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Contents

Bringing in the rice harvest near the old imperial capital of Mandalay in central Myanmar (see related article on page 10).

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The North American Free Trade Agreement: Bad News for non-NAFTA Countries?

Maureen Grewe*

The North American Free Trade Agreement (NAFTA) was signed by Canada, Mexico and the United States in December 1992, and is scheduled to take effect, pending ratification by representative bodies in each of the three signatory countries, on January 1, 1994. Many hailed the recent ratification by the U.S. House of Representatives as a step away from protectionism and toward a freer world trading system.

The NAFTA negotiations generated much discussion, both among the participating countries and non-members. Despite the general support among free traders for opening up trade among the three countries, many parties are concerned over the details of the agreement and anticipate that its effects will not all be positive. Areas of concern include possible job losses, further damage to the environment, and less attention to human rights.

Non-NAFTA nations especially fear losses in trade and investment. Table 1 shows why these excluded nations harbor such fears. The European Community (EC), Japan and the ASEAN nations are particularly concerned. Based on trade volume, the implications of the agreement to their access to U.S. markets is clearly worrying for non-NAFTA members. The Canadian share of trade, for example, is yearly more important to Japan. And the anticipated growth in the Mexican economy will increase that country's future importance for most Asian economies.

NAFTA will create the largest single economic bloc in the world, larger than the European Community (EC) and the European Free Trade Area (EFTA) combined. It will do this both in terms of Gross National Product (GNP) and in populations covered. ASEAN's population, for example, is of comparable size, but its GNP is only a fraction of NAFTA's. Japan has 58 percent of NAFTA's GNP, yet only 35 percent of its population. Though still a developing country, Mexico alone has 90 million citizens, a high annual population growth rate, and a rapidly expanding economy. As an international trading bloc, therefore, NAFTA, in terms of both production and consumption, will unquestionably be a powerful force in world affairs. Table 2 illustrates this inescapable conclusion.

NEGATIVE CONSEQUENCES OF A FREE TRADE AGREEMENT

The aim of a free trade agreement is to promote greater mutual trade and economic harmony among its member countries, while enhancing both efficiency and competitiveness and thereby increasing economic welfare. Proposed benefits for members include more and wider employment, increased exports, lower prices and faster economic growth. Outsiders may view these gains as a threat to their own well-being. They may fear they will end up losers in a zero-sum game, where the members' benefits will come at the expense of non-members. The principal causes of these feared losses are trade and investment diversion and a deterioration in terms of trade.

Trade diversion is the re-orienting of imports within a free trade area from a low cost outside source to a more expensive inside source in response to a change in trade policies. A welfare loss results from the allocation of resources away from the most efficient producer. The extent of trade diversion that can be expected to occur for a given change depends, in part, on how protective the market was prior to change.

A free trade area, for example, may decrease tariffs for its members, thus decreasing the costs of importing products from these trading partners. If the tariffs for all trading partners are low prior to the change, the effect will be minimal as the marginal differences in cost will

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Table 1 Trade Volume with NAFTA as a Percentage of Total Exports and Imports, 1990

		NAFTA	U.S.	Canada	Mexico
EC	Exports to	8.3%	7.2%	0.7%	0.4%
	Imports from	8.3%	7.0%	1.0%	0.3%
Japan	Exports to	34.8%	31.7%	2.3%	0.8%
	Imports from	26.9%	22.5%	3.6%	0.8%
ASEAN	Exports to	21.9%	20.6%	1.1%	0.2%
	Imports from	12.9%	11.9%	0.9%	0.1%

Source: International Monetary Fund, *Direction of Trade Statistics 1991.*

be small. Additionally, outside trading partners will only be adversely affected to the extent that their goods compete directly with goods produced within the free trade area where tariffs have been lowered. Within NAFTA, both Canada and Mexico have higher trade barriers than the U.S., so exporters to those countries will face more potential trade diversion. The Canadian and Mexican markets, however, are much smaller than that of the United States. Understandably, the U.S. is, therefore, the typical concern of most outsiders.

Despite the general consensus that overall diversionary effects are likely to be small, regional or sectoral effects could be significant for particular industries or countries that compete directly against the NAFTA countries in exports, or where high existing trade barriers will be dramatically lowered for insiders. One study asserts that "NAFTA's sectoral impact will be essentially neutral in Canada and the U.S., but highly significant in opening the Mexican investment regime."[1]

The U.S. International Trade Commission estimates that American investment in Mexico – for automobiles and parts, computers, electronics, household appliances and apparel – will increase 16 percent in the long term.[2] To the extent that this investment, were there no NAFTA, would have been made in countries other than Mexico, it represents a diversionary effect. Aside from automobiles and parts, other sectors identified as likely to experience trade diversion are textiles and apparel, and agriculture.

Diversion of investment capital from both inside and outside NAFTA is of great concern to non-members, especially developing countries for whom foreign investment is crucial for further development. Investment diversion could occur if investors want to capitalize on the ability to export duty-free among the NAFTA nations or ensure market access to the three member countries. Low barriers, however, already exist for most products in the NAFTA region, rendering investment for tariff-jumping purposes unlikely. Tariffs are the lowest for the U.S. market, especially for countries qualifying under the Generalized System of Preferences. Tariffs are the highest in Mexico, making investment diversion for production within the Mexican market the most economically beneficial. Given the present size of its economy, however, it is unlikely that there will be sufficient economies of scale to warrant extensive foreign investment in the near future for Mexican consumption.

Contrary to the fears of many NAFTA opponents, investment decisions are usually most heavily influenced by the economic and political stability of the host country, the existence of well-defined property rights, the stability of the currency, and the ability to repatriate profits, not merely wage costs or tariff evasion.

Jeffrey Schott states that "The trade agreement is only a small part of the package of reforms that is influencing the investment decision" of firms considering relocation to Mexico.[3] Given similar costs, NAFTA will presumably give Mexico an edge in attracting investment because it will lock in the economic reforms undertaken during the 1980's in the country and brighten its growth prospects, making Mexico less risky for investors.

It is likely that investment diversion to Mexico will originate from outside of NAFTA, as non-members position investment to take advantage of Mexico's enhanced stability and growth, as well as its improved access to the U.S. and Canada. Nevertheless, the

Table 2 GNP and Population Comparison

	GNP in Billions of US$*	Population in Millions**
NAFTA	5,932	357
EC and EFTA	5,784	358
ASEAN	394	325
Japan	3,374	124

Sources: Hufbauer and Schott 1992, *Far Eastern Economic Review Asia 1993 Yearbook.*

* 1989 figures for NAFTA, EC/EFTA, and 1991 figures for ASEAN and Japan.

** 1989 figures for NAFTA, EC/EFTA, and 1992 figures for ASEAN and Japan.

lowered tariffs probably will not in themselves cause large diversionary effects. Mexico's path of economic reform would attract investment even in the absence of NAFTA.

Environmental laxity in Mexico has also been cited as a reason that investment diversion might occur. The theory is that environmental regulations in the industrialized countries involve substantial costs and that firms could lower these costs by relocating to Mexico. Environmental costs, however, represent a small fraction of manufacturers' total costs and can be only part of a "package" of reasons for relocating.

For non-members, NAFTA's investment provisions do provide some cause for concern about its external trade policy. Gestrin and Rugman express reservations about the possible discriminatory effects of the investment exemptions in the annexes to NAFTA's investment chapter, contending that "they also constitute an emerging North American industrial policy."[4]

The proposed rules of origin for automobiles of 62.5 percent, combined with duty drawback restrictions, will encourage regional sourcing of auto parts and the location of new automobile sector investments in North America. Another example where NAFTA's proposed rules of origin could negatively effect outsiders is in the electronics market. It is anticipated that these rules will promote the use of U.S.-made television tubes at the expense of Asian products.[5]

Despite reservations expressed about investment provisions, they are generally viewed as successful in achieving the goals of clarity, enforceability and transparency. They should also liberalize the Mexican investment regime and provide greater protection for foreign investment in the three NAFTA countries.

Terms of Trade Effects

A possible result of enhanced competitiveness and rationalization of production for NAFTA members is a deterioration in the terms of trade for non-members. This can occur for several reasons. Insiders may experience reduced costs through obtaining duty-free inputs from other members. Rationalization of production among the three countries based on comparative advantage can produce economies of scale that enable members to reduce costs. These two factors would result in a strengthening of the position of an insider who is the existing low-cost producer, or allow a member to newly become the low cost producer. In either case, outsiders will have to cut prices to match the preference given to insiders.

Another possible cause of deterioration in the terms of trade to outsiders is the relaxing of quotas for members. For example, the proposed agreement lifts U.S. import quotas under the Multifiber Arrangement for Mexican textiles, which qualify under the NAFTA rules of origin, and allows no new quotas to be imposed. As a result, increased Mexican textile imports to the U.S. may force down prices and allow the U.S. to recapture quota rents previously earned by outsiders. The outsiders, still constrained by their quotas, would have to drop their prices to remain competitive with the lower prices of Mexican products.

If the NAFTA countries represent a large enough market for a particular product or country, adjustment costs may occur for that industry or country as well. Textile exports, for example, from the Caribbean could decline if the NAFTA member textile industries become more competitive. Yet trade creation and income effects could cause increased exports from the Caribbean to NAFTA members in other sectors. If NAFTA markets represent a large enough portion of a non-member nation's trade, then reallocation of resources could occur in non-member countries as well. This scenario could only credibly occur, however, for a small group of countries for all of whom the U.S. is the dominant import source and export market.

A less directly negative NAFTA consequence could be a shift in U.S. focus to regionalism, thus diminishing its leading role in the General Agreement on Tariffs and Trade (GATT). To date NAFTA's aims have included continuing trade liberalization on the multilateral level. The failure of the Uruguay Round, however, could cause a re-orientation inward. This would be dangerous for outside nations who stand to gain much from continued liberalization under GATT, and for whom a more protectionist U.S. market would be disastrous. Recent discussions by U.S. policy makers have somewhat dispelled this fear by speaking of NAFTA as a step toward a freer and more open world trading system. The close margin of the U.S. House of Representatives' vote on NAFTA, however, underscores the strength of U.S. protectionist interests.

POSSIBLE BENEFICIAL RESULTS

NAFTA may provide some benefits and opportunities for outsiders. The benefits of investment in Mexico for non-members will be increased by enhanced access to NAFTA markets and continued economic reform and stability in Mexico. And higher growth in all of the NAFTA countries is anticipated to cause income effects and trade creation. Thus, the question remains whether trade creation will dominate trade diversion in providing a welfare-enhancing outcome for outsiders as well as for NAFTA members.

Trade creation results when a member of a free trade area imports goods it previously produced itself from a lower cost producer who is also a member of the same free trade area. The welfare of members is increased because resources are reallocated based on comparative advantage. There is a production effect, reflecting the shift from a less to more efficient producer,

and a consumption effect, as consumption of the now lower priced good should increase. Expanded production of a good within the free trade area will provide benefits to outsiders if it requires more inputs imported from outside the preference area.

Income growth in the member countries should expand import demand, thus increasing imports from outside nations as well as member countries. This effect should be especially important for Mexico, which will undoubtedly experience increasing demand for consumer goods as its per capita income grows. This growth dividend can result in a positive sum game with overall net welfare enhancing effects if the increased volume of imports exceeds trade diversion.

A positive externality to outsiders can result if an insider is already the lowest cost producer of imports for outsiders, and the price of those goods falls further due to duty free components or economies of scale. If Canada, for example, produces machinery for export to ASEAN manufacturers and can lower its costs because it can *now* obtain parts from the U.S. duty-free, lower prices can be charged. The ASEAN manufacturers, as a result of NAFTA, will therefore gain from improvements in Canada's cost position.

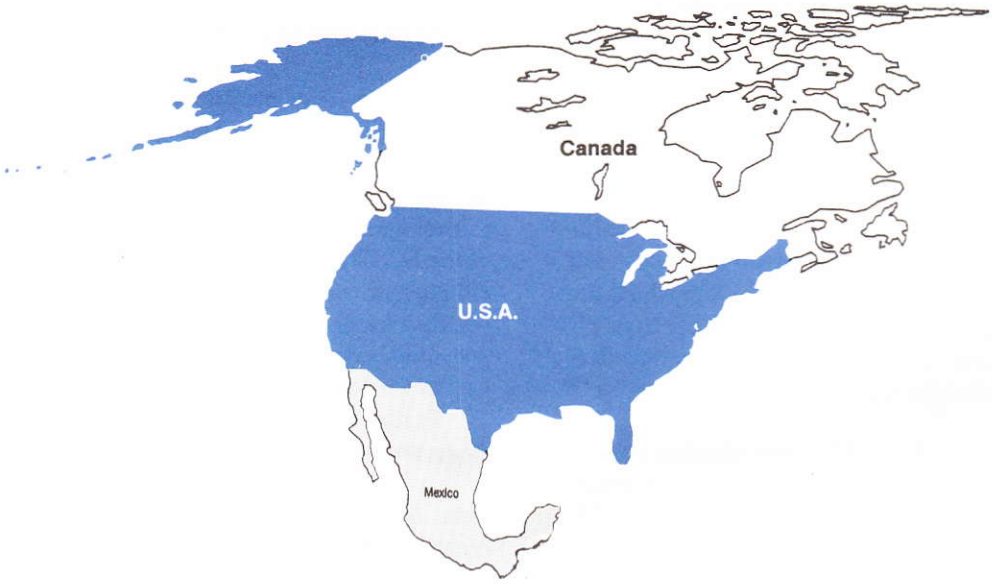
ACCESSION AND EXTERNAL POLICY ISSUES

A question raised by NAFTA is whether it will have differential impacts on industrialized versus developing countries. The answer may vary from country to country, depending on its trade pattern and the complementarity of production with NAFTA members. Generally, with tariff barriers, the agreement is likely to hit developing countries less hard as they currently face lower tariffs than the industrialized countries under the Generalized System of Preferences. Hufbauer and Schott, however, point out that failure to successfully conclude the Uruguay Round will be more damaging to developing countries, insofar as it reduces the multilateral system to competing regional blocs, as many of the industrialized countries now belong to regional organizations like the EC, which exclude the developing nations. ASEAN, as a grouping of rapidly industrializing developing countries, is a clear exception, though the degree of its intra-regional trade is much less than the EC's or NAFTA's, leaving it more exposed to protectionism in other regional blocs.

