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INDUSTRIAL RESEARCH INSTITUTES:
Their Role in the Application of Appropriate Technology and Development

THAILAND:
The Introduction of Mint Agriculture

Ronald P Black and Sachee Piyapongse

A series prepared by the
University of Denver
Denver Research Institute
Office of International Programs
under the sponsorship of the
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Office of Science and Technology

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FOREWORD

This case history has been written to assist development planners, personnel of industrial research institutes, and USAID mission personnel in understanding the role that IRIs can and do play in the application of technology to development. This case history is one in a series of eight prepared by the Denver Research Institute under the sponsorship of USAID/Office of Science and Technology (contract AID/ta-C-1337).

The cases in this monograph series first appeared in another DRI publication, Appropriate Technology for Development: A Discussion and Case Histories, edited by Donald D. Evans and Laurie Nogg Adler (Boulder, Colorado: Westview Press, 1979). This book was sponsored by the USAID Office of Science and Technology in preparation for the United Nations Conference on Science and Technology for Development (UNCSTD).

INTRODUCTION

INDUSTRIAL RESEARCH INSTITUTES

In many countries the creation of a viable indigenous industrial sector has long been considered one of the key elements to economic development. Consequently, an industrial research capability is of significance in defining the industrial needs and priorities of a country or region and matching them with appropriate technologies. An industrial research institute (IRI) has been defined as a technical organization established to make direct contributions to industrial development in the private and public sectors[1]. In this context an IRI differs from private research entities which have no proclaimed mandate or responsibility in the practical application or adaptation of technology to their countries' development needs. Frequently industrial research institutes are in some manner government funded and are therefore closely allied to the economic, social and political climate of that government. Ideally, IRIs play a supporting role in the design and implementation of national policies that reflect economic development and growth, while functioning autonomously. In reality, however, government usually plays a substantive role in research institute operations. In any case, compatibility and cooperation among government agencies should be preserved, and selection of industrial research programs should reflect needs of both the public and the private sector.

In many instances, the IRI acts as liaison between government and industry. Ideally and particularly in less developed countries (LDCs), the IRI acts as an intermediary in determination of the need for and the subsequent creation, adaptation or transfer of technology. In fact, the study of technological opportunities or the choice of appropriate technology for development is one of the major functions of the industrial research institute.

In comparison to other technologies, appropriate technology represents the social and cultural dimensions of innovation[2]. As a mediator in an innovation process, a research institute's task is to identify the real needs of the local community, develop or introduce technologies and organizational means which can meet these needs and initiate a process of development based on the internal innovative forces of the local community[3]. In this manner, the IRI addresses the issue of appropriate technology and its role in the development process.

However, opportunities for innovation do exist in areas other than just industrialization--increasing agricultural productivity, developing

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[1] United Nations. Industrial Research Institutes, United Nations Publication No. E. 70.II B. 21. New York: UN, 1970, p. vii.

[2] Nicolas Jequier, Appropriate Technology: Problems and Promises. Part I, The Major Policy Issues, 1976, Development Center of the Organization for Economic Cooperation and Development (OECD). p. 9.

[3] Ibid., p. 36.

rural technologies, and offering incentives for small industrial projects are also duties that a research institute is likely to perform.

The methods by which IRIs assess technological choice and stimulate innovation are varied. Most often development strategies would include a combination of the following:

- Survey, study and develop uses for local raw materials.
- Develop new processes and improve existing ones.
- Develop new products and recognize new uses for existing ones.
- Improve industrial and agricultural productivity.
- Study the technological and socioeconomic feasibility of industrial and agricultural projects.
- Develop standards and specifications.
- Determine choice of technology and scale of operation.
- Determine industrial location and site.
- Conduct marketing research[4].
- Acquire and disseminate scientific and technological information.
- Systems design and management of development programs.
- Evaluate a chosen technology and its relationship to local economic and cultural traditions.

To establish solutions to identifiable problems, the research institute often adapts foreign technologies to suit local conditions and offers incentives to small industries to create new technologies. Technological innovation is accomplished in a variety of ways from actual adaptation of a chosen technology to training of researchers and engineers for institution building and infrastructural support, to establishment of extension services to help define and fulfill needs.

The creation of linkages between research institutes has allowed increased communication and the transfer of information and technologies, not only between developed and developing countries, but among developing countries as well. In a few instances, regional research

[4] United Nations. Proceedings of the Interregional Seminar on Industrial Research and Development Institutes in Developing Countries, Beirut, Lebanon, 30 November-11 December, 1964. Vol. 1, New York: UN, 1966. p. 45.

institutes or networks of institutes have been established to facilitate development in common geographic and cultural areas. (ICAITI in Guatemala representing Central America is such an example.) Similarly, an international IRI organization called WAITRO (World Association of Industrial and Technological Research Organizations) has been created.

Industrial research institutes tend to become the foci for national S&T development and have offered essential infrastructural support. Research institutes, therefore, may play a very important role in mapping the future economic growth and development of a country. With this increasing responsibility, an IRI's task becomes more complex and difficult, particularly when original development goals are overwhelmed by other considerations. Factors such as politics, financial risk, societal or cultural considerations, legal restrictions, staffing problems, marketing problems, fear of change, and sheer inertia may impede or block the transfer process and thus weaken or negate its economic effect[5].

CASE HISTORIES

Much can be learned about development from the investigation and analysis of industrial research institutes. The Office of International Programs (OIP) at the Denver Research Institute (DRI) has initiated linkage activities with a variety of research institutes worldwide over the last decade under the sponsorship of USAID's Office of Science and Technology. Through these linkage activites, choice and adaptation of technology, training of researchers and engineers, exchange of information and help in the management of research institute affairs have occurred. A dynamic process of communication has been established through DRI's relationship with each research institute, and much knowledge has been gained about the development process by all those involved.

Realizing the value of imparting research institute experiences to others in the development field, DRI has gathered several case histories of industrial research institutes' endeavors in the area of technology transfer. The cases were collected for the most part by OIP staff (often assisted by IRI colleagues) who acted as impartial reporters when collecting the information. The goal of the research was not to select cases that showed only successful adaptation of technology, but to show ways and means by which IRIs must operate to encourage and achieve progress in the development scheme. There are, in fact, examples where a transfer of technology is considered unsuccessful or unsatisfactory.

The case Thailand: The Introduction of Mint Agriculture and Processing, written by Ronald P. Black and Sachee Piyapongse, describes how mint agriculture and processing were introduced in Thailand. It also details how farming, mint oil extraction, menthol

[5] James P. Blackledge, The Industrial Research Institute in a Developing Country: A Comparative Analysis. Washington, D.C.: USAID, 1975. p. 19.

production, and related research activities were developed. The research organizations involved in the process are also examined.

THAILAND: THE INTRODUCTION OF MINT AGRICULTURE AND PROCESSING

Ronald P. Black and Sachee Piyapongse

INTRODUCTION

In 1970 and 1971 several parties became interested in Mentha arvensis, var. piperascens, commonly known as Japanese mint, as an agricultural product that held potential opportunities for agriculture and industry in Thailand. A major activist and catalyst for the development of the nation's mint agriculture and processing industry was the Applied Scientific Research Corporation of Thailand (ASRCT), the country's major multidisciplinary applied research organization.

The mint agriculture and processing industry of Thailand was introduced from 1970 to 1974, and its potential for the country was projected. From 1974 to 1979, Thailand attempted to commercialize the technology. By 1974, ASRCT had an active research project concerning mint agriculture, mint oil extraction, menthol production, mint economics, and a nationwide promotion and extension program. A number of farmers had begun to grow mint; oil distillation plants had been set up; and a firm for the production of menthol had been established. ASRCT had projected a 200 ton annual rate of production of mint oil by the end of 1974 and a 1,000 ton-per-year rate by 1978. The production of 1,000 tons of mint oil per year would occupy approximately 116,000 farmers, 1,400 workers at distillation plants, and 130 at menthol production firms. This level of oil production would contribute U.S. $15.4 million to the national economy annually as a direct result of mint agriculture, oil extraction, and menthol production.

However, in 1978 Thailand actually produced only slightly more than thirteen tons of mint oil; many mint oil distillation plants had gone out of business; and the original menthol production firm had halted operation. How had the development of such a promising "appropriate technology" turned out so dismally? Or had it?

DEVELOPMENT OF MENTHOL AND MINT OIL PRODUCTION UP TO 1974

Of the several varieties of mint grown in the world, the most valuable is peppermint. Peppermint (Mentha piperita) and spearmint (Mentha spicata and Mentha cardiaca) are grown in temperate zones and do not grow well, if at all, in tropical climates. The essential oils of peppermint and spearmint, which are produced by distillation, are used as a flavoring in foods and candies. Although it is possible to extract crystallized menthol (the major aromatic chemical constituent), from peppermint, it is not economically desirable. A higher value is placed on peppermint oil as a flavoring; also, peppermint contains a lower proportion of menthol, 50 to 55 percent by weight, compared with alternative mint varieties.

The primary source of commercial menthol is Japanese mint (Mentha arvensis, var. piperascens), which is grown mainly in temperate or subtropical countries. This is the original source of menthol and was produced in Japan for menthol export prior to World War II. When the war caused Japanese exports to cease, Brazil began supplying menthol to the Western Alliance and replaced Japan as the leading world supplier. In 1974 Japan produced much less mint oil than it had before, relying mainly on mint oil imports and on synthetic menthol. Although several countries, e.g., Argentina, Australia, the People's Republic of China (PRC), Indonesia, New Guinea, the Union of South Africa, the United States, and Thailand, produced some Japanese mint for their own use, in 1974 the bulk of the world supply came from only two exporting countries, Brazil and Taiwan. More recently, the PRC has begun exporting menthol while Taiwan's role has decreased.

The essential oil of Japanese mint, which constitutes approximately 3 percent of the dry weight of the plant, can be recovered by a steam distillation process. The crude mint oil is further separated by a freezing process into menthol crystals and "dementholated" mint oil, in which about 55 percent menthol by weight remains. By more intensive and expensive processing techniques, greater amounts of menthol can be recovered from the mint oil.

The proportion of menthol in crude mint oil varies by the variety of Mentha arvensis grown and by the location where it is grown. Brazilian mint oil contains about 80 percent menthol by weight. Taiwanese varieties in 1974 contained between 60 and 80 percent. More recently, however, a Thai variety, So Wo-1, has been used in Thailand and Taiwan and is yielding 80 to 90 percent menthol.

