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**APPROPRIATE TECHNOLOGY
FOR
FOOD STORAGE AND PROCESSING**
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FOOD STORAGE AND PROCESSING IN THAILAND

Background Paper

FOOD STORAGE AND PROCESSING
IN THAILAND

by

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As in most South-east Asian countries, agriculture is Thailand's economic base. The continued stability and growth of its economy is dependent upon its ability to produce sufficient and good quality food for its population and surplus food for export.

Agricultural crops, fish and meat which provide the basic materials for food processing industry are quite abundant in Thailand in comparison to some other developing countries. However, raw material availability, important as it may be, is only one of the many factors governing the prospect of food industry development in a country.

Storing and packaging are very important for the food products during consecutive harvests, particularly those products that lend themselves to process and preservation. Fruit storage helps to preserve the excessive supply of fresh fruits and make them available during the off-season periods.

The products which have been processed and properly packaged to importing countries standards represent an important source of income to developing countries, with the natural resources to generate surpluses of exported agricultural products. Proper processing, preservation and packaging are particularly important in the cases of meat, fish, fruits and vegetables, if distant markets are to be supplied.

1. MAJOR FOOD PROCESSING IN THAILAND

Seafood processing

The fishing industry is a major contributor to the country's economy. Along with the fishing industry it has developed linkage industries such as cold storage, ice plants, refrigerated transport, canning, fish meal plants, fish sauce factories, etc.

Of all means available for processing seafood, cold storage is the most common. Included with cold storage should be the refrigerated transport, which makes it possible for the supply of seafood to reach provincial cold storage. The important methods for processing fish when group together are drying, salting, smoking, steaming for the domestic markets.

Seafood canning is also used widely and it is divided into two groups - one for export and the other for domestic consumption.

Seafood processing has lately been a fast growing industry. Its progress is greatly beneficial to the country's economy.

Dairy processing

The bulk of the industry consists of the manufacture of condensed and evaporated milk recombined from imported milk solids. At present, some fresh milk is locally produced for consumption, while some is locally processed into reconstituted milk.

Other dairy products such as fresh milk and pasteurized milk are growing at satisfactory rates. Sterilized milk by UHT process is recently introduced into the local markets.

Fruit and Vegetable processing

Canning is the major process for preservation of fruits and vegetables. Among Thailand's export of canned food, pineapples undoubtedly occupy the most prominent place; more than 90 per cent of them are being exported.

Apart from canned pineapples, the others are longans, rambutans, water chesnuts, lychees, fruit cocktails, mangoes sliced etc.

Among the vegetable categories are bamboo shoots, asparagus, green beans, champignon and straw mushrooms, cream corns, and young sweet corns, etc.

Besides, there are number of traditional processed foods that enjoy good domestic markets. They are, for example, dehydrated and pickled such as dried banana, pickled vegetable and fruits, fish sauce, shrimp paste, dried meat, pork sausage, fermented bean curd etc.

2. TECHNOLOGY PLANNING FACTORS

2.1 Among other processings, the fruit canning industry, dominated by the production of pineapples for export, now represents the largest sector in the processed food industry.

The high demand from overseas has created the rapid growth of Thailand's canning industry, particularly for canned pineapples. From 1973 to 1976, the production had increased almost fivefold.

Within the last few years a number of modern plants for processing canned food have been set up and enjoying an expanding market.

2.1.1 Canning process for pineapples

Canning process itself is a very simple operation. There are a few basic steps which aim at cleaning and preparing the raw material for canning. The process is conducted by the continuous production lines which use a certain uniformity of models and systems.

After the arrival of the fruits at the factory, they travel along the conveyer belts to the grading machine which determines automatically the size and weight of the pineapples. Next comes the washing and peeling operation. The machine transforms the fruits

from raw state into juicy yellow hunks. The hard exterior is sliced away and the core is cut out. