OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

08745

Distr.
LIMITED

ID/WG.293/11
15 February 1979

ENGLISH

United Nations Industrial Development Organization

Workshop on Fermentation Alcohol for Use as
Fuel and Chemical Feedstock in Developing Countries

Vienna, Austria, 26 - 30 March 1979

POWER ALCOHOL INDUSTRY FOR THAILAND: POTENTIAL AND PROSPECT*

by

Ta-noo Vi narangsan**

* The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

** Chief of Factory Division, Department of Industrial Works, Ministry of Industry, Bangkok 4, Thailand

id.79-908

with
08745

United Nations Industrial Development Organization

IDO

Distr.
LIMITED

ID/WG.293/11
ABSTRACT
5 February 1979
ENGLISH

Workshop on Fermentation Alcohol for Use as
Fuel and Chemical Feedstock in Developing Countries

Vienna, Austria, 26 - 30 March 1979

ABSTRACT

POWER ALCOHOL INDUSTRY FOR THAILAND POTENTIAL AND PROSPECT*

by

Ta-noo Vicharangsan **

The kingdom of Thailand is striving to stabilize her agricultural outputs. Surplus production in agricultural crops is a normal occurrence, and the nation's economy suffers as a consequence. With all of liquid fuel requirements met by importation, this country faces heavier payment deficits as oil price rises. Power alcohol from agricultural materials will help solve this country's plight.

Suitable raw materials for alcohol production, e.g., sugar cane, cassava, etc., are abundant and more of these could readily be cultivated for alcohol production should power alcohol industry be established.

---

* The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

** Chief, Factory Division, Ministry of Industry, Bangkok, Thailand

At present, the government is seeking appropriate measures to promote this new industry, and an official engine and road test program is under way to comfirm the compatibility and to ascertain the applicability of the alcohol blended fuel in all areas of the country.

An alcohol-gasoline blended fuel containing 20% alcohol for domestic consumption would require 400 million liters of alcohol per year immediately, rising to 1,000 million liters per year in ten years. Further demand might arise should the use of alcohol in diesel engines become practical.

The rural economy would improve if power alcohol program could be instituted successfully. Local investors and grower-groups would be ready to invest once they could be convinced of the feasibility of the program.

THE NEEDS

The energy crunch of to-day is affecting the kingdom of Thailand as well as many other developing nations. Having no sources of liquid fuels of her own, Thailand is totally dependent on importation for supply of fossil fuels in the form of crude oil. With the perpetual rise of oil price in the world market foreseen, Thailand faces increasing payment deficits as oil price continues to rise. This country is now spending more than a quarter of import expenditures in energy bills.

Search for oil on land and off-shore is underway. So far, some consolation has been derived in the form of natural gas found in the Gulf and large sums of money will be invested to pipe the gas to be used as fuel in power stations, as feedstock for some heavy industries and for home consumption.

At the village level and in the rural areas in general, wood and charcoal are the main fuels for cooking and other heating activities. Considerable amount of forest land is denuded each year for firewood and charcoal making, and now only 37 per cent of Thailand remains forested, and this is below the safe minimum ecological level. Re-afforestation programs cannot replenish the loss of forest land by firewood cutting, charcoal making and illegal logging, if these activities are allowed to proceed at the present day rates.

POWER ALCOHOL : DAWN OF HOPE ?

The advent of alcohol-blended fuel as automotive fuel in many countries has been watched intently by Thailand as these countries applying this energy conserving concept use agricultural materials to produce alcohol. Successful implementation of alcohol-blended gasoline in Brazil and the United States of America in present day conditions has instilled hope in Thailand's quest for means to ease her imported fuel burden. This country is now consuming more than 2,200 million liters of gasoline annually, and close to 4,000 million liters of diesel fuel annually. With nearly a million motor vehicles on the road, plus farm machinery and other prime movers, the consumption increases 8-12 per cent each year. If a portion of these fuels could be produced domestically, as in the case of alcohol from agriculture, it would be a blessing, and it would give an impetus to rapid economic recovery.

Adding alcohol to gasoline would lessen harmful effects of automobiles exhaust. Bangkok traffic has caused concentrations of toxic elements in the exhaust emission to rise far above safe maximum levels in many areas, thus endangering life and health of the population accordingly.

Total consumption of wood for fuel in Thailand is estimated at 60 million cubic meters per year, of which half goes to commercial charcoal. Virtually all fuel-wood is for residential cooking and heating.

A woodfuel substitute is needed immediately, and alcohol, from sugar cane and other sources, might be part of the answer to halt forest destruction, allowing replanting to take hold. Alcohol-fuelled cooking stoves could be developed and in case of kerosene shortage, alcohol could give light to the villagers' lamps.

THE GOALS

The Thai Government is initiating the development of an agro-alcohol industry to provide a liquid fuel supplement for the consumption of the nation's motor vehicles, and to provide a nucleus for related industries utilizing co-products and by-products of the agro-alcohol industry. The primary goals of the development program are to utilize over-produced agricultural crops such as sugar cane and cassava in a gainful production of supplementary fuel thus helping to stabilise the equilibrium of the agricultural sector, and easing the heavy burden of the nation's imported fuel costs. Other important goals include reduction of toxic elements from the motor vehicles' exhaust and provision of income to the population in rural areas.

PRESENT STATUS

Production of Alcohol

Until recently, all alcohol produced in the country was for human consumption. Yearly distilled liquor consumption has reached 75 million liters in alcohol 95 v/v equivalent. Alcohol is produced in some 40 distilleries scattered throughout the Kingdom. Raw materials are sugar cane molasses and rice. Surplus molasses is also an important export item.

Demand of alcohol for liquor blending overseas has resulted in establishment of two distilleries processing molasses for export-alcohol. One has a capacity of 60 KL per day and is exporting its alcohol to Japan. The other is of 200 KL per day capacity and is under construction at a location near Bangkok.

Power Alcohol Scene

Since the beginning of the worldwide oil crisis, there has been an awakening in Thailand for the need of alternative fuels, and alcohol has been regarded as a renewable fuel with a promising future. Toward the end of 1973, the Factory Division of the Ministry of Industry was assigned to study and investigate the possibility of using alcohol-blended gasoline to fuel motor cars. In 1976 a road test was made employing 5 sedans, using 95 v/v alcohol from cane molasses as the fuel blend. It was found in this test that, with the engines tuned to the premium grade gasoline (95 RON), alcohol-blended fuels (83 RON base) containing from 15 to 25 percent of alcohol could be used satisfactorily without altering engine adjustment.

Following the encouraging result of this primary test, an attempt was made to conduct, by foreign assistance, a feasibility study on power alcohol production. At the same time, objections to implementation of such a plan were forwarded by many organizations in the government, and many more expressed doubts as to the feasibility of alcohol-gasoline blend. In 1977, the Ministry of Industry sent a 5-man study team around the world on a fact finding mission. The team witnessed the production of power alcohol and its usage as car fuel in Brazil. The team's report has resulted in a continuing study and assessment of this fuel.

THE POTENTIALS

In the private sector, there has been even a keener interest in this matter. Surplus production in agricultural crops is a normal occurence in Thailand, and the results are invariably the same : the growers suffering from the low prices of their crops, and

often compelled to switch over to growing other crops, only to find out, to their dismay, that the new crops are now also over-produced. Such occurence has done considerable damage to this agricultural -based economy. Sugar cane and cassava are examples of those crops plagued with problems of over-production, as demands for these crops depend on world market situations and protective policies of importing nations. Presently, the growers as well as the government are searching for an outlet for a stable demand for these crops, and power alcohol industry may be one answer to their problems.

Even if there is not yet a definite government policy on power alcohol, a few investors and cane-grower groups, deeming that implementation of this renewable fuel is inescapable, are pressing ahead with plans to establish distilleries for this purpose. One cane-grower group intends to convert their semi-finished sugar mill to a 120 KL per day alcohol distillery from cane plus a bagasse particle-board plant, the project will be expanded to produce 100 million liters of power alcohol par year. More plans are on drawing boards to build alcohol distilleries for fuel and for chemical feedstock.

These investors are requesting the government to give guidance and assistance to their operations, viz: issuing of an alcohol-blended gasoline implementation program, pricing and distributing systems, allocation of appropriate raw materials, exemption from excise tax on ethyl alcohol, etc.

Agro-Fuel Test Program

At present, an alcohol-fuel test-program, conducted jointly by the Ministry of Industry and the National Research Council, is being conducted. A dozen motor cars and a number of stationary engines are employed in this test program. The test includes usage of alcohol-gasoline blended fuel of various ratios in test cars for day-to day use in the traffic congested Bangkok, and in cross-country driving; several trips of more than 2,000 km. have been made. The alcohol used is of 95% v/v quality, since anhydrous alcohol in substantial quantity is not available. The results so far are encouraging. However, it remains to be seen if the wear and tear of the engines in this case will be compatible to those run on pure gasoline.

THE PROSPECT

Alcohol and Raw Material Requirements

Should it become feasible for Thailand to adopt addition of alcohol from agriculture to gasoline to fuel her motor vehicles, at an average ratio of 20 per cent alcohol by volume in the blended fuel, it will require some 400 million liters per year of alcohol immediately to blend all gasoline consumed rising to some 1,000 million liters per year within 10 years.

Cane and cassava are designated as the main raw materials for alcohol production with cane molasses as a reserve raw material. Five million tons of cane per year could readily be obtained for this purpose from normal surplus conditions in sugar industry, and more could be

obtained with improved cultivation practice, An equal amount of cassava roots might also be obtained for alcohol production. Together with an expected amount of half a million tons of cane molasses allocated to energy production each year these raw materials would have a potential yield of more than 1,000 million liters of alcohol per year. Taking scattered growing areas, varying outputs due to climatic conditions, practical locations of distilleries and other factors into consideration, at least half of these quantities could still be obtained for immediate feeding into distilleries.

Distillery Types

Three types of power alcohol distilleries are envisaged, viz

a) Distilleries attached to sugar mills

Taking advantages of less expensive raw material (molasses), tapping of steam and electrical powers from the sugar mills for their operation, the first type of power alcohol distilleries may be those attached to the sugar mills. This rather limited but low cost operation could be expanded by fermenting also cane juice directly from the sugar mill during crushing season, and also fermenting molasses during slack season if desired.

b) Distilleries using cane juice

In some cane growing areas, surplus cane from sugar industry and cane grown specially for alcohol could be fed into large sized distilleries completed with cane crushing or diffusing equipment. This arrangement would help foster rural economic development as steady income would be re-distributed directly to the agricultural sector. However, to off-set comparatively high cost of cane, the distilleries of this type would have to rely on the ability to produce salable goods from by-products, e.g., bagasse (by making particle board or paper pulp), CO_2, etc. Off-season the distilleries might also ferment stored cane syrup and/or purchased molasses.

c) Distilleries using Cane and Cassava

When such combined operation using these two raw materials becomes practical, it would be one of the most suitable types of operation for the semi-arid land of Northeastern Thailand. Sugar cane would provide juice for fermentation and bagasse as fuel for operations during crushing season, as well as during off-season, when cassava would be used for fermentation. If a number of "production units" of this category could be developed in various regions, impacts on rural economic development would be considerable, as well as on socio-political issues.

GUIDELINES FOR PLANNING

While reports on success of power alcohol programs and several prospective ones are making headlines at present, there appear equally conflicting reports on problems of implementation in technical and economical aspects of alcohol-blended fuels.

Therefore, it is commendable to establish, on an international scale, guidelines regarding appropriate alcohol technology for developing nations who intend to embark on production of this renewable fuel and versatile chemical. Regional feasibility studies as well as country-by-country feasibility studies of promising producing areas should be conducted to appraise raw material availabilities, capacities of distilleries, suitable processes, by-product utilization, waste treatment and utilization of residues so that guidelines could be established for developing nations in planning to increase their energy independency.

In these aspects, international development agencies such as UNIDO and industrially advanced countries could foster the development of power alcohol industry in developing countries by making available

information and data on implementation of alcohol-blended fuel and sharing experience of those countries which have successfully installed power alcohol programs. Systematic fuel, engine and vehicle road tests using alcohol-blended fuels and possibly pure alcohol should be conducted in an international scale in the regions of the world where fuel from agriculture has a promising future. To facilitate technology transfer, small pilot plants for fermentation, distillation and de-hydration, as well as waste treatment and by-product recovery processes could be constructed into mobile units and arrangements made to have them shipped to developing countries, stopping in each country over a period of sufficient time to demonstrate abilities to utilize indigenous raw materials and to effectively treat distillery wastes or process them into profitable by-products. Such demonstrations would help convince local entrepreneneurs of the feasibility of the program, and help governments' planners draw up incentive and control measure for this industry.

Thailand, with her size, topography and economic and social structures, has an opportunity to develop fuel from agriculture without altering agricultural infrastructure or pattern, thus minimizing costs arising from establishment of the power alcohol industry. With inherent flexibility, the agricultural sector could expand to supply both food and fuel demands. Fuel from agriculture, therefore, has a good prospect in this country.

APPENDIX A

THAILAND : THE COUNTRY AND THE ECONOMY

LOCAL CONDITIONS

The kingdom of Thailand is on the Southeast Asian peninsula. It has an area of 514,000 square kilometers, and a population of some 45 million.

Climate

Situated between 6° and 20°N, and 97° and 106°E, Thailand's climate is tropical. Average monthly temperatures range from 32.6°C (90.7°F) to a low of 23.6°C (74.5°F)

The year is divided roughly into three seasons. From November through February, the northeast monsoon bring a cooler, drier period. During this season, early morning temperatures may drop below 10°C. in the north and 15 - 20°C. in the central region. March through June usually is hot and humid, with the temperature range of 35 - 40°C. during the day.

Geography

Terrain ranges from the sandy beaches bordering the Gulf of Thailand, through the great central plains, to the rugged mountains and jungles of the north. Mountain ranges run along the border between Thailand and Burma, extending down as far as Malaysia. The Chao Phaya River, with its tributaries originating in the north, flows through the country, providing water for agriculture as well as communication.

ECONOMY

Thailand is primarily an agricultural country, one of Asia's leading food producing and exporting areas. Agriculture employs over 65 % of the country's economically active population and accounts for an estimated 42 % of the GDP. Manufacturing and mining account for some 33 % of the GDP and is becoming more important. Currently, per capita income is about US $ 420.

Important crops are rice, corn (maise), natural rubber, cassava, kenaf and vegetables. Much of Thailand's industry is related to those primary products. There are many rice mills, corn mills, factories processing rubber products, tapioca products, gunny bags, vegetable oils, etc. A wide range of consumer goods is also produced, for the domestic market and export.

Thailand's balance of trade is generally unfavorable due to importation of capital goods for industrial development, and fossil fuels. Recently, the country has begun to face increasing payment deficits due to oil price hikes and general price rise worldwide.

APPENDIX B

SUGAR CANE PRODUCTION IN THAILAND

THAI CANE SUGAR INDUSTRY

The Thai sugar industry was developed primarily to supply cane sugar for the domestic market. However, growing demand in the world market during the 1960's and early 1970's has brought about considerable growth to this industry whose expansion currently has been geared mainly for export. Originally, the export of sugar began with a modest quantity of 14,000 tons in 1967. Ten year later it peaked at 1,640,000 tons. During the same period, domestic consumption has risen from 200,000 tons per year to some 500,000 tons per year.

The quantity of sugar cane increased year-by-year due mainly to expansion of cultivated areas. Within a span of ten years, the total area planted to cane increased, from 72,000 Ha. in 1967/8 season, to 566,000 Ha. in 1977/8 season. Cane harvest increased from 2.38 million metric tons in 1967/8 to some 26 million metric tons in 1976/7, dropping (due to slump in world sugar market) to 19 million tons in 1977/8 season.

There are two main cane areas in Thailand, i.e., the central region where 70 per cent of cane output is harvested, and the eastern region where some 15 per cent is harvested. The remaining quantity of cane is produced in the northern and north-eastern regions. Map I illustrates cane growing areas of Thailand.