While the accession clause to the agreement is of special interest to the Caribbean Basin countries and those of Latin America, prospects for the agreement's expansion will also concern other outsiders. The proposed accession clause stipulates that unanimous approval by the NAFTA members is required, yet delineates no geographic limitation.

Hufbauer and Schott note several flaws in the accession provisions.[6] There are no specified application procedures or criteria, for example. Each NAFTA member can form its own free trade or bilateral agreements with non-member countries, even those rejected for accession to NAFTA. This could create a "hub and spoke" system as described by Wonnacott.[7] Additionally, there are several industry-specific sectors of the agreement that make no reference to possible extension to outsiders. It may thus require extensive renegotiation to admit additional members.

Wonnacott discusses the implications of NAFTA's expansion for non-members.[8] He notes that the more the benefits to members, the less they will want to share these benefits by pushing for multilateral liberalization.



Beneficial terms, however, increase the incentives for outsiders to end such discrimination and preferential benefits. This adds external pressure for either expansion or increased multilateral liberalization. One caveat is that insiders may soften to multilateral liberalization after a rationalization and restructuring period if they feel they are more prepared to face international competition and will, therefore, not be hurt by lower trade barriers.

The possibility of a hub and spoke system, as described by Wonnacott, exists if member countries pursue separate bilateral agreements rather than the expansion of the free trade area itself.[9] The U.S., for example, could become a hub with spokes representing NAFTA, the Caribbean Basin, and several South American nations. Wonnacott argues that this arrangement would be less beneficial to all the participants than an extended free trade area. At first glance, it would seem that the U.S. might benefit as the hub by having preferential access to all of the spokes. Such a system would be administratively costly, however, and could raise accusations that the U.S. is exploiting the Western Hemisphere. This would be detrimental to the U.S.'s role in multilateral circles.

For multilateral requirements, GATT requires that preferential trade areas address all trade among the member countries without raising external barriers as a group. NAFTA complies with this provision. There may be scope, however, for unilateral protectionist action by any of the three countries using non-tariff barriers, including such "gray-area" measures as voluntary export restraints, contingent protection measures (anti-dumping and countervailing duties), and "rules of origin."[10]

The likelihood of these measures depends, in part, on the outcome of the Uruguay Round. Failure may provoke a dangerous trend toward protectionism, especially the use of non-tariff barriers not easily dealt with under the existing GATT dispute resolution mechanism. NAFTA's damage to outsiders will be exacerbated by failure to successfully conclude the Uruguay Round as "the sectors in which the potential for trade diversion is the greatest ... are likely to be subject to extensive liberalization in the Uruguay Round."[11] Consequently, without any further action, agreement on the measures proposed by the current GATT talks would mitigate NAFTA's impact for non-members.

REVIEW OF EMPIRICAL STUDIES[12]

Many attempts have been made to determine NAFTA's economic implications for the participants. Several models attempt to predict the results for the rest of the world. According to Braga, "the overall impact of NAFTA on the rest of the world should not be significant if the agreement fosters freer trade."[13] This section will review the results of several such studies and attempt to highlight sensitive assumptions.

A partial equilibrium analysis of NAFTA by Samuel Laird found minimal trade diversion effects of 0.72 percent of total value of exports to the U.S. from non-member Western Hemisphere countries and 0.55 percent decrease from other industrialized countries.[14] This study modeled only tariff removal among the participants. Effects of tighter rules of origin and changes to non-tariff barriers, as well as investment diversion, are thus not captured. Laird also found that if particular anticipated benefits from the Uruguay Round are implemented simultaneously with NAFTA, then trade creation exceeds trade diversion, with Western Hemisphere countries and the industrialized countries experiencing a 1.8 percent and 2.4 percent increase in exports to the U.S., respectively. A partial equilibrium model of a U.S./Mexico FTA by Erzan and Yeats[15] finds a similar result to Laird's NAFTA model. It predicts a total trade diversion of one percent of U.S. imports from all non-NAFTA countries, with 94 percent coming from outside the Western Hemisphere.

Braga found that "the results of computable general equilibrium models... are sensitive to their specifications (particularly, elasticities of supply and demand, market structures, pricing behavior of firms, and assumptions about capital flows)."[16] He reviews three models,[17] each with two or three cases. Each model assumes increasing returns to scale and imperfectly competitive firms that set prices. Without international factor mobility, very small decreases occur in the NAFTA countries' demand for imports and supply of exports to the rest of the world. Cases that allow for international capital mobility, however, result predictably in deterioration of the terms of trade for non-members. These results expose the sensitivity of the model to assumptions about capital flows, which actually have a larger impact than the preferential trade liberalization component.

Referring to a study conducted by Robert McCleery,[18] Michael Plummer and Pearl Imada reviewed the potential impact of NAFTA on the Philippines, Indonesia and Thailand. The study gauged the effects on these non-member countries by pairing their exports with those of NAFTA countries to determine which products would face competition, plus comparing existing tariff levels and non-tariff barriers with a cutoff of US$5 million. The results predicted little net trade diversion for any of the three countries, while cautioning that particular sectors could be adversely affected, especially agriculture, steel and metal products, chemicals, and textiles. As to investment diversion, the study found marginal diversion for the Philippines, a negative impact of 2-5 percent of investment annually for Thailand over an eight year period, and a decrease in investment for Indonesia ranging from 0.5 percent in the first year to 2-5 percent in the fourth year. This represents a significant handicap for these nations, as all are trying to expand foreign direct investment to promote technology transfer and continued economic growth.

Looking at income growth, the study found a small positive impact in the Philippines, due to increased exports to the U.S., and a negative impact for Thailand, ranging from a decrease in GDP of 0.35 percent in the first year, rising to 0.6 percent in the third year before falling to one percent in the sixth and seventh years. For Indonesia, the study anticipated a fall in GDP of 0.2 percent a year starting the first year and moving to a one percent annual decline in the fifth year and afterwards. These results occur under assumptions of high trade and investment diversion due to NAFTA. To the extent that reality is less extreme than these assumptions, the impact on these countries would be softened.

There are several sensitive assumptions that can dramatically alter the results of the studies, especially changes in capital flows and non-tariff barriers. Unfortunately, these important factors are difficult to predict and model, leaving room for further research. The results of these empirical studies can be summed up by this statement from Hufbauer and Schott: "On balance, we believe that trade created by growth in the NAFTA region should more than offset the trade diverted in particular sectors."[19]

SUMMARY AND CONCLUSIONS

NAFTA's impact on both member and non-member countries remains a subject for debate, and will increasingly be so as the NAFTA signatories move through the ratification process and toward implementation. With the results dependent on modeling techniques and assumptions, the effects cannot unambiguously be predicted. Competing interest groups will choose the agreement's features that suit their arguments either for or against. The following conclusions can nevertheless be drawn about the impact of NAFTA on non-member countries:

- Most studies conclude that trade creation and income effects will exceed or balance out trade diversion and terms-of-trade effects. Thus NAFTA will have little or no effect on non-member countries. The effect for any particular country will, of course, vary depending on its trade pattern and particular export products.
- Given low pre-NAFTA barriers, investment diversion from the U.S. is likely to be minimal. It may be higher for certain sectors if significant liberalization takes place in Mexico, for example, in financial institutions. For the rest of the world, some countries with less preferential trade relations with the member countries may divert investment to them to increase their market access. Most of the studies do not project a specific investment diversion effect for ASEAN. The ASEAN countries, however, can counter investment diversion by maintaining liberal investment provisions and by promoting infrastructure investment and a stable macroeconomic environment attractive to investors.
- The enhanced competitiveness of NAFTA participants is a double-edged sword for non-members. Some industries will gain from lower costs of existing low cost producers and income effects, while others will lose from direct competition. Sectors likely to lose include textiles and apparel, automobiles and parts, and agriculture.
- Successful completion of the Uruguay Round and continuing multilateral liberalization is the best way for non-member countries to minimize any of NAFTA's possibly adverse impacts.

ENDNOTES

1 Jeffrey Schott in "Comments" on Carlos Alberto Primo Braga, "NAFTA and the Rest of the World," in Lustig, Bosworth, and Lawrence, 1992.

2 Gestrin and Rugman, p. 3.

3 Ibid, p. 27.

4 Hufbauer and Schott, 1993, p.114-6.

5 Wonnacott, 1993.

6 Ibid.

7 Ibid, pp. 9-15.

8 Hufbauer and Schott, 1993, p. 112.

9 Ibid, p. 114.

10 This section relies heavily on the review of empirical studies by Carlos Alberto Primo Braga in his chapter "NAFTA and the Rest of the World" in Lustig, Bosworth and Lawrence, 1992.

11 Braga, p.234.

12 See Laird, Samuel. "U.S. Trade Policy and Mexico: Simulations of Possible Trade Regime Changes." International Trade Division working paper, the World Bank, 1990.

13 See Erzan, Refik and Alexander Yeats. "Free Trade with the United States: What's in It for Latin America?" Working Paper 827, the World Bank, 1992.

14 Braga, p.218.

15 The models discussed were developed in Drusilla K. Brown, Alan V. Deardorff, and Robert M. Stern, "A North American Free Trade Agreement: Analytical Issues and a Computational Assessment," *World Economy*, vol. 15 (January 1992), pp. 11-30; Horacio E. Sobarzo, "A General Equilibrium Analysis of the Gains from Trade for the Mexican Economy from a North American Free Trade Agreement," *World*

Economy, vol. 15 (January 1992), pp. 83-100; and David Cox and Richard G. Harris, "North American Free Trade and Its Implications for Canada: Results from a CGE Model of North American Trade," *World Economy*, vol. 15 (January 1992), pp. 31-44.

16 The study reported in Plummer and Imada is Robert McCleery, "NAFTA and Its Effects on Other Regions: U.S. Trade Policy and Asia's Concerns in a Global Context," Regional Integration and Its Impact on Developing Countries Project, East-West Center, 1993.

17 Hufbauer and Schott, 1993, p. 113.

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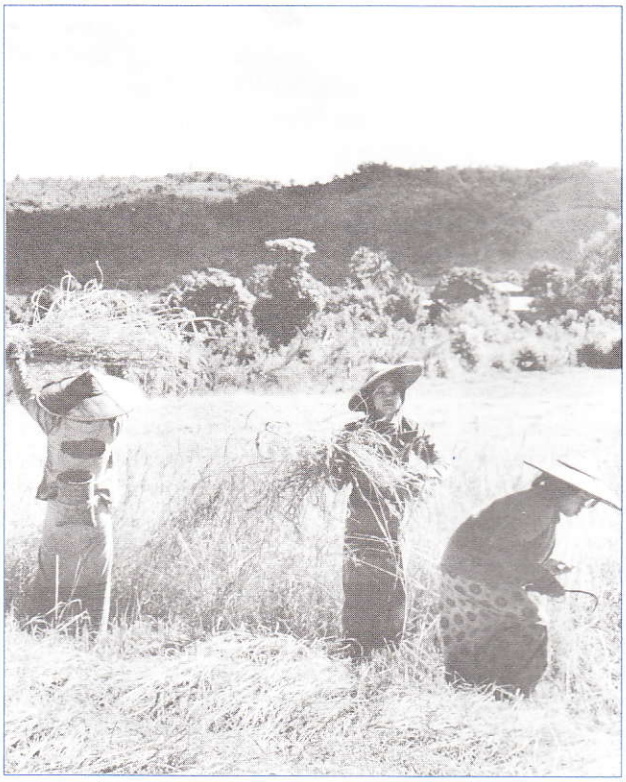
Myanmar: Rice Policy Reforms and the Potential for Export

Prabhu Pingali
Ammar Siamwalla

Myanmar, a major rice exporter in the mid-1960s, has witnessed a dramatic fall in its exports over the last two decades. Current exports amount to approximately 250,000 metric tons a year. This article argues that Myanmar's loss of rice exports was policy-induced and that corrective policies could lead to a significant increase in the country's rice exports. The authors believe that the liberalization of rice export policies could lead to Myanmar exporting over two millions tons a year.



PRE-1988 INSTITUTIONS AND POLICIES

In Myanmar, agricultural institutions and policies in place until 1988 resulted in centralized control of land, crop choice, and input supply. The state had monopoly control on all internal and external trade in rice. Individual incentives for increasing productivity and output were minimal. Despite its historic exporter status, Myanmar re-oriented itself as a closed economy and the small amount of exports allowed were pre-determined, based on foreign exchange needs. The following is a brief description of production conditions prior to 1988:

Programming Agricultural Output. All of Myanmar's agricultural land was placed under two categories: program areas and non-program areas. Program areas had to grow crops specified by the government. Farmers in these areas had a limited role in crop choice decisions. The area under program crops, such as rice, cotton, pulses, etc., was determined on the basis of an aggregate demand vector. Crop location was determined in terms of agro-climatic suitability.

Program areas were provided with subsidized fertilizers, pesticides, tractor plowing, and pumping services. Subsidy elements included lower input prices and zero interest rates. Repayment could be in cash or paddy at harvest. There was no incentive for the private supply of these inputs.

Program area farmers were required to deliver crop quotas. Compulsory procurement was used as the primary means the state used to control land use. Rice procurement quotas ranged from 20-30 percent of output. Typically, quotas for a particular location would be determined in July each year and the procurement price would be announced at harvest time, usually in December. Although it took place furtively, private trade was generally not allowed. The implicit tax levied on the compulsory procurement policy is not clear.

Land and Labor Markets. While land use decisions and input supply allocations were centrally determined, agricultural production continued to be farm-household-based. Land theoretically belonged to the state. Individuals had the right to long-term leases and this right was inheritable. Land allocations were made by a committee of cultivators who systematically prevented landless households from acquiring land. Land rental was prohibited. Operating units, therefore, coincided with ownership units and tended to be large. Approximately 40 percent of all agricultural households were landless and depended on agricultural labor for

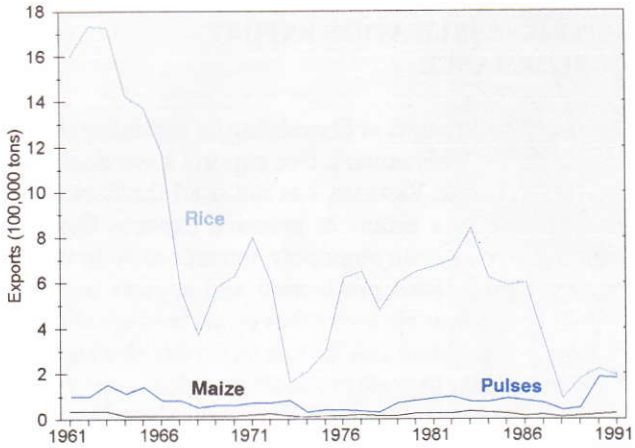


Figure 1 Trends in Exports of Rice and Non-rice Crops, Myanmar 1961-1991

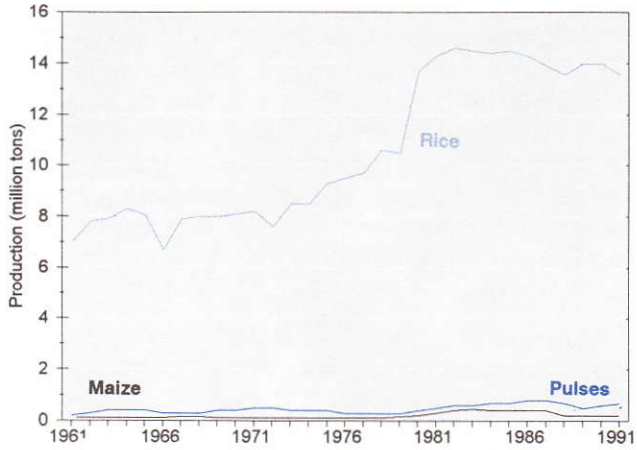


Figure 2 Trends in Rice and Non-rice Crops Production, Myanmar 1961-1991

their survival. A variety of labor contracts existed, before and after 1998. These ranged from casual seasonal to permanent labor contracts. Payments, depending on the contract, could be in a fixed amount of cash or output per day, or share of output for long-term contracts. It is also possible that land rental markets masqueraded as seasonal labor contracts, or even were acquired through marriage. One large land owner we met, for instance, had seven wives.

Trade. Prior to 1988, the government was the monopoly exporter of all agricultural products. Within the country, inter-regional – or inter-divisional – trade was also handled exclusively by the state. While private trade was allowed within a division, it was subjected to arbitrary restrictions, such as the rationing of milling capacity. Farmers were instructed to limit milling to only enough rice for home consumption. Sales to private traders had to come from this quota.

The state distributed rice obtained from its compulsory quotas to its military and civil personnel and for export. It also distributed rice through co-operatives for the general public, particularly in divisions that are chronically deficit. For rice obtained through cooperatives, households were subject to rationing.

POST-1988 POLICY REFORMS

Beginning in 1988, limited reforms were introduced to liberalize Myanmar's agricultural economy. These reforms were primarily in crop choice decisions, compulsory procurement, and internal trade. While these reforms improved producer incentives, productivity growth is still constrained because of restrictions imposed by macro-policies and centralized institutions.

Myanmar's total annual paddy production comes to 13-14 million tons. Of this 2-5 percent is exported.

Crop Choice. Large area programming of land use is now restricted only to rice. For areas programmed for rice, farmer choice is limited and land use is based on the criteria described above. Farmers are free to grow, or not grow, non-rice crops in the non-program areas. The biggest contention appears to be land use during the dry season. While the government is pushing for an expansion in the dry season rice program area, the farmers prefer to grow non-rice crops as these do not have a quota requirement.

Fertilizer and Other Inputs. For the program areas the government continues to provide subsidized fertilizers, agro-chemicals, and mechanical services. Since 1992, private import of machines has begun to emerge. The problem now is that the sharp fall in foreign aid to Myanmar has led to reduced supplies of fertilizers and other inputs. How the increasingly sparse allocations are rationed across program areas is still unclear. Despite the disappearance of subsidies for non-program crops, private fertilizer importers did not emerge until 1992. Observers noted, however, large scale diversion of fertilizer and other input supplies from rice to non-rice crops during the period before the removal of import restrictions in 1992.

Compulsory Procurement of Rice. After 1988, quota deliveries were no longer required for non-rice crops and, for the main season rice quota, deliveries declined to about 15 percent. Myanmar Agricultural Product Trading Company (MAPT) provides 30 kyats per basket of the procurement quota as advance payment in July. Another 20 kyats per basket is paid on delivery. The 50 kyats the farmers receive from the government compares poorly with the 150 kyats they receive from private traders. The calculated implicit tax on rice production works out to (% quota requirement

times % price shortfall) 10 percent of gross revenue. Quota requirements are apparently revised according to the previous years' yield figures. So in the long term, tax applies at the margin as well. The main contention now is summer rice, which the government is promoting as a new program crop. Although officials claim they do not wish to have quota requirements, farmers believe that quota requirements will still apply.

Internal Rice Trade. After 1988, inter-divisional trade was opened to the private sector. MAPT share in this sector is now conducted through a joint-venture company (50% MAPT share). Because the export trade is not yet open to them, private traders' main interest is in moving rice into Yangon and from lower to upper Myanmar. Consequently, traders look to Mandalay as the price-forming center. Supplying rice to government personnel still exists – one basket per employee each month at one-quarter the market price.

Rice distribution through co-operatives has been discontinued. As the compulsory procurement system does not specify quality requirements, the rice in the government system is consistently of poorer quality than private rice.

Myanmar's rice, like Thailand's, varies in quality and is graded accordingly. The current (June 1993) milled rice and paddy prices are 20 to 30 percent below corresponding prices in Thailand. We attribute this difference to the export ban. With the margin being higher for paddy prices, this indicates a higher internal marketing margin as well.

Exports and Foreign Exchange Transactions. Since the end of 1988, only rice exports are still monopolized by the government. The government has joint ventures for exporting other products, but these ventures are not state monopolies. Private traders must obtain licenses for each export shipment. Officially, these traders can freely use foreign exchange earnings. We understand, however, that the government requires exporters to use part of this foreign exchange to import, on their own account, items currently in short supply in domestic markets. This measure has lead to complaints that it tends to discourage exports.

The official exchange rate currently stands at 5.5 kyats per US$1, and the parallel market rate stands at 112 kyats. It is unclear just which transactions are made at the official exchange rate. In any case, all visitors have to show that they have changed at least two hundred dollars at the official rate.

POST-LIBERALIZATION EXPORT PERFORMANCE

Despite attempts at liberalizing its agricultural sector, since 1988 Myanmar's rice exports have declined. Myanmar, unlike Vietnam, has not used the liberalization process as a means of boosting exports. Exports continue to be a state monopoly, unresponsive to world market signals. Rice production and exports are discriminated against vis-a-vis other crops because of compulsory procurement and the ban on private rice exports. Farmers appear to prefer to grow non-rice crops where they have a choice, especially during the dry season.

Fertilizer supplies have dropped drastically due to the decline and then cessation of foreign aid. Only in 1992 did the government make a consistent attempt to partially improve supplies by allowing private imports. The productivity growth that has taken place has helped boost domestic rice supplies. This has occurred through privatization and improvement in the domestic market's infrastructure.

Potential for Future Exports. Myanmar's domestic price is one-third to one-quarter lower than the world rice price. Assuming a supply elasticity of 0.6 (from previous studies), the production impact of a complete liberalization of rice exports would be of the order of 2.25 million tons. We have not included the effect of the government's implicit tax on compulsory procurement because we have not been able to determine the implicit subsidization through the provision of various inputs. We expect it to be smaller than the effect of the export ban.

CONCLUSIONS

This article argues that the complete liberalization of Myanmar's rice sector would lead to a boost in the country's rice exports. Myanmar has spare rice land capacity, both in terms of absolute area and in intensification, that can be drawn into production once "the prices are right."

Although we are certain that Myanmar could export over 2 million tons of rice per year, it is difficult to predict when this extra supply would be available. Improving price incentives has to be complemented by increased infrastructural investments, especially for milling and small scale irrigation. The question we have not addressed is: Can the depressed world rice market handle Myanmar's additional supplies?

Environment and Development: The Thai Experience

Mingsarn Santikarn Kaosa-ard *

It is widely debated whether environmental quality improves as an economy develops. Those holding that it does base their arguments on the observation that economic development in its early stages tends to rely on the exploitation of natural resources. As an economy is restructured towards high-tech industrialization, however, the resultant broader technological and socio-economic options promote sustainable development (Macris, 1993).

The relationship between economic development and a cleaner environment is optimistically presented in a study by Grossman and Krueger (1992). The study concludes that air-borne particulate and sulfur dioxide pollution increase with Gross Domestic Product (GDP) up to about US$5,000 per capita a year. Beyond that point pollution allegedly begins to decline. Those who believe, on the contrary, that uncontrolled development harms the environment cite the Stockholm Environment Institute studies which indicate that emissions of carbon monoxide tend to increase, not decline, with per capita rises in GDP.

This major tributary of the Chao Phraya River is highly polluted. It is used to transport logs to sawmills and markets.

THAILAND'S GROWTH AND DEVELOPMENT

From 1987, Thailand attained double-digit real growth rates for three consecutive years and has now emerged as one of the world's fastest growing economies. Although growth is estimated to slow throughout the 1990s, and it has indeed since 1990, the economy is still expected to expand at a rate of 7-8 percent a year. The agricultural sector, which was Thailand's engine of growth in the 1970s, was replaced by manufacturing in the 1980s. In 1991, the manufacturing sector accounted for more than three-quarters of Thailand's export earnings.

Thailand has been relatively successful in curbing its annual population growth rate, which dropped from 3 percent before 1980 to 1.4 percent by the end of 1991. As a result, per capita GDP growth remains relatively high at US$1,812 in 1992 (preliminary estimate).

During the high growth period, the economy suffered various setbacks, including during the Gulf War.

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The most severe test for the nation's social fabric was the bloody military crackdown in May 1991. Political stability was, however, rapidly restored and an elected government is now ruling the country.

The political disturbances have not distracted the Thai people's attention from environmental issues. On the contrary, public awareness of environmental issues is high. Environmental problems are not only physical and economic, but are also social issues. While the rich can, to a certain extent, use their wealth to escape from the decline in the quality of the environment, i.e. by staying in air-conditioned surroundings or by escaping at least temporarily to cleaner locales, the poor generally have no choice but to live with environmental degradation. As will be discussed later, the quality of life and the health of the poor and the uneducated is often severely affected by industrial and urban pollution.

MANIFESTATIONS OF ENVIRONMENTAL DEGRADATION

Deforestation and Land Degradation

Once a land-abundant country, Thailand since the early 1980s has begun to feel the pinch of land scarcity. The land/man ratio stopped increasing in the late 1970s. As the late 1980s ushered Thailand into a period of rapid economic growth, brightening the country's prospects for becoming another NIC (newly-industrialized country), land prices, both rural and urban, began skyrocketing.

Land and forest are inter-related resources. Expanding land uses, particularly for agriculture, almost invariably mean a depleting forest cover. The last three decades have seen Thailand's once thick forest cover rapidly depleted by about half. Thailand's average annual rate of forest loss, at 3.85 percent a year from 1976 to 1982, is one of the highest among all tropical countries worldwide.

Logging and improving roads in rural areas made opening up more and more land for agriculture, particularly for field crops, easier and more profitable. From 1960 to 1990, Thailand's agricultural population increased by 14 million, while 90 million rai (14.4 million hectares), or about half the country's total forests, was cleared at the calamitous rate of some 3 million rai (480,000 hectares) per year, or 6.4 rai – slightly more than one hectare for each person added to the agricultural population. New farm lands opened in the country's highlands have caused soil erosion, sedimentation, fertility loss, water logging and many other serious problems.

Thailand's forest cover, which was 50 percent of the country's total land area in the 1960s, is now reduced to 26 percent. Failures to account for resource depletion adjustments suggest that the real GDP was overstated by one to two percent, depending on the adjustment methods used (Sadoff, 1992).

Another study suggests that forest loss is a major cause of CO_2 emissions into the atmosphere (TDRI/TEI, 1993). Between the 1970s and the 1980s, fully two-thirds of Thailand's CO_2 emissions resulted from deforestation. In 1989, the same study estimates Thailand's per capita emission of greenhouse gases at 0.27 tons.

More importantly, Thailand has around one million families living in natural forest reserves. Forest degradation is thus not only an environmental issue but also an increasingly serious social and political problem. Conflicts between the government, which claims jurisdiction over government forest land, and the poor, who occupy that land and earn their livelihood from it, have become increasingly hostile. Yet it is not only landless farmers but also major land speculators who continue to encroach on forest land. Although the current government has continued the ban on logging and yielded to the demand of the landless for the right to use degraded forest land, what is lacking is the foresight and management needed for a solution that prevents further forest encroachment while ensuring sustainable social and ecological balance.

Water Resources and Pollution

The average annual rainfall for the last decade in Thailand's northern region, which is the source of water for two of the country's largest dams, is significantly below the average for the last four decades (TDRI/TEI, 1993). This year, in fact, water levels in the country's largest dams have reached an all-time low.

Conflicts between upper and lower watershed dwellers have also become more frequent. The lowland farmers of Chom Thong district in Chiang Mai province, for instance, have asked the government to move hilltribe people from the headwaters to the lowlands. Forced relocation of hilltribes, however, not only uproots traditional communities, but leads to political instability as well.

The growth of the industrial and service sectors has increased demand for water. Yet these very sectors release polluting wastes into waterways shared by various communities. The pollution of the Nam Pong River in Khon Kaen province in northeastern Thailand is a recent example. Two other examples from this same river were the leakage of a molasses tank from a sugar factory in 1992, and the alleged discharge of untreated waste by a pulp and paper factory in May 1993 into a natural reservoir. The public outcry, especially from the affected communities, led to the factory's closure for 36 days. Such issues are still far from solved.

The increasing number of golf courses sprouting up throughout the country has created widespread water use conflicts. It is estimated that Thailand now has several dozen golf courses, with a further 35 under construction (Matichon, 1993). On average, each golf course occupies about 533 acres and consumes some 6,500 cubic meters of water per day, or 2.37 million cubic meters per year. A paddy field the size of a standard golf course requires only 2.4 million cubic meters of water for an entire crop season. Golf courses are obviously highly water-intensive. When all Thai golf courses are completed, they will consume 476.9 million cubic meters of water per year. This is equivalent to half of the surface water used by the country's urban communities in 1991. And, because of their excessive use of fertilizers, golf courses are also alleged to pollute waterways.

Water quality is further threatened by population congestion in urban areas, especially greater Bangkok. As continuing migration from rural areas to urban centers triggers yet more rapid urban growth, public utilities have inevitably lagged behind the spiraling growth of urban population. Domestic sewage is now commonly discharged into waterways at such a high rate that the water in the Chao Phraya River, the nation's lifeline, has become unfit for domestic use. Since 1981, some species of fish have also disappeared. More will no doubt follow.

Air Pollution

About 28 percent of the Thai population lives in cities. According to the official register, the country's principal city, Bangkok, houses at least 8.9 million people. In fact, each day more than 10 million people, or almost 20 per cent of Thailand's population, work in the city. Bangkok alone accounts for 51 percent of the country's energy consumption for land transport. As roads are Bangkok's main means of transport, ever more heavy traffic is now in itself a major source of air pollution. The city now suffers dangerously high levels of lead, carbon monoxide, sulfur dioxide and other pollutants in the air its frustrated inhabitants breath.

Among the various atmospheric pollutants, lead is believed to be the most socially harmful. A USAID-sponsored study speculates that children exposed to lead in Bangkok for the first seven years of their lives may lose four or more points in their intelligence quotient.

The electricity sector is yet another major contributor to air pollution, as a substantial part of Thailand's electricity is generated using lignite, or "dirty" coal. During October 1992, airborne pollutants, mainly sulfur dioxide emitted from electricity generating plants in Mae Moh, Lampang, damaged the health of more than 1,000 people and caused crop failures and the death of untold domestic animals. To overcome this problem, fuel-gas desulfurizers, or "scrubbers," should be installed as soon as possible. This means substantial investment in capital costs. It would also increase electricity charges by 25 percent (*TDRI White Paper* No. 1, August 1992). As electricity is income-elastic, i.e. demand rises faster than income, domestic need is projected to grow at about 10 percent annually until the end of the Seventh Plan in 1996. In 1991, the energy sector contributed an estimated 36 percent of total national CO_2 emissions (TDRI/TEI 1993).

For the long term, reducing pollution caused by electricity generation requires an investigation into cleaner energy production alternatives and measures to make electricity use more efficient. And energy should be priced to include the costs of preventing environmental degradation.

A totally-devastated area in Thailand's northeast. Once heavily forested, it is now a wasteland.

Industrial Hazardous Waste

As Thailand is restructured further towards more manufacturing activities, the number of industries which produce hazardous waste continue to increase. From 1979 to 1989, for instance, these industries zoomed up from 29 to 58 percent of all factories in the industrial sector. Frequent industrial accidents invariably accompany the runaway type of industrialization which Thailand is currently pursuing. Chemical fires, lethal gas and dynamite explosions, gas leaks and other mishaps, as tragic as they are avoidable, are more and more frequently reported in the daily newspapers. All this suggests an "unfriendly" and out of control industrial environmental future. Small factories using chemicals, and sometimes even mixing chemicals whose properties are not clearly understood, are springing up everywhere. Their waste chemicals are then irresponsibly dumped into public waterways, all finally ending up in the Gulf of Thailand, the nation's most vital source of marine resources.

Yet the state's role here is quite clear. It must turn these present hazardous uncertainties into manageable risks. Monitoring agencies urgently need to have information systems as to who is using what, where, when, and how much. Obviously environment and development issues are becoming increasingly interwoven, even inseparable. To solve environmental problems thus requires inter-disciplinary knowledge and an understanding of the physical and social sciences, as well as of Thai culture and traditions.

CAUSES OF ENVIRONMENTAL DEGRADATION

Population growth and poverty are often cited as the root causes of environmental degradation. This observation is not wholly accurate. Case studies reveal that both the rich and the poor have helped devastate national forest resources. The root cause is the failure to ensure efficient and equitable allocation of these resources and to protect them for the nation's future. These can be termed market and/or policy failures.

Market Failures

Generally speaking, the market provides an efficient means of allocating resources and pricing products. Prices in a competitive market normally reflect the true costs of products. Market mechanisms ensure that products in high demand are highly priced. But many resources, such as forest products and water, are not priced at a level which reflects their true cost. For these products, the market fails to become an efficient means for allocation. The property rights for forest, water and fisheries resources are ill-defined and difficult to enforce, leading to their over-extraction. Deforestation and the conflicts between highland and lowland farmers over water typify environmental degradation arising from common access and unclear ownership. In the absence of appropriate allocation, farmers and golf course owners – neither of whom pay for it – will continue to waste water.

Air pollution from traffic congestion, dumping of residential waste into public waterways and industrial pollution, are all examples of market failure. The abuses of polluters also adversely affect other individuals innocent of these environmental crimes. This phenomenon is known as an "externality problem." Moreover, when the number of polluters is high, it becomes increasingly difficult to identify individual culprits and to determine the damage caused by each.

Thus, when the market fails to function efficiently and if the problem is to be overcome, the government must step in. The government can, for instance, allocate the use of forest timber through concessions and provide property rights to farmers for land. The lack of clear property rights discourages long-term investment in land and encourages further encroachment on the forests. Governments can also set up sewage systems and treatment plants, and then force recalcitrant polluters to pay for the use of these facilities.

Government Failures

Ill-conceived government measures can themselves cause environmental degradation. Government failures are of four types (Panayotou, 1993). First, government intervention unintentionally disrupts a well-functioning market. In the district of Tron in Uttaradit province, a local community invested in pumping river water for irrigation. The costs were shared according to the volume required for each crop. The government later imitated this system in other villages, but provided free water for all, thus destroying the previously efficient market system.

Second, governments fail to charge the full costs of environmental damage. An example is issuing forest concessions at unrealistic prices that fail to reflect forest replacement and externality costs. Electricity charges that exclude the cost of preventing environmental degradation or adverse public health effects are obvious illustrations of this second type of policy failure.

Third, government intervention aims to improve the market, but sometimes worsens it. Poor, early development of permanent agricultural sites is a good illustration. Traditionally, Thailand's hilltribes practice shifting cultivation: they clear and burn forests every year to open new land for cultivation. Once farmed out, the farmers allow the land to reforest itself, both to regain fertility and to minimize erosion, thus guaranteeing long-term productivity. As land has become more scarce, development agencies have introduced the highlanders to cash crops and permanent agriculture, disrupting the

traditional time-tested system. If permanent agriculture is not introduced with sound conservation practices, expansion of cash crop farming produces only temporary, non-sustainable development. Yield decline and runaway deforestation becomes both more widespread and more disastrous. Yet governments continue to pour scarce cash into just such "development" schemes.

Finally, governments ignore glaringly obvious market failures. This is clearly the case with water. The government allows all parties to take all the water they want free of charge until there is no water left and taps run dry.

It is true, of course, that environmental management is a delicate art. In some cases, the state should promote the market. In others, it should itself set the rules of the game and, while doing so, be careful neither to over- nor under-regulate the system, no easy accomplishment in any country.

THE NEED FOR INTEGRATED MANAGEMENT

Realizing the prohibitive costs of environmental degradation, government agencies are now trying, with mixed results, to protect the national environment. The logging ban, watershed protection, energy demand management scheme, subsidies for unleaded gasoline, and increased investment in waste treatment are all examples of government responses to environmental degradation. The Seventh National Economic and Social Development Plan (1992-1996), in particular, has endorsed the "Polluter Pays Principle." A most important breakthrough was the enactment of the highly-innovative Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992). First, the Act attempts to manage environmental problems in an *integrated* way through an inter-disciplinary ministerial committee with both short- and long-term plans. Second, it delegates environmental management to the provincial authorities. Third, it recognizes and encourages the participation of non-governmental organizations (NGOs) and the people themselves in environmental protection. Fourth, the Environmental Fund has been set up to promote investment in pollution control and to translate the Polluter Pays Principle into actual practice.

Priorities for the near future should be as follow:

- Fair and equitable resolution of conflicts over natural resources among different social groups (i.e. hilltribes, farmers, industrialists, various government agencies, rural and urban consumers, etc.). Provenly valid economic instruments should be employed for allocating resources. Governments tend to ignore a problem until it becomes so socially and politically costly they have no choice but to intervene.
- The use of "stick-and-carrot" measures to encourage "good" industrial behavior in facing pollution and hazardous waste.
- Prevention rather than treatment measures must be designed.

Despite the extensive legal and administrative overhaul for environmental protection, current attempts are still limited to end-of-pipe treatment rather than prevention. The indispensable next step must be to institutionalize preventive measures. As the experience of the industrialized economies shows, treatment costs invariably far exceed prevention costs.

A number of barriers must be honestly faced:

- shortsightedness and the unwillingness to hold discussions between the government and the various interest groups, as well as among the interest groups themselves
- lack of awareness and incomplete information regarding current industrial practices and potential environmental hazards and disasters
- ineffectiveness and indecisiveness of the government administration.

By correcting such inadequacies, Thailand can save its own environment and also contribute to moving the world towards a brighter, healthier and more sustainable future.

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What's in it for Us? The Benefits of Software Protection in Thailand

Ashokvardan Rao*

Thai-U.S. tensions concerning international property rights (IPRs)[1] have escalated in the 1990s, the result of a declining U.S. trade balance, and the growing importance of the information sector to the U.S. economy.

An initial investigation under the U.S.'s Section 301 law was launched in 1989, and resulted in Thailand being placed on the Priority Foreign Country (PFC) list in 1991, which meant that it could face immediate trade sanctions.