The menthol crystals, with an average 1974 world price of about $42 per kilogram, are used in the manufacturing of

cigarettes, cough drops, toiletries, balms, and medicinal preparations. Dementholized mint oil, with an average 1974 world price of about eighteen U.S. dollars per kilogram, varying by menthol content, is used for flavoring food, candy, chewing gum, and so on. Dementholized Japanese mint oil is inferior to peppermint oil as a flavoring, although the two types of mint oil are chemically similar. In many parts of the world, Japanese mint oil has been used to adulterate peppermint oil.

In the years just prior to 1974, Brazil produced about 6,000 metric tons per year of mint oil, while Taiwan produced about 1,000 tons per year. In the 1973-1974 season, however, floods in Brazil reduced production to only 2,000 metric tons, while in Taiwan's fertilizer-intensive agricultural economy, the shortage of petroleum and the resulting high cost of fertilizers caused the 1973-1974 mint oil production to drop to only 300 tons. In 1974, world demand for menthol and dementholized mint oil had been growing by 10 to 15 percent a year, and a world shortage of mint oil and menthol developed.

INTRODUCTION OF JAPANESE MINT TECHNOLOGY

ASRCT was formed in 1964 and by 1965 had initiated an essential oils program with the purpose of identifying and testing available natural materials as potential sources of commercial perfume or flavor materials. One of the materials on the ASRCT list for study was mint.

In 1970 the Nissho-Iwai Company of Tokyo sent representatives to Thailand to discuss the possibility of a joint venture between two Thai firms, Hong Huat Company (HHC) and T. Unichem, and Nissho-Iwai for the development of a menthol industry in Thailand. The Thai firms, owned by the Tangtrongsakdi family, were both involved with chemicals. It was the family's opinion that between the two companies the technical problems associated with processing the mint and the marketing of the mint products could be managed; however, the family felt it would need assistance in promoting the growth of mint. Therefore, the family approached the owners of a Thai fertilizer firm, the Metro Company, of which one member of the Tangtrongsakdi family was a major shareholder. It was proposed that Metro join the discussions with the Nissho-Iwai representatives.

In early March 1971 a Metro employee informed a senior staff member of ASRCT's Tropical Agricultural Products Institute about the interest of the Thai and Japanese firms in introducing mint to Thailand. Later in the month a representative of the Japanese firm brought mint cuttings to Thailand; he remained in the country for approximately two weeks to organize the venture and to survey possible areas for growing the mint.

Later that month the Metro representative again approached his friend at ASRCT to inquire about the possibility of ASRCT working on the project. He was informed that ASRCT would be interested but that the services of ASRCT would cost about 20,000 baht.[1] This was the last that ASRCT heard of the joint venture's interest in assistance for some time.

Shortly after the representatives of Nissho-Iwai returned to Japan, the Thai investors and Nissho-Iwai reached an impasse in their negotiations and discussions were terminated.

The Thai investors, however, did not give up the idea of producing menthol. They decided to form a corporation called Thai Chemicals Company, Ltd. (TCCL), and in June 1971 they purchased a former pharmaceutical plant in Bangkok. The facility had been closed for about one year and could easily be modified to produce menthol.

The Ming Sheng Chemical Company Ltd. of Taipei, Taiwan, whose Ice Berg brand of menthol had been distributed in Thailand by HHC, was approached with an offer to join TCCL in a venture to produce menthol and mint oil products. Ming Sheng was Taiwan's largest producer of menthol. It not only used Taiwan-grown mint oil but also purchased dementholized mint oil from Brazil and extracted the remaining menthol. The company's major markets were South Asia, Canada, and the United States.

After considering the HHC offer, Ming Sheng decided to accept. TCCL would own 51 percent of the venture and Ming Sheng 49 percent. The new manager of TCCL, Pirote Tangtrongsakdi, was to visit Taiwan for several months to study menthol processing, and Ming Sheng was to send one of its men, who also was an investor in the new venture, back to Thailand to be production manager. The TCCL manager spent October and November 1971 at Ming Sheng then returned with his new partner and several engineers to begin the project. Crude mint oil was to be imported from Taiwan.

Also during the same October-November period, a trip was provided by Metro for several major users of their fertilizer to Japan, Taiwan, and Hong Kong. One of these users was Somchai Lohajoti, the general manager and principal shareholder in the family-owned Nanleaf Tobacco Company Ltd. (NTCL). In 1971 NTCL had approximately 5,000 families working at its tobacco-curing facilities or growing tobacco for the company. Somchai was an elected representative to the Thai National Assembly for the province of Nan. Nan, located in North Thailand on the Laotian

[1]One U.S. dollar equals approximately twenty baht.

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[1]One U.S. dollar equals approximately twenty baht.

quality would need to be improved but that Colgate was interested. Following this, ASRCT entered a systematic research program aimed at investigating Japanese mint.

It was just at this time that the Metro representative arranged an informal meeting between the general manager of NTCL and his friend at ASRCT.