Thailand's 45 sugar mills have a combined cane crushing capacity of 250,000 metric tons per day, and nearly three-fourths of their production is available for export. Raw sugar is produced for export only, while double-sulphitation and double-carbonation white

sugar is produced for domestic consumption. Some refined sugar is produced for food and beverage industries.

CANE MOLASSES PRODUCTION

Between 4.5 - 5.0 per cent cane by weight of molasses is released in the sugar making process, and molasses production is around 1.0 - 1.2 million metric tons per season. Present domestic consumption is half a million tons per year as raw material for liquor distillation, food essence, animal feed and some yeast production. Increasing quantity of molasses is used to produce ethyl alcohol for export, and some 18 million liters per year of export alcohol is currently produced. The remaining quantity is exported as raw material to various countries.

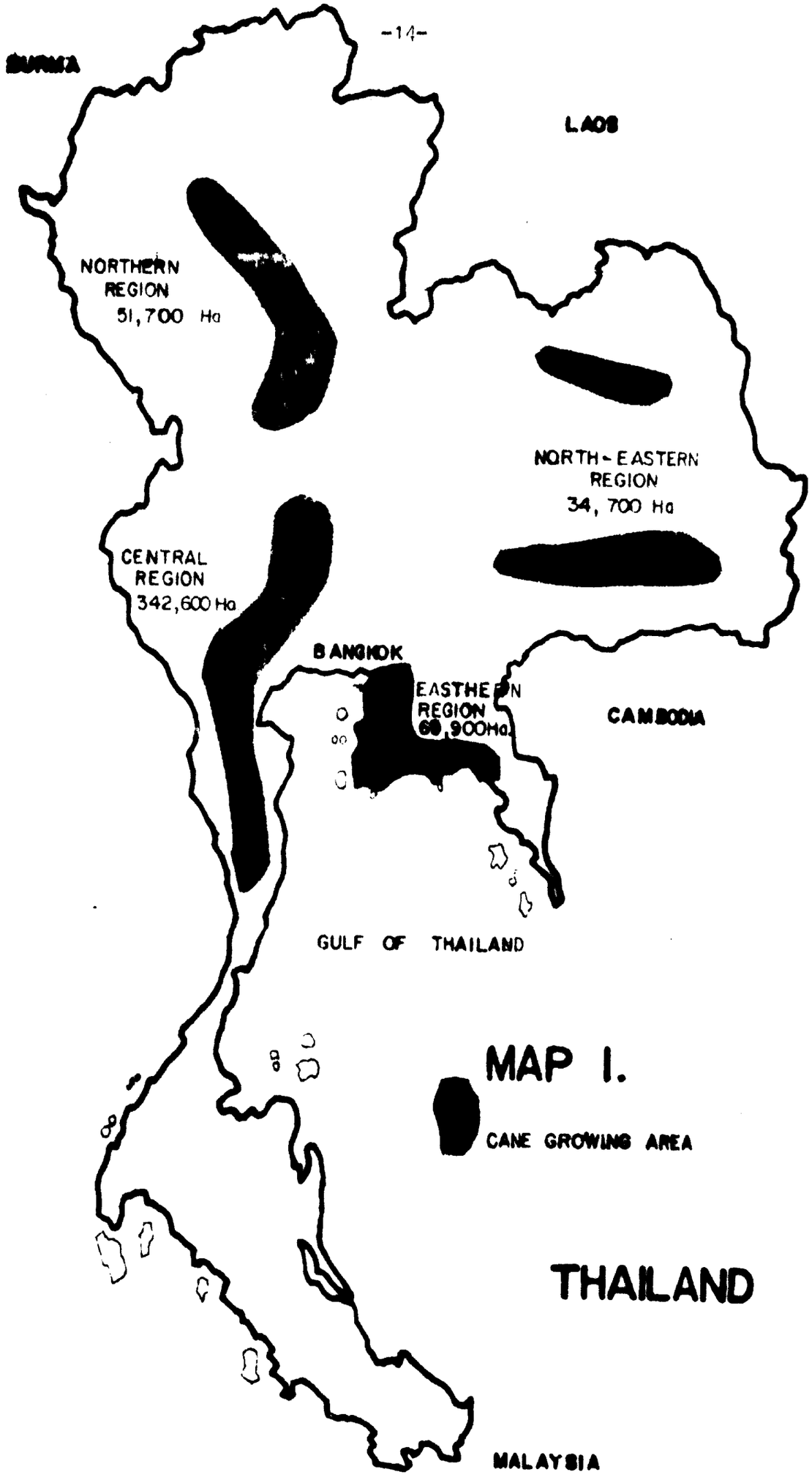
CANE BAGASSE

During each crushing season, 6-8 million metric tons of fresh cane bagasse is released from the cane crushing process. Due to lack of organized collecting procedure, almost all of the released quantity is burnt as boiler fuel in sugar mills, and less than 100,000 metric tons per year is collected for use in paper pulp manufacture.

References

1. Netayarak, P. "Impact of Joining International Sugar Agreement", Essay on current problems, Bangkok, 1978.

2. Thai Farmers Bank, "Sugar", Technical document, Bangkok, 1978.


BURMA
LAOS
NORTHERN
REGION
51,700 Ha
NORTH-EASTERN
REGION
34,700 Ha
CENTRAL
REGION
342,600 Ha
BANGKOK
EASTHERN
REGION
68,900Ha.
CAMBODIA
GULF OF THAILAND
MAP I.
CANE GROWING AREA
THAILAND
MALAYSIA

APPENDIX C

CASSAVA PRODUCTION IN THAILAND

Cassava, while grown predominantly in the eastern and northern areas of Thailand (see map II) is a common crop throughout the country.

Cassava owes its wide popularity to its extraordinary characteristics. It is a tropical zone crop, and grows well between the latitudes of 30 degrees north and south of the equator, and will thrive at altitudes of up to 1,000 meters.

Cassava is drought resistant. Thus no irrigation is necessary for the planting and growth. Another of cassava's attributes is that it does not matter very much where it is grown, and in Thailand its prime importance is that it can produce results in soils where no other crop will grow. This means soils which are either very low in nutrients or which have a high degree of acidity.

