld [1996].

Social movement action in North America and Europe galvanised development of the new, ECF technologies. New environment/technology regulatory regimes also diffused from North to South, both directly through North-South regulatory agency cooperation, and indirectly, through the establishment of global environmental norms and expectations, including among corporate and individual consumers. Australia is included in Figure 2 due to its geographical proximity to South-East Asia, and the direct involvements of Australian regulatory agencies, social movements, and industry consultants in South-East Asia. This characterisation is especially pertinent to the newest mills.

Discussion

Based on this summary of research findings, to what extent can it be said that South-East Asian pulp and paper industries have ‘ecologically modernised’? Let us return to the objectives, mechanisms, and institutional dimensions of ecological modernisation delineated above as a framework for addressing this question.

The first objective of ecological modernisation is *waste reduction and elimination*. South-East Asian pulp firms have made significant strides in reducing waste, at least in terms of the amount of waste per ton of product. The technologies utilised by the new pulp mills built and operating in South-East Asia are among the most efficient in the world. Modifications to reduce waste have been made to the previous generation of pulp mills as well. Where waste-reduction has least occurred is with the smaller, older pulp mills, some government-owned, which have been kept operating despite their inefficiencies & pollution. With regard to this criterion of ecological modernisation, South-East Asian pulp industries can be said to be well on the road to ecological modernisation, even while problems remain with small and medium-sized enterprises (SMEs).

The second objective of ecological modernisation is *resource recovery and reuse*. With regard to the pulp industry, several resources might be considered: water, chemicals, and fibrous raw materials. The new mills in South-East Asia show remarkable achievements in the reduction of the amount of water used per ton of pulp produced. Chemical recovery, as well, is highly advanced in the new mills. Historically, South-East Asian pulp industries were great *re-users* of fibre resources, utilising agricultural waste and wastepaper as raw materials. As the scale of production has increased, however, the industry has moved away from recycled inputs to greater reliance on virgin raw materials from native forests and tree plantations [see Sonnenfeld, 1998c]. In sum, South-East Asian pulp manufacturers are making substantial progress in recovering/reusing water

and chemicals; fibre is another story, discussed more below.

Perhaps the biggest Achilles heel of South-East Asian pulp producers with regards to ecological modernisation is the criterion of *dematerialisation*. In ecological modernisation, dematerialisation is achieved through the substitution of high-technology for raw material inputs, or alternatively, the substitution of recycled or recovered waste for virgin raw materials. As South-East Asia's pulp industries expand and modernise, less water and fewer chemicals are used and less waste is produced per ton of product. At the same time, producers have adopted wholesale the industrial model promoted by their Northern technology suppliers and funding sources, one based on large increases in both absolute and relative use of virgin raw materials.

Of greatest immediate concern are the proliferating greenfield pulp mills, especially in Indonesia, each of which must be 'fed' a tremendous volume of virgin fibre to maintain full production. Typically, native forests provide the first round of raw materials in the form of 'mixed tropical hardwood' (MTH) chips, while extensive fast-growing plantations have been established to address future raw material needs. Government policies which awarded very large forest concessions at little or no cost to well-connected companies and individuals only compounded and accelerated this dynamic.

Resource conservation, one of the long-term objectives of ecological modernisation, thus remains in the distant future of South-East Asian pulp industries. As with the shorter-term goals of waste reduction and resource recovery, South-East Asian pulp industries fare much better with regard to the second longer-term objective of *clean production*. Perhaps nowhere is the contradiction between these two objectives more evident than in South-East Asian pulp industries, where there is imaginably a future of clean production while resource conservation is nowhere in sight with regard to virgin fibrous materials.

Through what mechanisms have the industries' accomplishments been achieved? A number of *market factors* were significant in the adoption of environmental technologies in South-East Asia's pulp industries. South-East Asian producers made good use of downturns in the global economy together with the reconfiguration of European trade in the wake of the dissolution of the USSR to negotiate rock-bottom prices for the new technologies. International environmental standards and policies were a minor but nonetheless present factor. Faced with making large investments in fixed capital, South-East Asian producers did not want to be locked out of current or future markets requiring International Standards Organisation (ISO) certification, establishing environmentally preferred purchasing policies, or implementing eco-labelling.

Science and technology played a critical role both directly and indirectly. In South-East Asia, firm-based research and development laboratories, national industry research centres, and regional networking such as through the UNEP NIEM program also contributed to the development, diffusion and modification of environmental pulp and paper industry technologies. South-East Asian producers also were able to take advantage of technological innovation in Finland and Sweden and other countries with major research and development efforts in pulping technology.