The ASRCT staff member gave Somchai six cuttings of the mint from the Division of Agricultural Chemistry and agreed that ASRCT would work with NTCL. In May 1972 Somchai made two trips to Taiwan to observe mint farms and distillation facilities. In October the ASRCT essential oils program coordinator prepared what he considered to be a good menthol crystal from mint that ASRCT had grown at an experimental farm in Pakchong. Somchai took this to the Thai Tobacco Monopoly, where he was encouraged.

Somchai's next step was to distill samples of crude mint oil from mint he had grown in Nan. In November samples were sent to firms in Taiwan and Japan that produced and exported menthol. They found the quality high.

In the meantime, Somchai established formal contact with ASRCT, which led to discussions of a possible technical assistance contract between NTCL and ASRCT. ASRCT's first offer was to provide assistance over a period of one year for a sum of 15,000 baht. The NTCL general manager thought this amount too high, however, and negotiations were about to break down when the research director of ASRCT's Technological Research Institute, which ran the essential oils program, offered an alternative proposition. He suggested that ASRCT would provide the requested technical assistance if NTCL would pay ASRCT 1.5 percent of its sales of crude mint oils for five years, plus out-of-pocket expenses incurred by ASRCT in providing the assistance. The NTCL general manager immediately accepted this offer, and ASRCT began a program of technical assistance that involved agricultural aspects, such as growing mint in Nan, and distilling mint to extract the crude oil. In November 1972 ASRCT established an experimental mint farm in the northern part of Nan on land donated by NTCL.

The ASRCT essential oils program coordinator, however, still wanted to involve TCCL in the project. In February 1973 he met with the three brothers of the Tangtrongsakdi family, who also were the major shareholders of TCCL. Although the meeting concerned other business, the subject of menthol arose. It was suggested that ASRCT assist TCCL by promoting mint farming and providing technical assistance to the farmers and crude oil distillers who would thereby provide TCCL with an indigenous source of crude mint oil. After considerable negotiation, a contract was signed in November 1973. ASRCT was to promote the farming of mint and provide technical assistance to mint farmers and distillers of the crude mint oil. In return, ASRCT would receive

border, was a rural province far "up-country" from Bangkok, the center of Thai business and government. Even in 1974 it required one day of traveling over stretches of unpaved roads to reach the province; nor had telephone service penetrated the area.

Despite the remote location, Somchai's company employed the latest agricultural techniques: he had his own experimental farm that grew tobacco cuttings from around the world. In 1971 Somchai was looking for a crop to rotate with tobacco.

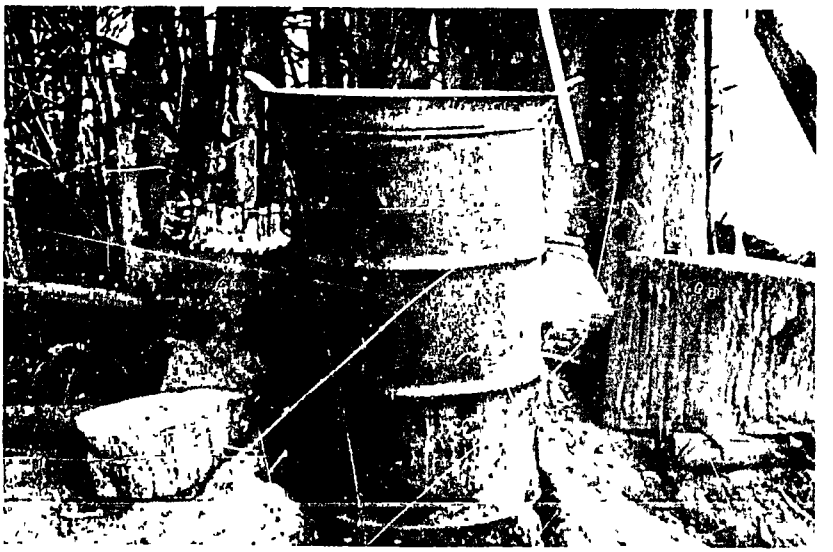
During his Metro-sponsored trip in late 1971, Somchai was introduced to the possibility of growing mint. This immediately caught Somchai's attention because mint was an important raw material used by the tobacco industry. As a result, the NTCL general manager arranged to visit a mint farm in Taiwan.

In the meantime, several ad hoc attempts had been made to grow Japanese mint, brought to Thailand by the Nissho-Iwai representative, in various locations in that country. These experiments generally were unsuccessful.