In 1992, a decision was made to keep Thailand on the PFC list for a further year. A similar decision was made by the present U.S. Trade Representative, Mickey Kantor, on April 24, 1993.

The sustained pressure to reform IPRs led Thai legislators to draft an amended copyright act that explicitly included computer programs in its definition of "literary works" protected by copyright law.

The draft act was approved by the Cabinet on July 20, 1993, but has yet to pass through Parliament and the Senate. Several potential loopholes in the draft worry software owners and distributors. These include exceptions to copyright infringement for personal use, use by or for the government, and "reverse engineering" or decompilation of computer programs.

On July 28, Kantor informed Thailand that it would remain on the PFC list for at least another 30 days, despite progress on the IPR front. The U.S. wanted a written agreement on several further steps by the Thai government before Thailand could be removed from the PFC list.

For software, this meant inclusions into the draft copyright amendment that would restrict the practice of decompilation of computer programs. Thailand has accepted the request for a written agreement, including the provision for restricting decompilation.

Throughout much of the year, media coverage of Thai-U.S. dialogue has centered on the on-going dispute between the two countries over protection of IPRs. None of the discussion, however, has comprehensively addressed the issue of what advantages, besides the absence of trade retaliation, will befall Thailand with enhanced IPR protection. This article considers one area of contention, i.e., copyright protection for computer software, and seeks to determine the benefits of increased protection for Thai industry.

Why protect intellectual property in a developing country? Those in favour of protection argue that it provides necessary incentives for domestic research and development (R&D), leads to the disclosure of new knowledge, allows for global technological dynamism, leads to increased technology transfers, and brings in more direct foreign investment.

Other benefits include additional human capital formation through better training practices and an environment conducive to R&D, pro-competitive effects such as "patenting around" existing technology, and consumer benefits through greater variety and quality of products.[2]

Let us consider these benefits in detail, and attempt to discern whether they would be realized with the enhanced protection of computer software in Thailand.

DOMESTIC RESEARCH AND DEVELOPMENT

The general question addressed in economic literature is whether or not protection of intellectual property

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stimulates inventive activity and, if so, to what degree. This article asks a much narrower question, i.e., will the protection of computer software by copyright law be an incentive to domestic R&D and, if so, to what degree. To answer this question, one must first think about the kind of software for which copyright protection is relevant.

A distinction should be drawn between the package software market and the customized software market. The customized software market involves software "solutions" developed for a particular public or private sector entity, typically for mid-range or mainframe computers. A solution may consist of software developed in-house, i.e., by the entity itself, software developed by an outside consultant, or imported components of the overall system (for example, database management systems). There are several reasons why piracy is not a significant problem in this market. First, complete software solutions are not mass-produced, packaged and distributed. Hence they are not easy to access and copy. Second, even if copied, the software often cannot be used without training. Third, periodic after-sales support and maintenance is needed to keep the systems running and up-to-date. Software obtained illegally would be more difficult to maintain. Fourth, software for this market is specialized and is a disincentive to piracy because it is not easy to sell. Finally, and most importantly, customized software is adequately protected by contract law.

The designers of software systems for clients, such as banks, retail stores, and government agencies, agree to specific terms regarding the use, sub-licensing (by the client) or marketing (by the designer) of the software. Unauthorized copying for any of the above reasons by the client, designer or third parties implies a violation of contractual law.

The conclusion, then, is that copyright protection is significant for "package" software, especially PC-based software. Operating systems, word-processing programs, and spreadsheet programs for PCs are incorporated in a few disks and are therefore accessible, easy to copy and, requiring little training, are easily sold. Clearly, lack of protection and enforcement thereof is a disincentive to innovate in this area. If there is no legal protection for the programs one writes, or if this protection is not backed up by effective enforcement, developing PC-based software will lead to giving away free software. This is precisely what occurred with early Thai-developed programs such as Rajavithi Word – a DOS-based, Thai word-processing program. Originally intended to be marketed commercially, lack of IPR protection and widespread piracy led to Rajavithi Word becoming virtually public domain software.

At present, locally-developed packages are mainly accounting and financial software packages produced by small, local firms. To prevent piracy, they must devise expensive hard locks and/or time-consuming "soft locks" (instructions within the larger program that are designed to detect and prevent unauthorized copying). Enforced legal protection of software, they assert, would allow them to lower prices on their products and use their time more productively. It would also give them the confidence to undertake more difficult, but also potentially more lucrative, projects. This suggests that weak IPR protection hinders the growth of locally-developed package software.

It is true that in the PC/package software market Thai firms produce barely a dozen, low-end products, while foreign packages localized and distributed in Thailand number in the hundreds and are much more sophisticated. Yet to conclude from this observation that the beneficial effects of increased IPR protection on domestic R&D are not significant misses the point. Greater protection could lead to more local products. As an industry develops technologically, IPRs can only increase in importance.

DISCLOSURE OF NEW KNOWLEDGE

This argument refers mainly to patents, which require full disclosure of the nature and design of a purported invention. Nevertheless, it is important to demonstrate that enhanced copyright protection of computer software leads to very few benefits, if any, in the form of disclosure of new knowledge. As the regime for protection of software is copyright, there is no mandatory disclosure of source programs,[3] which are the "blueprints" of computer programs. Furthermore, decompilation of programs to reveal their source codes is a practice dominant software producers consider to be infringement of copyright, and they campaign vigorously to have this declared illegal. As noted, the proposed written agreement between the U.S. and Thailand includes a provision to restrict the practice of decompilation. (Disclosure of knowledge in the form of technology transfers is dealt with in a separate section below.)

GLOBAL TECHNOLOGICAL DYNAMISM

Here the theory is that "the reform of intellectual property rights in developing countries could have an impact on global technology trends."[4] Two main lines of argument are used to support this theory. The first is that domestic R&D fostered by IPR reform would lead to innovations that would otherwise be unavailable. When made with respect to the software industry, this is an extremely weak argument. Although it is acknowledged that weak IPRs do adversely affect the growth of a local package software industry, this does not imply that innovations in the package software market that can be

used locally will be unavailable or slow to enter the market. This is because foreign-made software is, and continually will be, adapted or localized for Thailand. Package software derives its name precisely from the fact that it can be easily learned, used, and also modified for local conditions (primarily language modifications).

The second line of argument claims that industrialized countries' R&D in areas of special interest to less-developed regions may be curtailed by weak IPRs. A classic example is developed countries' research into tropical diseases. With software, however, it is apparent once again that the special needs of a developing country, or any country for that matter, involve the customized software industry. Contractual law, and not copyright or any other IPR regime, is an appropriate and adequate mechanism of protection for this kind of software. In the package software sector, special needs would refer mainly to incorporating Thai-language capabilities into all kinds of packages. Industrialized countries' R&D in this area is limited, regardless of the degree of IPR protection.

TECHNOLOGY TRANSFER

This argument maintains that without adequate protection of IPRs in developing countries, technology owners in developed countries have fewer incentives to transfer their proprietary knowledge to developing countries. Again, the argument seems to have been formed with patentable technology in mind. For example, it makes sense to argue that with patent protection for pharmaceuticals and the processes used to produce them, patent owners will be more willing to enter into production and technology-licensing agreements with a host country.[5] Economic benefits accrue to the host in the forms of increased efficiency in the manufacturing process (through use of the new technology) and possible savings from not having to import the product (or substitutes if the owner previously refused to export its product without patent protection). Copyright protection of software is biased against the transfer of proprietary knowledge – for example, it precludes decompilation of source codes.

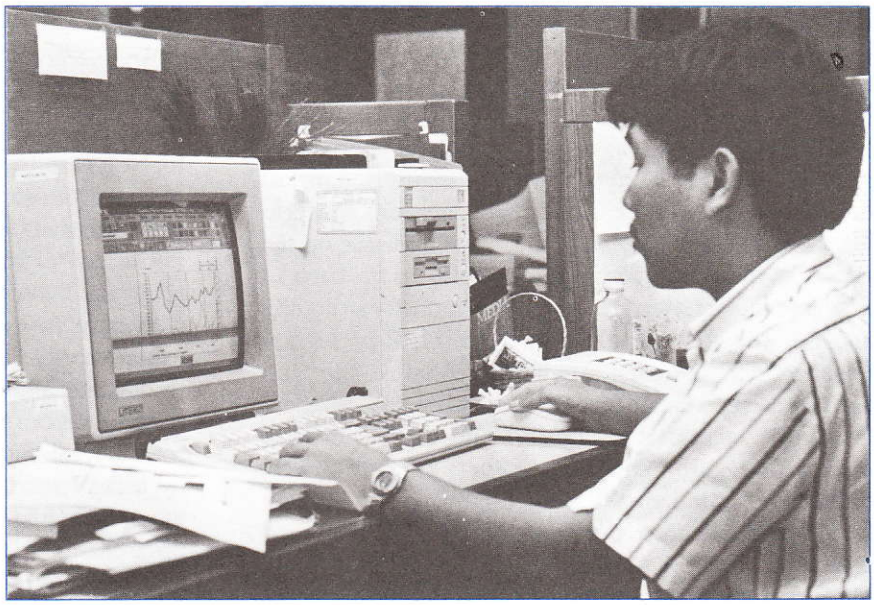
For the software industry, it is argued that technology transfers (through training and technical support) that accompany subcontracting arrangements require strong IPRs in developing countries. This is why countries like India will be favored over Thailand for subcontracting. Subcontracting of software projects, however, depends more on the availability of labor with the requisite educational (including English-language skills, which are essential for developing PC-based software for the global market) and technical skills. These factors, rather than IPRs, have a greater influence on the location of subcontracting projects. Legally enacted (and enforced) protection of software will not result in a flood of new subcontracting deals for Thailand if the quantity and skill levels of Thai software professionals remain unchanged. Of course, all other things being equal, a strong IPR protection system in place would make a developing country more attractive than one without.

An objection to this argument might be that it fails to consider the effects of enacted and enforced protection of software on indigenous capacities. The premise is that there is a causal relationship between increased software protection and the growth (in quantity and quality) of labor for the software industry. Protection of software would allow local and foreign firms to undertake new projects and offer better compensation careers to programmers and analysts. This would encourage more students to enter the field, and would attract better talent.

This objection is valid only up to a point. There is an infrastructure constraint posed by the limited capacity and facilities of secondary and university educational institutions in Thailand. Protection of software cannot influence the development of indigenous capacities in a major way because of these limitations. Software protection must therefore be accompanied by measures to increase indigenous capacity if technology transfer gains are to be realized.

It should be noted that subcontracting of software projects does take place in Thailand. In the customized software industry, this may be for international or regional projects. Lack of copyright protection for software does not seem to be a constraint, probably because contractual arrangements between employees and firms are adequate. In the package software industry, arrangements are mainly to localize software packages for use in Thailand. As many PC package software producing companies refuse to market their products in Thailand, one valid argument is that with effective protection, these companies would have incentives to enter the Thai market, which would imply having to hire local software professionals for the localization/adapation of their products. This in turn would expose Thai software professionals to a broader range of PC-based products, and would help to increase their knowledge and skill in PC-software development, which is becoming more important relative to proprietary mainframe software.

Other benefits that usually accompany technology transfers include access to new research methods and software development tools. In the software industry, these benefits are available regardless of the degree of protection for software, and even without subcontracting arrangements. In both the custom and package markets, the latest research methods are disseminated through academic and industry literature, as well as transcontinental electronic linkages. In the custom



Package software derives its name precisely from the fact that it can be easily learned, used, and also modified for local conditions.

market, software developers must perforce train their recruits using the latest software engineering methods and tools to compete with other developers. Software development tools for the PC market are relatively easily obtained from the major software producers because of their desire to establish standards. Microsoft would be eager to sell anyone their application software development kits to create MS-DOS/Windows-compatible software.

CAPITAL FORMATION

This is one of the weakest arguments in favor of IPR protection. Empirical studies focusing on direct foreign investment (DFI) and its relation to IPR systems have produced weak associations at best, highlighting instead how broader economic and business conditions influence investment decisions.[6] Thailand is a particularly good illustration of this fact.

A refinement of this thesis states that, although IPR systems may not affect levels of foreign investment, they do affect the composition thereof. Foreign firms will not choose to locate the more technology-intensive production stages in countries with weak IPRs for fear of losing proprietary knowledge. This is essentially a "technology transfer benefits" argument, and has been addressed in the section above.

OTHER BENEFITS

Increased protection of software will contribute to creating an environment conducive to R&D, which will provide incentives to additional human capital formation. As noted, though, enhanced protection in itself is neither a sufficient nor necessary condition for the formation of human capital. Public and private sector investments are the driving forces in this area. Strong IPR regimes assume critical importance only at a relatively advanced stage of development, which Thailand has arguably not yet attained. Protection also provides consumers with a greater variety of better quality products.