Although in some countries cassava is affected by a wide variety of diseases, in Thailand it is curiously free of any disease so far. Even in those countries where disease is known, cassava is considered a disease resistant crop.

Cassava has no set harvest season, and the planter can decide when to harvest his crop. This can be determined by high prices for cassava roots, the need for cash by the planter, or simply because it happens to be the most convenient time. There are, of course, limits to the harvest period. If the crop is left in the ground too long it will become too large, too fibrous and lacking in starch, while if it is harvested too early it will be too small to generate good financial return.

Probably the greatest controversy concerns the effect of cassava on the land it grows in. Some agronomists charge that cassava leaches the soil of its nutrients as demonstrated by declining yields. They say that if sufficient fertilizer is added to the soil to maintain its quality, cassava becomes uncompetitively expensive, and that the growers are merely robbing the soil to earn a short term advantage.

Cassava's proponents, while not denying the charges, point out that all crops naturally extract nutrients from the soil, and that the process is more noticeable with cassava because it can grow on very poor land with little nutrients if any.

Another of their arguments is that the declining yields do not continue indefinitely, but yields will reach a stable level after some years. Further, recent research has shown that yield can be increased by following normal agronomic practices.

Thailand's Cassava Production

Cassava Root Production 1970-78

Year	Planted Area (million Ha.)	Roots (million tons)	Yield (tons/Ha.)
1970	0.22	3.43	15.25
1971	0.22	3.11	14.06
1972	0.33	4.95	14.75
1973	0.43	6.41	15.00
1974	0.48	6.24	13.00
1975	0.59	8.11	13.63
1976	0.72	10.00	13.94
1977	0.84	10.25	12.19
1978	0.96	12.37	12.89

Source : Ministry of Agriculture

Thailand's Cassava - Product Export

	1974	1975	1976
Pellets	1,924,647	2,036,110	3,252,439
Flour	254,969	141,676	241,200
Chips and Waste,	105,711	67,989	63,721
Total	2,285,327	2,245,775	3,557,360

Source : Thai Tapioca Traders Assn.