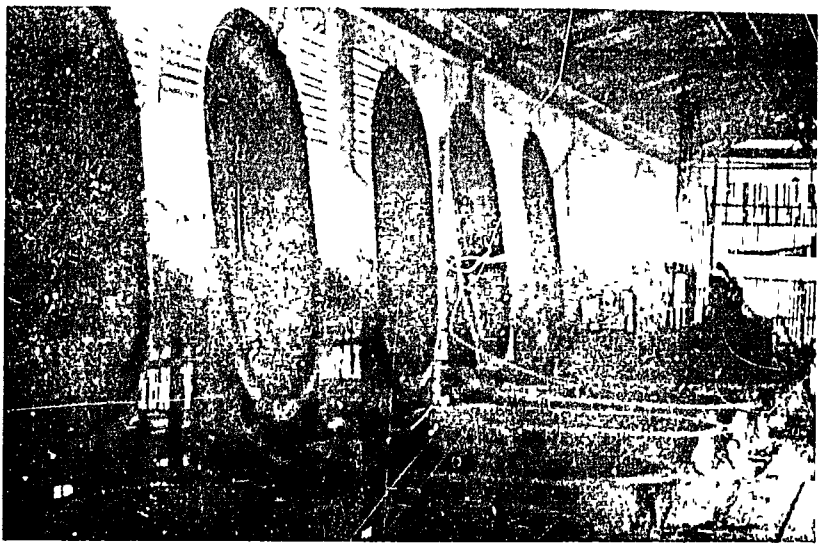
Also during this period, the coordinator of the ASRCT essential oils program had become more actively interested in the possibilities of Japanese mint for Thailand. He had discovered that a Bangkok candy company, Adams (Thailand) Ltd., used menthol in its candy. The possibility of local sales suggested a readily accessible market. This appeared particularly attractive because the import duty on menthol was 30 percent of the price. The essential oils program coordinator subsequently visited Adams and obtained the specifications for the menthol used by the firm.

Other interest was found in a Thai source for menthol when an ASRCT group leader met with the production manager of Colgate Palmolive (Thailand) Ltd. at an Australian trade fair. This growing interest encouraged the ASRCT essential oils program coordinator, and in December 1971 he decided to attempt to crystallize menthol from Japanese mint.

The first step was to obtain a source. Another ASRCT staff member--the one who had earlier met with the Metro representative--was aware that the Division of Agricultural Chemistry of the Ministry of Agriculture and Cooperatives had obtained some of the Nissho-Iwai mint cuttings and had been growing, curing, and drying mint. A batch of dry mint leaves was obtained from this source. The essential oils program coordinator distilled oil from the leaves and crystallized menthol from the oil. The crystals were given to the acting plant manager of Colgate Palmolive (Thailand) Ltd. for tests. This manager formerly had spent time at ASRCT as a UNIDO associate expert, so he was familiar with the corporation's capabilities. ASRCT was informed that the



Primitive still composed of an oil drum and pan, Prae Province



NTCL still--most common type in Thailand

TABLE 2
LOCATION AND AREA OF FARMS SERVING DISTILLATION PLANTS DURING THE 1976-1977 SEASON

Companies of Persons Owning Distillation Plants	Plant and Farm Location	Area Projected To Be Under Cultivation* (rai)**
Nanleaf Tobacco Co. Ltd.	Nan	3,000
Sai Khangkit	Chiangmai	500
Manop	Tak	200
Menthol Thai Import Export Co., Ltd.	Chanburi	4,000
	Nakornpathom	2,000
	Chacherngsao	100
	Supanburi	100
	Krabee	400
Producer in Amphoe Chiang-Kum	Payao	1,500
TOTAL AREA PLANTED		11,800

*From an ASRCT survey in 1976.

**One rai is equivalent to 1,600 square meters.

Source: ASRCT Survey 1976, report published in 1978 by ASRCT.

An ASRCT study of production costs and returns of twenty-seven farmers in Nan province revealed that Nan farmers obtained an average annual yield of 4.3 tons of mint per rai (see Table 3). The production costs per rai were 3,018 baht while the income was 4,348 baht, yielding a difference of 1,330 baht, or $66.50, per rai. Of course, since the labor was done by the farmer and his family, this difference included the cost of labor and so was not "net" profit. Nan farmers sell their mint to NTCL and thus have benefited from the experimentation and extension activities of ASRCT. Also, NTCL has set a price of one baht per kilogram of "standard" mint leaves that is not altered with the fluctuating prices of menthol. This is not a universal practice in Thailand.

Most of the farmers own their land for growing mint; only a minority has to rent. Most farmers obtain operating funds, usually in the form of fertilizer, stolon, and cash, from the oil distillers. Repayment of the loan occurs when the farmer sells his crop to the distiller. At this time the loan is deducted from the total sale price of the mint. The

TABLE 3
COST AND REVENUE OF MINT GROWING IN NAN PROVINCE 1976

Harvest	Land Rent (baht/rai)	Plowing by Tractor (baht/rai)	Labor Cost: Weeding (baht/rai)	Labor Cost: Harvesting (baht/rai)	Other (baht/rai)	Material Costs: Fertilizer (baht/rai)	Material Costs: Stolon (baht/rai)	Transportation (baht/rai)	Others (baht/rai)	Cost of Production (baht)	Production per rai (kg)	Revenue per rai (baht)	Net Revenue per rai (baht)
I	110	60	414	146	317	149	33	122	80	1,431	1,539	1,539	108
II	-	-	429	196	34	166	-	151	40	1,016	2,016	2,016	1,000
III	-	-	300	93	24	79	-	67	8	571	793	793	222
TOTAL	110	60	1,143	435	375	394	33	340	128	3,018	4,348	4,348	1,330

Source: ASRCT Survey of Mint Plantations in Nan Province in 1976.

TABLE 4
PRODUCTION AND IMPORTATION OF MINT OIL IN THAILAND

Year	Local Mint[1] Oil Production (Kg.)	Imported[2] Mint Oil (Kg.)
1972	---	65,283
1973	1,930	61,854
1974	10,199	85,882
1975	15,704	22,439
1976	12,869	67,275
1977	13,246	132,218

Source: (1) Industrial Statistics 1977. Ministry of Industry.
(2) Department of Customs.