In summary, although many of the theoretical benefits of stronger IPR protection are not relevant to Thailand's software industry, there are nevertheless some distinct advantages that could be gained through effective protection. These include:

- R&D and investment incentives for local PC/package software developers
- technology transfers (through training and technical support involved in localization of software) accompanying the entry of PC/package software producers (specifically, those who currently do not market their products in Thailand because of piracy)
- technology transfers and industry growth through increased international subcontracting for PC-software (subject to human capital development)
- industry growth through the attraction of more and better qualified labor
- consumer benefits in the form of greater variety and better quality of products

Critics of software protection might object that most of these benefits, purported to flow into developing countries from countries with stronger IPR protection, have not been empirically verified. This is true. Of the relatively few studies that have been conducted, most involve industrialized countries. Those conducted with

reference to developing countries have reached ambiguous conclusions on issues such as the positive effects on domestic R&D and technology transfers.[7] There are, however, two responses to this objection. First, given that IPR issues in developing countries have only recently come to the forefront of national attention, empirical evidence is bound to be lacking. Yet decisions concerning these issues are being made. Thus opinions on the effects of these decisions must be made on the basis of available information and analysis of industry structure. Second, while the benefits of increased IPR protection of software in particular are difficult to assess, the costs are no easier to establish. Administration and enforcement costs, increased royalty payments, displacement of pirates and anti-competitive effects (higher prices, reduced knowledge diffusion, dominance of foreign firms) have all been put forth as costs of increased protection, but it is unclear, at least for the first three, whether these costs are major constraints. Arguments pertaining to the anti-competitive effects of software protection merit further comment.

Higher prices refer to two effects. First, prices of legal software will always be higher than those of pirated software (which is free, or almost free). Thus, effective protection of software will reduce knowledge diffusion as less software will be sold. Second, to the extent that local firms are very small players in the package software market, increased protection (which is relevant only in this market) will benefit mainly foreign software. The market power of foreign firms will increase, allowing them to raise prices and reduce output. This will again reduce knowledge diffusion. Alternatively, foreign firms may sacrifice profit-maximizing goals to gain market share, keeping prices low. This, however, could result in significant barriers to entry by local firms in the package software market, hampering the growth of a domestic software industry.

The first argument makes sense, but the magnitude of reduced knowledge diffusion is unclear. Approximately 70-75 percent of all PCs in Thailand are used by organizations in the public, private and non-profit sectors. The remainder consists of PCs owned by private users.[8] Among the organizations, package software purchased will be that required by the organization (the vast majority of which consists of word-processing, spreadsheet, database, and accounting/financial packages). Legalizing software will impose a cost on these firms and reduce their profit margins, but it is something most must do. Large organizations (for example, banks, financial firms, large retail chains) cannot, at this stage, opt not to use computers. Smaller firms, however, do experience a disincentive to computerize, and this reduces the rate of knowledge diffusion. For example, a small retail businesses using a local area network (LAN) of PCs could require operating systems software costing 150,000 baht, database software at 50-60,000 baht per workstation, and applications software costing 10,000 baht per station.[9] The total cost would be a substantial fraction of its turnover.

It is also argued that, for large firms, having to pay for software, while not permitting them to "de-computerize" creates incentives to reduce the amount of software used (i.e., by installing fewer PCs), thus reducing the rate of knowledge diffusion. Large organizations requiring PC-software, however, usually purchase network or multi-user versions of packages, which are more expensive than single-user versions, but which may be installed on and used by several PCs. Though converting to networks can also reduce the overall costs of legalizing software, this limits the organization's ability to cut costs by using fewer PCs. Thirty percent of individual PC users, including households, is clearly more sensitive to price changes. They are, however, also least constrained even by the very high degree of software protection, i.e., in the absence of door-to-door searches. They can obtain and use illegal software with impunity, unlike corporate or public sector users. In the recent Business Software Alliance's oft-quoted and hotly-disputed survey, the estimate of PC software piracy for the U.S. itself was 35 percent (99% for Thailand).[10] As commercial piracy in the U.S. is low, most of this can be attributed to individual PC users. Thus, for this group as well, the seriousness of reduced knowledge diffusion because of higher prices is questionable.

In summary, the costs of reduced knowledge diffusion will be borne mainly by smaller firms in the private sector.[11] How significant these costs can be depends on how sensitive smaller firms are to the costs of legalizing their software. If deemed significant, government policy can help to reduce the effects on smaller companies by eliminating tariffs on direct import of certain types and amounts of packaged software. Other instruments, such as tax incentives for equipment, may also be targeted for this sector.

Finally, there remains the issue of dominance of the local PC/package software market by foreign firms and their products. It is reasoned that stronger protection for software will enable foreign products to establish dominant positions in the domestic market and raise barriers to entry. There are several objections to this argument. First, the alternative of weak protection adversely affects the R&D and investment incentives of local PC-software developing firms and, as a few U.S. firms already control the market in Thailand and elsewhere, this alternative will merely maintain the status quo. Second, in the PC-software industry, financial, marketing and distribution muscle are the main barriers to entry. This is why a few firms are dominant now and will continue to be dominant for quite some time. Thai firms can get a foothold in the market by developing Thai applications which support standard platforms, for example, DOS, Windows, or OS/2. This goes beyond

localization of foreign products, and is aided by strong protection of software. Third, countries that have measures (high tariffs, similarity tests) to shield domestic software developers from foreign competition have arguably done more harm than good. Software, especially PC-software, continuously improves upon itself. Intense competition to establish standards creates this rapid pace of innovation, and any attempt to shield industry from the competitive arena will result in domestic products being quickly outdated, or being obsolete before they even reach the market.

CONCLUSIONS

This article argues that there are both costs and benefits of effective copyright protection for computer software and that, on balance, realizable gains outweigh potential costs, which can be mitigated by appropriate policy. There is an important point to be made, however, regarding the incidence of the two types of effects. The major cost is reduced knowledge diffusion experienced by smaller businesses. This effect will take place automatically if protection is effective and firms are compelled to legalize their software.

The benefits of protection, in contrast, are not automatic. Realizing long-term gains in increased domestic R&D and technology transfers in the software industry requires, in addition to strong IPR protection, implementation of measures that increase Thailand's capacity to innovate in this area. This implies a consistent and concerted effort to improve the educational and technological infrastructure, which will increase both the number and capabilities of professionals involved in software production. Software protection is a good idea, but protection alone is not enough.

ENDNOTES

1 In primarily three industries: pharmaceuticals, audio/video, and computer software.

2 Enumerated as in Wolfgang E. Siebeck, ed., "Strengthening Protection of Intellectual Property in Developing Countries: A Survey of the Literature," World Bank Discussion Paper No. 112, Washington DC (World Bank, 1990), Chapter 7.

3 A series of statements written in the English-like syntax of a high-level language. This program must subsequently be compiled into machine-readable (machine-language) form, which is incomprehensible to most programmers.

4 op. cit. 2, p. 81.

5 This despite the observation that intense licensing activity may take place in countries with weak IPR protection. G.S. Schumann, makes this point for South Korea in *Economic Development and Intellectual Property Protection in Southeast Asia: Korea, Taiwan, Singapore and Thailand, Intellectual Property Rights in Science, Technology, and Economic Performance.* See Rushing and Brown, 1990.

6 op. cit. 2, p. 83.

7 op. cit. 2, Chapter 7.

8 *Bangkok Post,* Post Database section. Approximate proportions for 1993.

9 *Bangkok Post,* July 21, 1993, section 2, p. 15.

10 *Bangkok Post,* June 4, 1993.

11 Note: Section 42 of the proposed Copyright Act permits government agencies, or those working for the government, to be excluded from infringement if the copying is neither done for profit nor causes unreasonable damage to the copyright owner.

The Environment and Economic Growth: Harmony or Conflict?

Eric Macris*

In recent years, international concern over the environment has grown to unprecedented levels, culminating in 1992 in Brazil with the United Nations Conference on Environment and Development. At this conference, more than 150 nations signed international agreements on the environment, ranging from the Biodiversity Treaty to the Framework Convention on Climate Change. Additionally, some nations have pledged that, by the year 2000, they will not exceed 1990 emission levels of the so-called "greenhouse gases," the atmospheric pollutants associated with global warming. Thailand has proven to be one of the most active developing countries in the international environmental arena, and is currently working to develop a national strategy to mitigate certain types of air pollution.

Beyond these specific agreements and pledges, the title of the United Nations conference suggests the focus of much ongoing debate: Are economic development and the environment fundamentally at odds, or can they co-exist more or less harmoniously? This debate continues in political, economic and scientific circles.

A prevailing belief is that technological and economic development will eventually bring a cleaner environment – that increasing industrial efficiency will lead to less pollution for a given level of economic output. By this reasoning, the challenge lies in assuring that the best and most appropriate technology is made widely available, so that all countries can follow a path of environmentally-sustainable growth.

The full picture is not nearly so clear. The growing body of scientific evidence may well lead to the opposite conclusion. Despite several clear areas of environmental success by industrialized nations, a broad range of environmental factors appear to be worsened by the industrialization process, despite the many technological advances of the past several decades.

And yet great international hope rests on the ability of industrial growth to raise the living standards of the world's vast numbers of impoverished people by creating the economic wealth necessary to provide such essentials as proper schools, homes, jobs and medical care.

Thailand now seeks to balance economic and social with environmental needs, and must make new compromises. The first step in reaching this balance is to acknowledge the conflict that exists, through a thorough look at available evidence. The second step is to develop an effective framework for reaching politically and financially feasible compromises.

This article presents a brief overview of relevant, newly-gathered scientific data confirming that a conflict does indeed exist between economic growth and certain environmental factors. The article then supports the use of economic valuation of environmental factors as a tool through which acceptable compromises can be achieved within an increasingly complex web of conflicting needs.

PREVAILING ASSUMPTIONS ABOUT THE ENVIRONMENT

Various articles and research papers have contributed to the belief that technological advances and economic development will lead to a clean environment. This line of reasoning is often cited by policy makers, and traces its foundations to various mainstream articles and academic research projects.

The controversial issue of economic growth's impact on pollution is addressed in a recent study by Gene Grossman and Alan Krueger, two policy specialists at Princeton University. While focusing on Mexico and the environmental effects of the North American Free Trade Agreement (NAFTA), the authors conclude that, beyond the initial stages of national economic development, various environmental problems tend to be diminished through further economic growth.[1] According to the Grossman/Krueger study, countries tend to experience higher levels of airborne particulate and sulfur dioxide pollution as Gross Domestic Product (GDP) increases, until economic output reaches approximately US$5,000 per capita GDP per year, at which point airborne concentrations of these pollutants tend to decrease with further economic growth.[2] Proponents of

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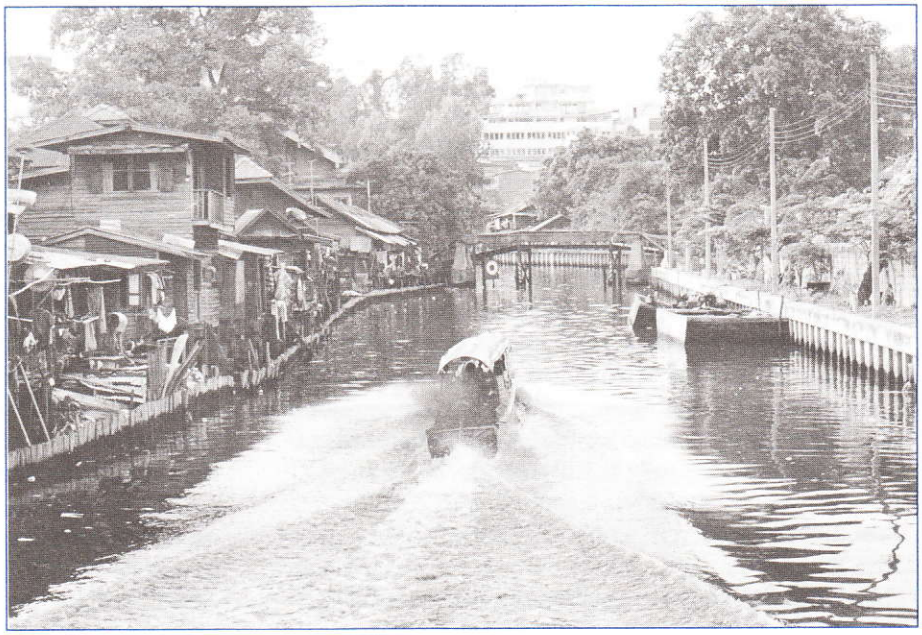


A long-tailed passenger boat speeds through one of Bangkok's highly-polluted canals.

both the NAFTA and the General Agreement on Trade and Tariffs (GATT) have cited the Grossman/Krueger study as evidence that free trade and growth hold potential benefits for the environment, beyond certain levels of development. Similarly, but from a different perspective, a 1992 article in *The Economist,* citing evidence from a recent World Bank report, summarized that "many of the policies that improve environmental quality will also strengthen development."[3] This article goes a step further than the Princeton paper by asserting that a division can be drawn between the local and global environments and that, in comparison to improvements in the local environment, "curbing global warming is a bad investment."[4]

While the limited scope of scientific data serving as the basis for these studies does not lend itself to the authors' broad conclusion that industrialization and economic development are generally "good" for the environment, the scientific analyses used appear thorough and balanced. The studies focus primarily on only a handful of pollutants and on the most pronounced urban environmental problems. While they may not reflect conditions for the world's vast rural populations, the studies are based on sound statistical data. Industrialized countries have indeed been able to solve or at least mitigate many environmental problems.