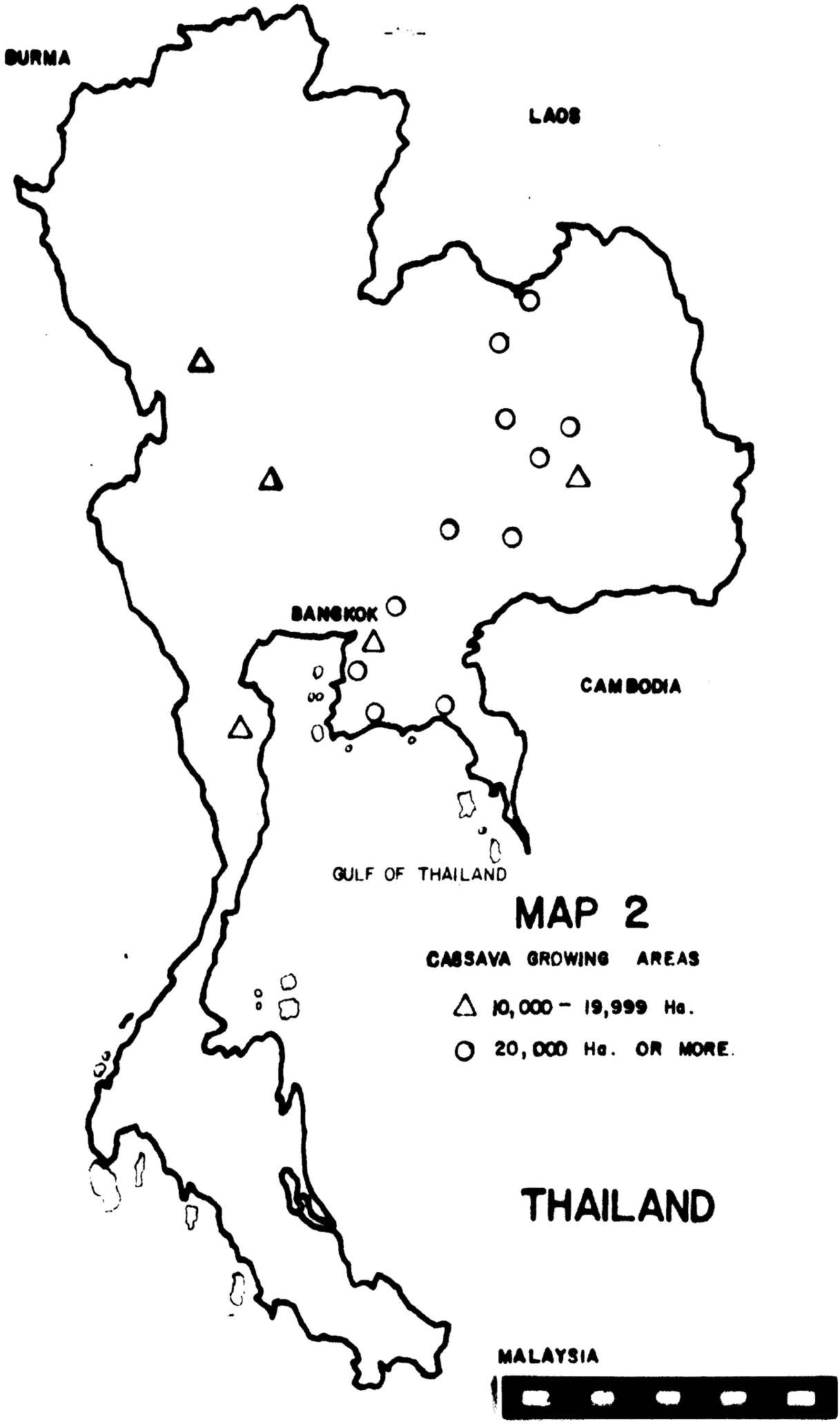
Unit : metric tons

Major markets of Thailand cassava-products are EEC and Japan.