South-East Asian *states* played an interesting and important role in facilitating adoption

of pulp industry environmental technologies. Though generally regarded as weak in their environmental regulatory efforts, in both Thailand and Indonesia, national environmental agencies were forced by popular pressure to intervene to halt production at pulp mills thought to be damaging the environment. They worked together with industry and NGOs, encouraging pulp producers to take preventative environmental measures so they could continue operations in a manner sensitive to community needs and less harmful to the natural environment. In Malaysia, national environmental officials pressed operators of Malaysia's only pulp mill at the time more than most businesses in the country.

Although regulatory standards were historically weak, government agencies, particularly in Indonesian, let industry know they would be setting progressively lower emission standards -- giving industry added incentive to invest in cleaner technologies from the beginning. In Thailand, agencies established site-licensing and environmental impact assessment review procedures that strengthened more general and weak emission standards, and created a context for public input and oversight. In Indonesia and Malaysia, too, government agencies supplemented general environmental standards with site-specific licensing, audits, and environmental reviews. In this way, the pulp and paper industry's big 'footprint' and high visibility made it an easy target for customised regulatory treatment.

The role of environmental and other *non-governmental organisations* (NGOs) was critical in the adoption of new environmental technologies in South-East Asian pulp production. Local community groups, often of ethnic and/or religious minorities, formed the 'first-line' of attack on the industry. National environmental, human rights, and alternative development NGOs took up the cause of local activists. Friendly journalists brought broad attention to the conflicts nationally and internationally. Together, local and national NGOs educated the public, forced regulators to act, negotiated with industry, and generally promoted an atmosphere in which producers were compelled to adopt new, environmental technologies.

Greenpeace International played a critical role in disseminating information about environmental risks associated with use of chlorine in pulp and paper manufacturing, spurring development of new technologies, and increasing regulatory scrutiny of the pulp industry. In South-East Asia, Greenpeace consulted with regulatory officials, NGOs, and even pulp companies interested in avoiding political hassles. Rather than be outside industrial and environmental planning, Greenpeace was very much 'inside' technology development (in Europe) and community oversight of industry (including in South-East Asia).

All of this took place in a context very much *interdependent with globalisation*. Technology, consumption, regulation, social movements all have global as well as local dimensions. None of this would have happened without the new technologies developed and available in the Nordic countries, green pulp and paper markets, converging global environmental regulatory standards, intergovernmental assistance programs, and global interaction between social movements.

Lastly, no argument can be made that there has been a trend towards *deindustrialisation* in South-East Asia's pulp industry. There have been some calls for smaller-scale,

appropriate technology in the global pulp and paper industry, e.g. the development of more mini-pulp mills to utilise agricultural waste rather than woody materials [Marchak, 1995; Smith, 1997; Sonnenfeld, 1998c]. However, even the late 1990s 'Asian flu' (global financial crisis) has not reversed development of additional, large-scale pulp manufacturing capacity, utilising cleaner production technologies in South-East Asia [cf. APP 1998].

Using criteria drawn from the literature, then, it can be argued that a partial ecological modernisation *has* taken place in South-East Asian pulp industries, with a major exception in regard to the dematerialisation of pulp and paper production, and continuing problems with small and medium-sized pulp and paper firms. What implications do these findings have for ecological modernisation theory and its applicability to newly industrialising countries?

Conclusion

Clearly, ecological modernisation is on the agenda of newly industrialising countries. Cleaner production technologies are being used with beneficial effects relative to older technologies. Like their counterparts in advanced industrial countries, government environmental agencies in newly industrialising countries are moving toward collaborative relationships with producers. NGOs play a critical role both 'inside' and 'outside' environmental regulatory and management processes in South-East Asia as elsewhere.

Processes of ecological modernisation have specific characteristics in different types of economies and industrial sectors. In advanced economies, industrial restructuring involves modernising an ageing manufacturing base. With well-developed consumer markets and high wage and raw material costs, ecological modernisation in advanced economies combines improvements in environmental performance with productivity gains and manufacturing efficiencies. NICs, on the other hand, have the advantage of being able to use the latest, cleaner technologies from the onset of large-scale, modern manufacturing -- 'leap-frogging', while benefiting from inexpensive raw materials and wages. Resource-extractive, export-oriented industries such as pulp and paper may be in a particularly strong position to benefit from such advantages. The marginal costs of adopting cleaner technology may thus be lower in the South, while the pull of international 'green' markets and standards may also be strong for export-oriented sectors.