In the United States, for example, atmospheric lead concentrations, which are caused primarily by vehicle emissions, have fallen by over 90 percent in the past 20 years with the introduction of unleaded gasoline.[5] High atmospheric concentrations of lead, however, remain perhaps the greatest environmental danger to human health in many large cities in developing countries.[6] One study indicates that children who spend the first seven years of their lives in Bangkok may lose four or more IQ points due to elevated exposure to lead. This loss of intelligence, recent studies indicate, will persist throughout the lifetimes of the individuals affected and ultimately may inhibit productivity and lead to significant economic losses.[7] During adulthood, the consequences of elevated exposure to lead include increased risk of hypertension, heart failure and strokes. Clearly, developing countries stand to gain a great deal by emulating the successful lead emission reduction strategies of the West. In fact, unleaded gasoline has recently been introduced into Thailand.

Progress with atmospheric concentrations of particulate matter, a cause of respiratory disorders and cancer, has also been significant in many developed countries. This particulate matter is generally produced through the combustion of coal and wood products. Various technological advances have led to efficiency improvements in combustion processes and also to the development of emission control equipment, now widely used in the industrialized nations. Moreover, economic development tends to make available a wider variety of alternative fuels, such as oil and natural gas, that tend to produce less particulate matter when combusted.

The same trends help to explain why a reduction in sulfur dioxide (SO_2) emissions has occurred in developed countries over the past several decades. Sulfur dioxide, produced in abundance through the combustion of coal, causes various health problems and is also the primary cause of acid rain. SO_2 emissions through coal combustion can be mitigated substantially through the installation of pollution control equipment in factories and electrical power generators, and through the use of advanced methods of combustion that result in more efficient use of coal, and therefore less pollution. These advances and improvements, however, are quite expensive, and while many industrialized countries have invested heavily in these technologies, many less

developed nations still find such investments either politically or financially infeasible.

A MORE COMPLETE ENVIRONMENTAL PICTURE

Improvements in all of these areas of environmental pollution are clearly desirable and commendable, but a study of only the environmental problems for which technology has offered solutions does not convey the full range of environmental challenges facing the world's nations. Studies outlining the positive effects of development on the environment are useful and important, but do not in themselves tell the full story.

Data Limitations

Much of the theorizing about the positive effects of economic development on environmental problems is based on data collected for urban areas only. For example, the United Nations' Global Environmental Monitoring System (GEMS), perhaps the most thorough international environmental data collection project undertaken to date, consists of atmospheric monitoring stations located in scores of cities throughout the world, and is the primary source of data for the Grossman/Krueger study discussed above. With only a limited number of monitoring locations in each city, the system is not capable of providing information regarding the effects of expanding urban development, or sources of pollution across an entire metropolitan area. At least two examples can be cited. Electrical power stations may be built farther from urban centers, thus dissipating the pollution stemming from increased urban activity. Additionally, the construction of highways connecting urban core areas to suburbs allows for more cars traveling greater distances each day. The effects of these trends cannot be monitored by stations left to measure atmospheric pollution at a single, fixed location. While the GEMS project is certainly a positive and useful step in building understanding of the global environment, the use of GEMS data to make broad-sweeping generalizations about national or global environmental trends is risky.

These once ravished hillsides in Thailand's central highlands have been reclaimed for highly-productive agriculture through "contour terraces," which give better yield than normal highland farming methods while slowing erosion and protecting the environment.

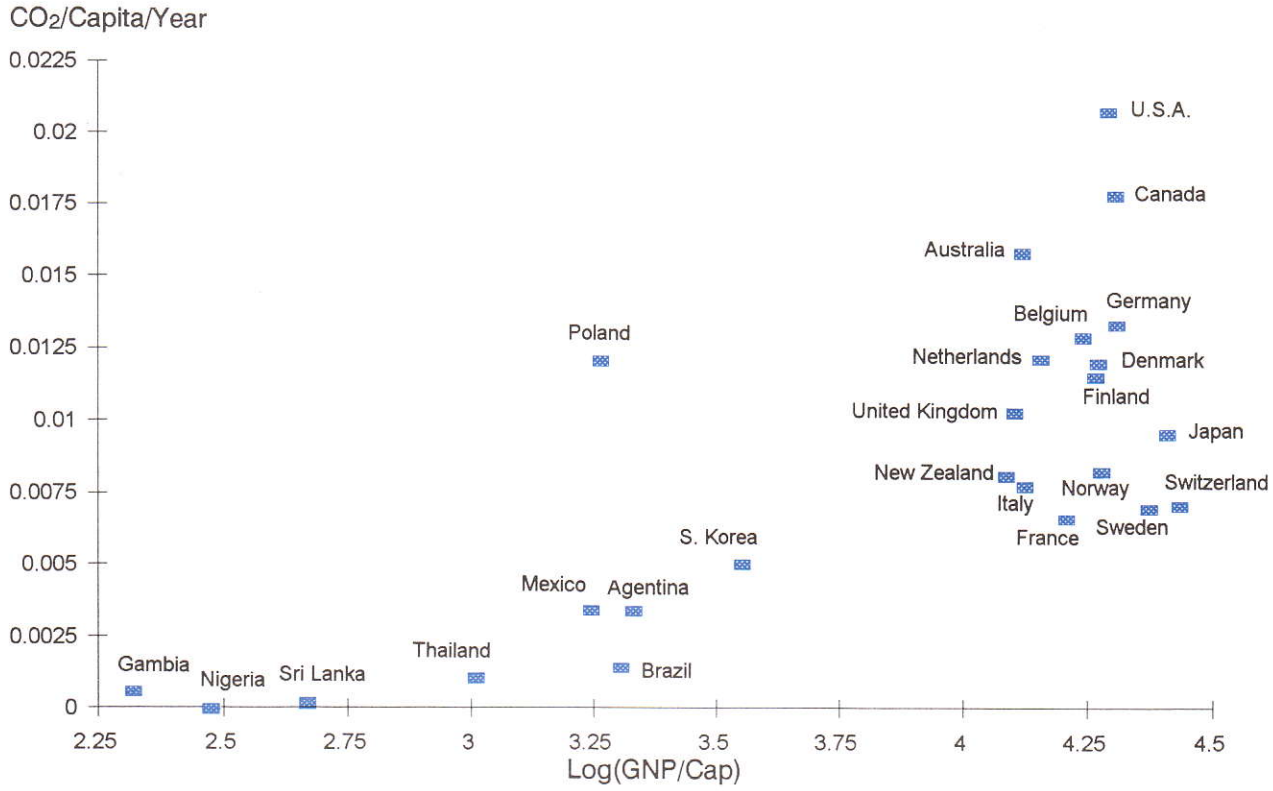
Some Disturbing Trends

As broader, nation-wide environmental information is gathered for various countries at varying levels of economic and industrial development, it appears that the process of industrialization leads to escalating output of certain substances, such as carbon dioxide, carbon monoxide and solid waste, which can have direct or indirect adverse effects on human health. Based on recently collected data, industrialized nations as well as developing countries have had a great deal of difficulty in preventing substantial increases in output of these and other pollutants as economic and population growth continues.

Global Concerns

Many environmentalists are most concerned about emissions of carbon dioxide, as this is the primary gas implicated in predictions of global warming. Global atmospheric concentrations of carbon dioxide have risen dramatically over the past 100 years, primarily through the combustion of fossil fuels and through deforestation. Climate change experts have reached a general consensus that this trend will cause the atmosphere to trap more of the heat energy radiated from the sun, thus leading to a warming of the global atmosphere – the so-called "greenhouse effect."

Figure 1 shows annual emissions of carbon dioxide versus Gross National Product (GNP) per capita for 26 nations over a wide range of economic output. Note the striking trend of rising carbon dioxide output as GNP per capita increases. The data used to generate the



Note: Poland does not appear to fit into the general trend suggested by the other countries shown in Figure 1. Poland's economy, considered by many experts to be unsustainable in its present form, has been weighted toward heavy industries relying on inefficient use of government-subsidized coal as the primary energy input. Thus, in relation to Poland's GNP per capita, the country produces far more than the expected level of carbon dioxide emissions. Under the current conversion to a market-based economy, however, inefficient industries will no longer be economically viable, especially since the price of energy is likely to rise to international market values. Poland's dirtiest industries will undoubtedly undergo significant modernization and energy efficiency improvements, or be shut down. Eventually, the relationship between Poland's carbon dioxide production and its economic output seems destined to fall in line with that of other countries.

Figure 1 CO_2 Emissions vs. Per Capita Income for Various Countries (based on World Bank Data)

graph are the most up-to-date and detailed available and, except in the case of three nations, were submitted to the United Nations by each nation as part of their obligation as signatories to the Framework Convention on Climate Change. Data for the three exceptions—Brazil, Mexico and South Korea—were calculated by the Stockholm Environment Institute, an independent research foundation. These "middle income" countries were added to fill a gap in the income range of the countries which have thus far submitted their own emissions inventories to the United Nations. This helps to substantiate the trend shown in Figure 1.

As the United Nations emissions inventory process proceeds, calculations will be refined and many more countries will submit national data. Given the strength of the trend demonstrated with currently available information, however, the use of improved data in the future is not likely to change the obvious conclusion: Wealthy nations produce far more than their share of the world's carbon dioxide emissions.

Local Environment

Some quite reasonable skeptics would argue that this trend just does not matter, as carbon dioxide itself is relatively harmless to human health under most circumstances. Carbon dioxide emissions, while contributing to the potential for global warming, do not pose a

substantial local environmental problem. Many policy makers, in an effort to refine decision-making and to hone policies, tend to distinguish between the global and local environment. Moreover, some investors and economists have embraced this distinction to discount concerns about global warming. These critics point out that considerable scientific uncertainty exists in predictions of global warming, and that the impacts of potential climate change are not likely to be felt for at least 50 years. By this time, so the argument goes, perhaps mankind will have developed new technologies and responses to the threat of global warming and climate change.

While such arguments by their basic nature are impossible to prove or disprove, the distinction between local and global environment is not necessarily a great boon to policy makers. According to a growing body of scientific data, economic growth appears tied not only to global environmental deterioration, but also to increases in several types of pollution acknowledged by even the staunchest skeptics as causing significant deterioration of the local environment, leading to well-established negative economic and social impacts.

Moreover, consensus among atmospheric scientists indicates that some pollutants that cause significant local environmental and health problems also contribute to potential global warming. Consequently, the distinction between local and global environments is ambiguous in some respects.

One pollutant hazardous to both the local and global environment is carbon monoxide, a gas produced in large quantities through the incomplete combustion of fossil fuels, such as in automobiles and some electrical power stations. Carbon monoxide, while acting as a significant threat to human health as a local atmospheric pollutant, also will eventually dissipate and react with other gases to form carbon dioxide, a relatively stable, long-lasting greenhouse gas, thus contributing to potential global warming. Figure 2, again based on calculations conducted by the Stockholm Environment Institute, shows annual national emissions of carbon monoxide versus GNP per capita for the same 26 countries that appeared in Figure 1. Note again the striking trend showing that wealthier nations tend to produce substantially larger per capita quantities of carbon monoxide than less-developed countries.

A positive correspondence between pollution and economic output is also shown in world production of solid waste generation, which industrialized countries again produce in larger quantities than the global average. While the physical and health-related impacts of solid waste production have been exaggerated by some environmentalists, the growing international political and economic concerns surrounding this issue, as well as some well-established health-related concerns, cannot be ignored. Nobody wants garbage in their backyard. Moreover, the pressures caused by lack of space for solid waste disposal can lead to waste incineration practices which can have adverse environmental effects.