TABLE 5
PRODUCTION COST OF MINT OIL

		Bt/distillation
Raw material	Mint, 500 Kg @ 1.30	650
Labor	One Foreman x 40 bt/day (2 distillations)	20
	Two Unskilled @ 25 bt/day each (2 distillations)	25
Utilities	Firewood	30
	Diesel oil (for water pump)	5
Transportation		70
Administration salary		25
Other expense		15
Depreciation		44
Production cost for 3 kg. of mint oil (1 distillation)		844
Average production cost per kg.		281
Sale price in 1978		310
Gross profit before income tax and interest		29

Note: This data is based on a mint oil factory with three stills. The capacity of each still is three kg. of oil per distillation; each still is operated for two distillations a day, 120 days per year.

Source: ASRCT Survey of Production Cost of Mint Oil in Tak Province in 1978.

TABLE 6
FLUCTUATIONS OF PRICES OFFERED BY THE THAI CHEMICAL COMPANY FOR LOCALLY PRODUCED OIL FROM 1974
(Baht/kg.)

	1974	1975	1976	1977	1978
January	400	350	280	310	320
February	400	365	290	310	320
March	406-412	320	300	320	320
April	406-412	320	300	320	320
May	406-412	320	280	320	320
June	406-412	260	280	320	320
July	406-412	280	280	320	320
August	406-412	280	280	320	320
September	406-412	280	280	320	320
October	406-412	310-320	280	320	320
November	406-412	310-320	280	320	320
December	400	300	280	320	320

Source: The Thai Chemicals Co., Ltd.

cost of creating a job place on a mint farm is calculated to be seventy U.S. dollars[2] (see Table 3).

Mint Oil Production in Thailand

While Thailand did not experience the 100-fold increase in mint oil production that some at ASRCT had hoped for in 1974, the country did witness an approximate 7 fold increase in oil output from 1973 to 1977 (see Table 4). One factor that affected the oil output negatively was a decrease in price from a high of 412 baht per kilogram in November 1974 to a low of 260 baht per kilogram in June 1975 (see Table 16.6 for price fluctuations from 1974 through 1977). International markets commonly demonstrated even greater variation;

[2]From Table 3, the operating costs for the first crop, including rental of land and equipment, is seen to be 1,431 baht or approximately seventy U.S. dollars. Assuming income generated from selling the first crop could finance the inputs for the second crop, and so on, then seventy dollars is all that would be needed to begin farming a rai of land. While approximately five different people would normally be involved in farming the land, ASRCT experts estimate that one rai of mint will require the equivalent of one full-time person. Thus, seventy dollars would provide one full-time job place.

for example, in early 1973 the price for menthol was 266 baht per kilogram, but in September 1974 the cost had risen to 987 baht per kilogram.

In 1976, sixty-seven mint oil plants were operating in Thailand, with 200 stills. Of these, eleven plants with 86 stills were owned by NTCL.[3] The other fifty-six plants with 114 stills were located in other parts of the country.

Studies of the investment and production costs of mint oil distillation were conducted by ASRCT in 1976 and 1978 (see Tables 5 and 7). Based on these figures, the cost per job place in a mint oil distillation plant was calculated to be approximately eight hundred U.S. dollars. The plant operates about four months per year, normally during March, April, June, July, and August. Oil extraction plants are operated mostly by men.

Menthol Production in Thailand

In 1977 Thailand consumed 120 tons of menthol (see Table 8). If the country were self-sufficient, mint oil distillation plants would have had to produce 200 tons of oil. This would have consumed approximately 40,000 tons of mint, which would have occupied 20,000 farm laborers. In fact, only thirteen tons of mint oil were reportedly produced during 1977. During the year, 148 tons of mint oil were imported, and 28 tons were exported. The perhaps curious phenomena of exports and imports of mint oil taking place at the same time apparently results from the actions of at least two involved groups. First, the menthol producers were attempting to obtain mint oil for the production of menthol that they would sell locally or internationally, depending on where they could obtain the best price. Also buying mint oil were Thai traders speculating in the world commodity market for mint oil. The traders would, of course, sell where they could obtain the best financial return, and this was often abroad.

The products of menthol companies are menthol and dementholized oil. Since 1974 the combined value of the local production of these has been modestly stable (see Table 9). Imports and exports of dementholized oil seem to have been more erratic, but due to the Thai Customs Department's acquisition of several types of oil under one code, it is difficult to be sure exactly what is happening with respect to the movement of dementholized oil.

In early 1979 two companies in Thailand had the technology to produce menthol. One of these, TCCL, formed early in the decade, had temporarily ceased operation due to

[3]Based on an ASRCT survey in 1976.

TABLE 7
INVESTMENT REQUIREMENT FOR FACTORY WITH EIGHT STILLS

Requirement		Cost (baht)
Land (10 rai) @ 5,000 per rai		50,000
Building		25,000
Machinery		
- Distiller (8 units) @ 35,000 per unit	280,000	
- Set of water pumps	16,000	
- Total		296,000
Equipment		
- Pulley	1,800	
- Scale	1,200	
- Container	600	
- Total		3,600
Total Fixed Capital		374,600
Average investment cost per still		46,825

Note: This information is obtained from a factory with eight stills having a capacity of 48 kg. of mint oil per day, when operating two distillations per day and 120 working days per year.