The biggest problem for the applicability of ecological modernisation theory in NICs -- and by extension for ecological modernisation theory more generally-- may be in the area of dematerialisation. The cases examined here suggest that production is supermaterializing in the South, even if arguably dematerialising in the North. This is particularly troubling given the large areas of tropical rain forest being clearfelled to supply fibre and establish pulpwood plantations for this industry. This raises a critical question: Is ecological modernisation in advanced industrial societies dependent upon *increased* materialisation elsewhere? (Or more specifically, if global pulp and paper consumption continues to increase, where are those raw materials going to come from, if not native forests and timber plantations in the South?)²²

A further concern is the applicability of ecological modernisation theory to small- and medium-sized enterprises, some of them government-owned. Such firms play an important role in NICs in providing employment and serving domestic markets. In South-East Asia's pulp and paper industries, many SMEs are older, use poorer technology, and are more polluting.²³ While it may make environmental sense to phase out some or many of such firms, doing so would have high social costs. Rather, governments and international agencies need to devise incentives to encourage technology firms to develop more ecological, smaller-scale production technologies.

As ecological modernisation theory further develops, it must take into account the entire globe -- not only as marketplace for new ecological ideas and technologies, but also as locus of shifting and increasing material production. Also, the theory must be broadened to include small- and medium-sized, as well as superindustrial, technologies and enterprises.

Notes

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² Data were collected from 1992-6 through fieldwork in those three countries, Singapore, Australia, and the USA, and from published and unpublished secondary sources.

³ The 'reduction in the resource input' discussed by Jänicke, et al.

⁴ Production without (un-recycled) waste.

⁵ Substitution of high-technology for material inputs.

⁶ Elementally chlorine-free (ECF) mills are indicated by a grey background.

⁷ I.e. 'being built on undeveloped land especially when unpolluted' [Merriam-Webster, 1999].

⁸ RGM transferred ownership of Indorayon and Riau Andalan to its Singapore-based subsidiary, Asia Pacific Resources Investment Holdings Limited (APRIL) in 1995, in part to facilitate raising funds via the international corporate bond market.

⁹ Conflicts in North Sumatra regarding the Indorayon mill continued after Suharto's resignation, with the new government intervening more strongly than its predecessor. See Reuters [1998].

¹⁰ The group now operates its pulp and paper companies through Asia Pulp and Paper Co., like its competitor, APRIL, a Singapore-based holding company.

¹¹ The relationship between environmental activists and government officials, along with many other things, is being renegotiated in the post-Suharto era.

¹² For further information on the Indonesian case, see Sonnenfeld [1998a].

¹³ Underlying the opposition-led state government were cultural, religious, and ethnic differences between Sabah residents and West Malaysia [Vatikiotis, 1992; *The Australian*, 1994].

¹⁴ UMNO recaptured the state government in 1995.

¹⁵ Primary shareholder of which is USA-born expatriate, George Davison.

¹⁶ Phoenix continues to have trouble. It was shut down most recently in July 1998, again for pollution of the Nam Phong [*The Nation*, 1998].

¹⁷ In 1998, the Soon Hua Seng group entered into a three-way strategic alliance in its Advance Agro subsidiary, taking on the Enso Group (Finland) and Oji Paper Co. (Japan) as major partners and board members [Suwannakij, 1998].

¹⁸ For further information on the Thailand case, see Sonnenfeld [1998b].

¹⁹ Participants appearing more than once are indicated with an asterisk (*). Stronger influence is indicated by a solid line; weaker influence with dashes.

²⁰ Interview, Mr. Mark Radka, Co-ordinator, Network on Industrial Environmental Management, United Nations Environment Program/ Regional Office for the Asia-Pacific, Bangkok, 6 August 1994. This project was particularly useful in assisting smaller and medium-sized enterprises (SMEs), some government-owned, with more limited access to financial and technical resources than the newer, larger, export-oriented pulp firms.

²¹ The four columns represent geographical region, social movement organisations, government and industry actors, and historical developments with regard to the 'greening' of pulp and paper technology, respectively. The arrow indicates the direction of diffusion of environmental transformation of industry: both horizontally, from social movements to government and industry; and vertically, from North to South.

²² Arthur Mol suggests that one way of addressing this question is to look at dematerialisation in pulp and paper manufacturing as a function of the amount (or proportion) of virgin raw material in the ultimate products. Thus increased paper recycling and/or use of agricultural wastes or other raw materials could result in dematerialisation, even if absolute quantities of paper produced continued to increase.

²³ Industry structures vary; e.g. in electronics, smaller supply firms may be obligated by contractual relationships with their customers to follow international environmental management standards and practices.