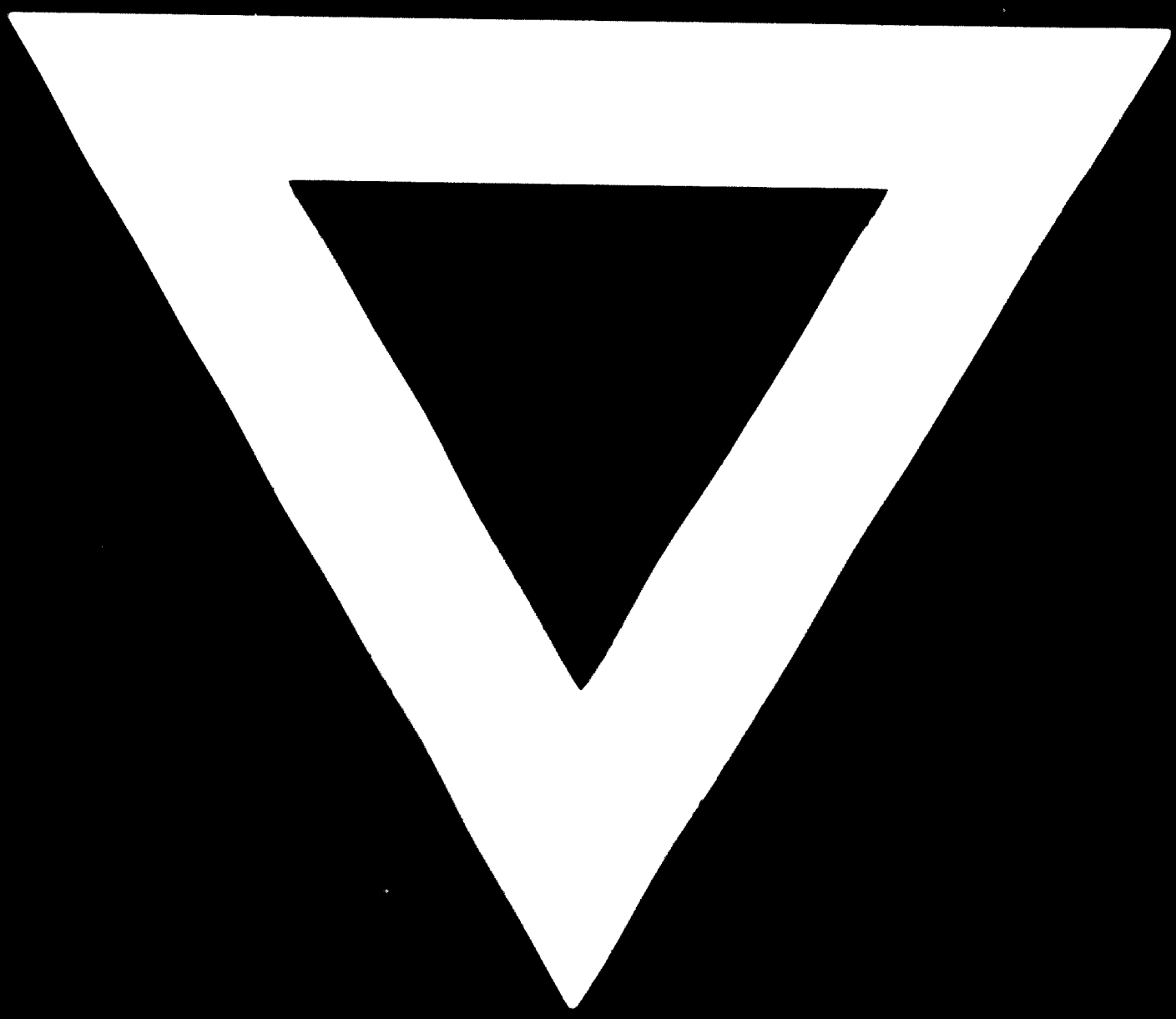
References

1. Sharp, T. "Tapioca," Bangkok Post, Bangkok, Thailand, Thailand, August 29, 1977

2. Ministry of Agriculture, "Cassava, Statistics on Planted Area and Production," Bangkok, Thailand, August, 1978


BURMA
LAOS
BANGKOK
CAMBODIA
GULF OF THAILAND
MAP 2
CASSAVA GROWING AREAS
△ 10,000 - 19,999 Ha.
○ 20,000 Ha. OR MORE.
THAILAND
MALAYSIA

G-83



80.02.04