Source: ASRCT survey on the Economic Condition of two Mint Oil Factories in Nan Province, 1976.

a lack of mint oil for processing. The other, the Menthol Thai Import Export Company Ltd., has been in existence since 1975. Only thirteen tons of the companies' mint oil came from Thai sources; the remainder was imported (see Table 8).

Pirote, the manager of TCCL, noted that, as a result of an ASRCT-sponsored seminar in 1977, the government placed a 20 percent surcharge on imported menthol in addition to an existing 30 percent import duty. According to Pirote, this only led to a rush of smuggling menthol that had been "dumped" on the Hong Kong market at below what he believed could be true production costs. Pirote said that the government could help the most by encouraging the growth of indigenous menthol. When self-sufficiency is reached, an effective ban could be placed on the importation of mint oil and menthol. According to Pirote, until this

TABLE 8
PRODUCTION AND CONSUMPTION OF MINT OIL AND MENTHOL IN THAILAND 1972-1977

Year	Mint oil				Menthol			
	(1) Local production (kg.)	(2) Imports (kg.)	(3) Exports (kg.)	(4) Quantity locally processed into menthol (kg.)	(5) Local production (kg.)	(6) Imports (kg.)	(7) Exports (kg.)	(8) Local consumption (kg.)
1972	-	65,283	-	65,283	39,170	94,521	-	133,691
1973	1,930	61,854	-	63,784	38,270	151,546	-	189,816
1974	10,199	85,883	5,040	91,041	54,625	33,532	1,362	86,795
1975	15,704	22,439	-	38,143	22,885	9,549	-	32,434
1976	12,869	67,275	4,788	75,356	45,213	41,981	3,930	83,264
1977	13,246	148,350	27,939	133,657	70,741	66,474	17,839	119,376

Source: (1) Industrial Statistics 1977, Ministry of Industry.
(2), (3), (6) and (7) Department of Customs.
(4) Data is obtained by adding (1) and (2) and subtracting (3).
(5) Production of menthol is calculated from (4).
(8) Data is obtained by adding (5) and (6) and subtracting (7).

TABLE 9
PRODUCTION, IMPORT AND EXPORT OF MINT AND MENTHOL IN THAILAND 1973-1977

Year	(1) Mint oil production	(2) Production of menthol from locally produced mint oil			(3) Production of dementholized oil from locally produced mint oil			(4) Imports of mint, dementholized and peppermint oils **			(5) Export of peppermint oil ***		
	(kg.)	Quantity (kg.)	Average imported price (bt/kg)	Value (1,000 bt)	Quantity (kg)	Average * World price (bt/kg)	Value (1,000 bt)	Quantity (kg.)	Average imported price (bt/kg.)	Value (1,000 bt)	Quantity (kg.)	Average exported price (bt/kg.)	Value (1,000 bt)
1973	1,930	1,158	182.66	211.5	579	139.1	80.5	61,854	121.33	7,504.8	-	-	-
1974	10,199	6,119	372.11	2,276 9	3,059	358.5	1,096.7	85,882	218 05	18,726.3	5,040	508.15	2,564.1
1975	15,704	9,422	414 5	3,905.7	4,711	188.2	866.6	22,439	290 12	6,509.3	-	-	-
1976	12,869	7,721	333.4	2,574 2	3,860	151.2	583.6	67,275	246.12	16,557.9	4,788	343.63	1,655.3
1977	13,246	7,947	365 2	2,902.5	3,973	194 0	770.8	148,350	234.27	34,753.5	27,939	218.50	6,104.9

Note: * The average world market price is used for calculating the value of dementholized oil because the average imported price is not available (import prices comprise cost, freight and insurance).
** Imports of mint oil, peppermint oil and dementholized oil are all included under the same code of the Thai Department of Customs.
*** Export of peppermint oil is comprised of peppermint oil or dementholized oil (imported), locally produced dementholized oil, and a small quantity of mint oil

Source: (1) Industrial Statistics 1977, Ministry of Industry.
(2) and (3) The production of menthol and dementholized oil was calculated as follows: weight of menthol equals 60 percent of the weight of mint oil; weight of dementholized oil equals 30 percent of the weight of mint oil; ten percent of the weight of mint oil is lost during processing.
(4) and (5) Department of Customs.

condition in mint oil production is obtained, the government cannot do much except attempt to reduce the level of smuggling.

Based on the capital required to set up TCCL and initiate operations, the TCCL manager estimated the cost of creating a job place in the menthol production industry to be approximately $15,000.[4]

AGRICULTURAL, ECONOMIC, AND SOCIAL FACTORS

Agricultural Factors

From its experiments and observations, ASRCT has found that the major agricultural problem in growing mint is weeds. ASRCT has demonstrated that a lack of weeding can reduce the yield of mint oil and fresh herbage by 80 to 90 percent. Weeds affect the smell of the oil, and the work necessary to harvest the mint increases. However, by weeding the plants once every two weeks, optimum yields[5] can be achieved. This requires the full-time labor of one person per rai of planted lands during the mint farming period.