References

- Asia Pulp and Paper (APP) (1998), 'Summary of APP's 1998/99 Expansion Plans'. [Online.] Available: <<http://www.asiapulppaper.com/expansion1.htm>>. Singapore. [corporate information]
- Australian, The [Sydney] (1994), 'Opposition Lonely Business in Malaysia' January, p. 6.
- Frijns, Jos, Paul Kirai, Joyce Malombe, and Bas van Vliet (1997), 'Pollution Control of Small-Scale Metal Industries of Nairobi'. Department of Environmental Sociology, Wageningen Agricultural University, Wageningen, The Netherlands.
- Hanafi Pratomo (1994), 'Impact of new government regulations on future existence of pulp mill,' in Proceedings, 48th Appita Annual General Conference, Melbourne, Australia, 1-6 May 1994. Carlton, Australia: Australia-New Zealand Pulp and Paper Industry Technical Association.
- Hajer, Maarten A. (1995), The Politics of Environmental Discourse: Ecological Modernization and the Policy Process. Oxford: Clarendon Press.
- Hengel, Petra van der (1998), 'Textile Industry in Vietnam'. M.Sc. Thesis, Wageningen Agricultural University, Environmental Sociology, Wageningen, The Netherlands, April.
- Huber, Joseph (1985), Die Regenbogengesellschaft. Ökologie und Sozialpolitik [The Rainbow Society: Ecology and Social Policy]. Frankfurt: Fisher.
- Jänicke, Martin, Harald Monch, Thomas Ranneberg, and Udo E. Simonis (1989), 'Structural Change and Environmental Impact', Environmental Monitoring and Assessment, Vol.12, No.2, pp. 99-114.
- Marchak, Patricia (1995), Logging the Globe. Montreal: McGill-Queens University Press.
- Merriam-Webster, Inc. (1999), WWWebster Dictionary. [Online.] Available: <http://www.m-w.com/cgi-bin/dictionary>. Accessed 14 January.
- Mol, Arthur P.J. (1995), The Refinement of Production: Ecological Modernization theory and the Chemical Industry. Utrecht: van Arkel.
- Mol, Arthur P.J. and Jos Frijns (1999), 'Environmental Reforms in Industrial Vietnam', Asia-Pacific Development Journal (forthcoming).

- Murtedza, Mohamed and Lars Landner (1993), 'Sabah Forest Industries Sdn Bhd Pulp and Paper Mill: EIA Before Construction of Mill and Comparison with Actual Performance', in Phase II Training Package 2, Volume II, Network for Industrial Environmental Management (NIEM). United Nations Environment Programme, Regional Office for Asia and the Pacific, Bangkok, March.
- Murtedza, Mohamed, et al. (1995), 'Country Paper - Malaysia'. Paper presented at NIEM seminar on Regulatory Options for Fostering Improved Environmental Management in the Pulp & Paper Industry, Bangkok, 15-18 November.
- Nation, The (1998), 'Phoenix Paper Mill To Be Closed'. [Online.] Available: <<http://203.146.51.4/nationnews/1998/199807/19980721/29181.html>>. 21 July.
- Paulus, Stephan (1986), 'Economic Concepts for Industry-Related Environmental Policies', in Proceedings -- Forum on Industry and Environment. New Delhi: Friedrich Ebert Foundation.
- Reuters News Service (1998), 'APRIL says Indonesia comments surprise'. [Online.] Available: <<http://biz.yahoo.com/rf/981007/x.html>>. 7 October.
- Simonis, Udo E. (1989), 'Ecological Modernization of Industrial Society: Three Strategic Elements', International Social Science Journal Vol.41, No.3 (August), pp. 347-61.
- Smith, Maureen (1997), The U.S. Paper Industry and Sustainable Production: An Argument for Restructuring. Cambridge, Mass.: MIT Press.
- Sonnenfeld, David A. (1996), 'Greening the Tiger? Social Movements' Influence on the Adoption of Environmental Technologies in the Pulp and Paper Industries of Australia, Indonesia, and Thailand'. Ph.D. Thesis, University of California, Sociology, Santa Cruz, California.
- Sonnenfeld, David A. (1998a), 'Social Movements, Environment, and Technology in Indonesia's Pulp and Paper Industry', Asia Pacific Viewpoint, Vol.39, No.1 (April), pp. 95-110.
- Sonnenfeld, David A. (1998b), 'From Brown to Green? Late Industrialization, Social Conflict, and Adoption of Environmental Technologies in Thailand's Pulp and Paper Industry', Organization & Environment, Vol.11, No.1 (March), pp. 59-87.
- Sonnenfeld, David A. (1998c), 'Logging versus Recycling: Problems of the Industrial Ecology of Pulp Manufacturing in South-East Asia', Greener Management International, No.22 (Summer), pp. 108-122.
- Spaargaren, Gert and Arthur P.J. Mol (1992), 'Sociology, Environment, and Modernity: Ecological Modernization as a Theory of Social Change', Society and Natural Resources, Vol.5, No.4 (Oct.-Dec.), pp. 323-44.
- Suwannakij, Supunnabul (1998), 'Two foreign firms take 25.4% of AA'. The Nation (Bangkok). [Online.] Available: <<http://203.146.51.4/nationnews/1998/199809/19980929/32398.html>>. 29 September.
- Vatikiotis, Michael (1992), 'Federal excess: Sabahans Feel Exploited by Central Government', Far Eastern Economic Review, 18 June.