The intention in discussing these pollution problems is not to isolate "guilty" nations, a tendency already

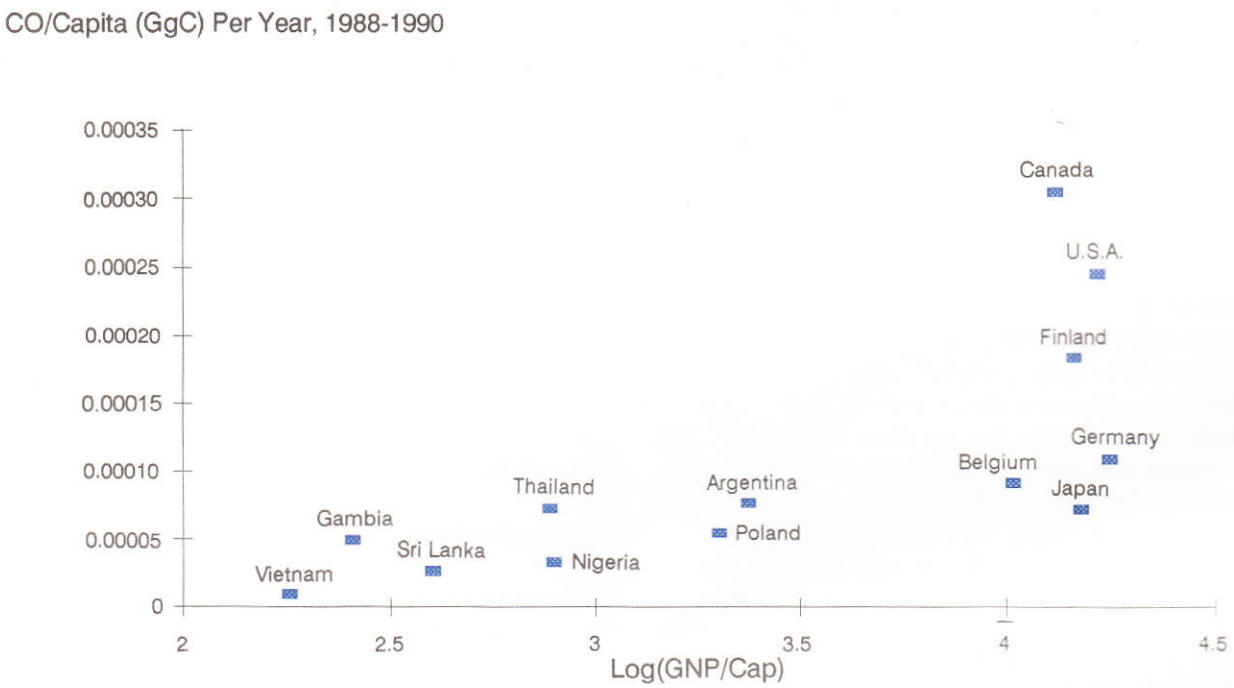


Figure 2 CO Emissions vs. Per Capita Income for Various Countries (based on World Bank Data)

straining relations between North and South, but to point out some environmental trends in the national progression from poor to rich, and to balance the popular belief that economic growth and technology alone can confront and solve the world's environmental problems. Inclusion of country names in Figures 1 and 2 merely reflects an effort to explore fully the available scientific information regarding the environment. The trends outlined perhaps deflect any potential accusations of blame; though rich countries do indeed produce more than their per capita, global share of some pollutants, these countries should not be held as culprits simply because of their relative wealth. To do so would be tantamount to the equally unfair, reverse accusation that relatively poor countries should be held solely responsible for other, well-documented environmental transgressions simply because these nations are relatively poor. Rich nations tend to consume and spend more, and therefore produce larger quantities of some pollutants than poorer nations; poorer nations tend to rely more on unsustainable exploitation of forests and other natural resources to help generate much needed national income. In either case, these activities have significant impact on the local and global environment alike. The challenge is to develop a viable framework for compromise.

CONFLICT AND COMPROMISE

As global trade expands and countries become more economically inter-dependent and as populations continue to grow and demands on natural resources escalate, the scope of environmental factors considered will broaden and will become a source of increased political conflict. Though the conflict is likely to be manifested in countless forms, the fundamental question will remain the same: How can the social needs addressed through economic growth be balanced with environmental needs? Equitable and politically viable compromises can best be developed through a commonly accepted, methodical framework for conflict resolution.

One such framework gaining favor among policy makers involves economic valuation of environmental factors. Through consideration of various economic consequences related to a specific environmental factor, a monetary value can be placed on this factor.

A typical reforestation project serves as a clarifying example: The environmental damage caused by deforestation has been well documented. Many current reforestation projects in Thailand are helping to curb the vast loss of the nation's forest area that has taken place over the past 40 years. Many of these reforestation efforts require government subsidies, as these projects are not directly profitable for individual growers. And yet, the societal benefits of such projects are often manifold. As trees grow, they absorb airborne carbon dioxide, thus helping to refresh polluted air. Moreover, forest growth can help reduce soil erosion and silt build-up in water supplies, thus contributing to agricultural productivity and reducing flood hazards. By considering the economic implications of these benefits, as well as a wide variety of other factors – even including such factors as the price visitors are willing to pay to visit forest areas for recreational purposes – researchers can attribute a monetary value to forest growth. This value can be included in a comprehensive study of both the costs and the benefits of a reforestation project. By sorting out potential forestry projects to determine which ones are profitable and unprofitable in the long run, governments can optimize their investments, and can balance environmental, political and social goals more effectively through economic analysis.

Many environmentalists have also called for a rigorous system of natural resource accounting to be incorporated into national economic statistics. Under this proposal, nations would tally up the economic value of their various natural resource endowments, such as mineral deposits, fossil fuels and forests. Then, if a nation exports or otherwise expends natural resources without replenishing the original endowment, the nation must subtract the net loss in resources from the national accounts. In this manner the economic value of a nation's natural resource endowment can be monitored more thoroughly, just as a private company balances its account books according to the value of its capital investments. If a new international standard were established for national accounting, so that all countries worked on a "level" statistical playing field, unsustainable exploitation of natural resources would not lead to inflated economic output figures, which often serve to attract international investment. In this manner, countries would find new economic incentives to develop industries based less on natural resource depletion and more on other, perhaps healthier mechanisms for boosting economic output, such as human resource development and infrastructure development.

The concept of economic valuation of environmental factors is as complicated as it is flexible. The examples cited here serve as a brief overview of the potential benefits of this tool, but clearly these examples do not explore fully the innumerable potential applications. In fact, this flexibility is perhaps the tool's greatest asset.

CONCLUSIONS

To some, the idea of placing a monetary value on objects of intangible natural beauty – on forests, clean air, rivers – may seem crass or elusive. And yet, few if any better options appear more acceptable. Recent scientific evidence, as presented earlier, indicates that the industrialization process – the process so closely tied to

improvements in quality of life in Thailand and scores of other nations – is in some respects inherently unsustainable, and will lead to escalating environmental deterioration in the years to come. A compromise must somehow be reached.

When a government must, for example, weigh the benefits of the increase in income to its people from the construction of a new factory against the environmental degradation caused by that factory's pollution output, or when societies in general must make decisions about issues as wide-ranging as medical care, economic growth and environmental protection, economic valuation methods seem to be the best available tool for objective analysis.

Nowhere is the conflict between environment and economic growth clearer than in Thailand. Industrial growth here has been sustained in recent years at over 10 percent a year. At this growth rate, even with the best available technology, corresponding increases in industrial pollution are inevitable. Conversely, if emissions are to be held constant or reduced, this rate of growth cannot be sustained. Technology does indeed offer some answers and, in some respects, economic growth and the environment can flourish together. The larger environmental picture, however, is complicated by a broad range of unanswered challenges pertaining both to the local and global environments. If Thailand is to achieve substantial environmental improvements, environmental issues must be considered as part of the same analytical framework associated with other economic and social decision making, with a view toward the needs of future, as well as present, generations.

ENDNOTES

1 Grossman, Gene M. and Alan B. Krueger, Princeton University, "Environmental Impacts of a North American Free Trade Agreement," Discussion Paper No. 158, February 1992.

2 ibid, p. 19.

3 *The Economist,* "Economics Brief," May 23rd, 1992, p. 75

4 ibid, pg. 76.

5 World Development Report 1992, "Development and the Environment," The World Bank, 1992, p. 40.

6 ibid, Executive Summary, p. 5.

7 U.S. Agency for International Development (USAID), "Ranking Environmental Health Risks in Bangkok, Thailand," Volume II, Technical Appendices, p. E15, December 1990.

NEWSBRIEF

TDRI Appoints New Director for its Science and Technology Development Program

Dr. Nit Chantramonklasri has been appointed as the new Director of TDRI's Science and Technology Development Program (STD). Dr. Nit comes to the Institute from the National Science and Technology Development Agency (NSTDA), where he worked as Deputy Director. He was with NSTDA from 1987 until his current TDRI appointment.

Dr. Nit's academic background is unique in that he is a technologist with a good understanding of economics through his further training, from an internationally-recognized institute, in the specialized and multi-disciplinary field of Technology Policy. He received his Bachelor's Degree in Engineering from Chulalongkorn University, and both his Master of Science and Doctor of Philosophy Degrees in Industrial and Energy Technology Policy and Technology Management from the renowned Science Policy Research Unit (SPRU) of the University of Sussex in the United Kingdom.

Dr. Nit has extensive experience in the area of science and technology development, in technical research, policy research, teaching, consulting activities, and as a senior administrator in major development organizations. He has worked in various capacities with the Thailand Institute of Scientific and Technological Research (TISTR) and the Science and Technology Development Board (STDB); as an advisor to the Science and Technology Committee of the Thai Parliament, as a member of the international staff at the Asian Institute of Technology, and as a consultant to various international organizations, such as the International Development Research Center (IDRC), the Economic and Social Commission for Asia and the Pacific (ESCAP), the United Nations Center for Science and Technology for Development (UNCSTD), and the United Nations Industrial Development Organization (UNIDO).

Dr. Nit is a firm believer in the need to develop Thailand's technological strength, so that further economic development and stronger competitiveness can be attained. Yet his vision is much broader than the popular ideas which narrowly focus on higher national investment in technical research and development and increasing the number of public research institutes.

"Research and development is important," he notes, "but never sufficient in itself for generating new products, processes and services, as well as various kinds of improvements needed in industry. A wide range of other technological resources and capabilities are also needed," he explains.

"Perhaps more important than R&D capability in the publicly-funded centers of excellence," he continues, "is technological capability, including R&D strength, within the production sector itself."

Dr. Nit places great importance on effectively utilizing international technology transfer for upgrading industrial capacity, while building technological ability, and to massively investing in creating technical human resources.

On the last issue, he warns that: "Without a new and more aggressive and comprehensive strategy for technical manpower development, Thailand may face an unprecedented economic disaster in the near future."

In his capacity at TDRI, Dr. Nit says that he hopes to "help generate more understanding of various complex issues of science and technology development, and define ways which may alleviate some major problems."

TDRI White Paper Series

In August this year, under the auspices of the President's Office, TDRI introduced a new "White Paper" series in which the pros and cons of current issues in Thailand are put forward. The contents are drawn from fora held at TDRI, where a group of specialists engage in debate, exchange ideas and propose solutions to particular issues.

The first in the series presented the hard facts behind the recent incident when air pollution at the Mae Moh electricity generating plant caused damage to the health of more than 1,000 people, caused crop failures, and the death of untold domestic animals. The participants in this first White Paper debated, among other issues, the "correct" way to generate electricity. Published in Thai, the White Paper is distributed free to 700 members of Parliament, academia, governmental and non-governmental organizations (NGOs), university libraries and, of course, the mass media.

NSTDA Contracts TDRI to Conduct Study on R&D in Biotechnology

TDRI's Science and Technology Development Program (STD) has signed a contract with the National Center for Genetic Engineering and Biotechnology (NCGEB) of the National Science and Technology Development Agency (NSTDA) to conduct a study entitled "Research and Development of Biotechnology for the Improvement of the Socioeconomic Status of the Thai Population."

The project will select the five or six areas of biotechnology that are the most useful for furthering the development of Thai society. It is also designed to formulate criteria for NCGEB to choose from research proposed to them for funding over the next decade. A few megaprojects, to be supported on a long-term basis, will also be suggested. Market demand will be the main criterion for project selection. Input/output for each area and subdivisions thereof will be worked out specifically where possible. The main areas presently identified for scrutiny in this work are:

- Biotechnology for development of plant stocks and plant products
- Biotechnology for development of animal stocks and animal products
- Biotechnology for rural development and small farmers
- Biotechnology for sustainable development
- Biotechnology for health
- Biotechnology for developing novel products and improving process efficiency

Final Reports available through the Publications Office:

TDRI's Human Resources and Social Development Program. "SRT Master Development Plan Study," May 1993.

TDRI's Science and Technology Development Program: "The Role of Information Technology in the Information Society in the Year 2010," October 1993, and "Future Directions of the Communications Authority of Thailand," September 1993.

COMPLETED PROJECTS

Financial Sector Policies in Thailand

This project constitutes one country's case in the Asian Development Bank's study of financial sector policies of selected developing member countries. Conducted by TDRI's Macroeconomic Policy Program (MEP), the study was undertaken with dual objectives: tracing the evolution and experience of the domestic financial system and, given that the current trend in global financing favors liberalization, examining the recently implemented policies on deregulation.

Presented at the beginning is a broad perspective of all financial institutions in Thailand, their roles, relative sizes, and evolution. Also included are changes in financial policy. The basic financial infrastructure is examined, with particular emphasis on fundamental rules concerning the operations of commercial banks, finance companies, the Financial Institutions Development Fund, and the stock exchange. Also investigated are outstanding features, past experiences, and lessons therefrom, of different types of financial institutions – commercial banks, finance and credit foncier companies, government finance institutions, and securities companies. To be fair to the central authorities, macroeconomic issues are considered to understand the constraints that preoccupy most policy makers. The development of various parts of the financial markets is also described. These components include money markets, foreign exchange markets, government securities and commercial paper markets, plus the stock market.

Recent reform experience covers the liberalization the Thai monetary authorities decided to give Thai financial institutions – dismantlement of exchange controls, freer interest rates, more flexible portfolio management, broader operations, globalized standard of capital adequacy, and the genesis of the Bangkok International Banking Facilities. Finally, there is a summary on the extent of financialization in the economy, its fundamental groundwork, sequencing of liberalization, consequences thus far, and future prospects.

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