A common experience observed by ASRCT is that a Thai farmer will experiment with planting one rai of his land in mint. It is given adequate attention, and good income is obtained. The next year, ten rai are planted, but the farmer is unable to provide adequate attention to the crop. His yield falls drastically and he gives up mint as a crop. Despite ASRCT's explanation of the problem, the farmer is no longer interested in mint.

The second most important factor affecting the crop is the need for irrigation. While mint can grow during both the wet and dry seasons, irrigation becomes critical during the dry season. The manager of TCCL also pointed out that the wet season causes problems. The farmers are inhibited in their weeding activities at this time, plus harvesting and drying the mint for processing become difficult.

ASRCT suggests that the third major factor affecting the success of mint farming is the application of fertilizer. In its experimental program, ASRCT has discovered which fertilizers and quantities provide the best return on investment. However, the ASRCT staff involved in this program numbers only four, and it is impossible for them to act as extension agents for the country. Consequently, information

[4]This estimate was in 1971 currency.

[5]This practice, however, may not give the maximum income if hired labor is used.

on fertilizer usage is not readily available to the average Thai farmer. Also, ASRCT points out that many farmers are reluctant to invest in fertilizer even when they are informed of ASRCT's results. This may be due to the lack of capital and inability to obtain it. An exception to these circumstances is Nan, where NTCL has the benefit of ASRCT's experimental program and where farmers may obtain the necessary information. Also, NTCL provides credit to farmers for purchasing recommended formulas and quantities of fertilizer.

Finally, ASRCT has discovered that the best soil for growing mint is sandy loam or loamy sand. Although this type of soil is found in most parts of Thailand, it is not the only kind. Farmers, who are unaware of soil effects on mint production, sometimes plant their mint in less than the optimum type of soil.

Economic Factors

In many parts of Thailand more attractive agricultural or industrial economic opportunities than growing mint may exist. For example, in 1976 farmers could get such a high price for growing chili that many mint farmers switched from mint to chili. As a result, many mint oil extraction plants went out of business. Now there may be no one to whom these farmers could sell mint if they wished to switch back.

Another example is that a few years ago the Thai government established a policy of encouraging new industrial ventures to be located outside of Bangkok. As a result, an industrial estate was located at Min Buri near Bangkok, an area that contained many mint farmers. The farmers wished to take advantage of the opportunities offered by the new factories. Mint, however, is a labor-intensive crop requiring constant attention. Other crops such as rice and corn can be planted and to a large extent left alone until harvest, allowing the farmer to work in a factory. Consequently, farmers in the Min Buri area switched from mint to crops that would allow them to work in the new factories.

A different type of economic problem that may affect the mint farmers has recently been reported. According to oil distillers in Thailand, mint oil is now being smuggled into the country.

Social Factors

The farmer and mint oil extractors are very dependent upon each other, and this relationship often has not been realized. As a result, farmers have shifted crops to maximize short-term profits and oil extraction plants have offered

low prices for mint when the world price for menthol is low and mint is abundant. The former causes the oil extraction plants to go out of business; the latter discourages farmers and they switch to new crops.

In Nan, however, NTCL recognized this interdependency and established a policy of paying the farmers a set, and presumably adequate, price for a kilogram of "standard" mint. This price is maintained by NTCL even when world mint oil prices would suggest a financial loss, and the farmers bear with the price when the opposite is true. This recognition of mutual interdependence may well account for 80 percent of all Thai mint oil coming from NTCL.

Another social factor relates to historical Thai agricultural practices. Thailand has always been relatively wealthy by world standards in terms of the land available per farmer. This has led to less intensive farming practices than are followed in many other parts of Asia. However, mint must be intensively farmed to be successful.

Finally, many Thais have indicated that they place different values on such things as freedom, the nature of work, and money than perhaps other cultures do. Freedom is rated high, as the name of the country suggests--Thailand meaning "land of the free." Drudgery in work may be shunned more than in some countries, possibly as a result of the abundance of food on trees and plants and in the streams of Thailand. For the same reason, money may not seem so important.

All of these factors, if true, might argue against the Thai going into mint farming. It certainly limits freedom, it is somewhat onerous work, and sufficient income is often available in Thailand from other sources.

CONCLUDING SOCIOECONOMIC CONSIDERATIONS

Mint farming in Thailand has provided work for 6,500 workers including 3,900 women. Oil extraction plants have employed nineteen.[6] Menthol-producing firms have employed a number of others. Mint agriculture and industry now contribute $.6 million annually to the Gross National Product. They have helped to diversify both agriculture and industry in Thailand. ASRCT says that it has learned much about how its research and services can affect the country. Despite the fact that early goals have not been achieved, some claim that mint growth and processing in Thailand still has been successful.

[6]The calculation is based on the present production of thirteen tons of mint oil per year.

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PERSONS INTERVIEWED

Nitasna Pichitakul, director, Project Development Department, ASRCT

Narong Chomchalow, deputy governor 1, ASRCT

Lumduan Maprasert, acting director, Economic Research Department

Songkhit Vitsuthipitakul, project leader, Mint Production Project, Agricultural Research Department, ASRCT

Pirote Tangtrongsakdi, manager, Thai Chemical Company, Ltd.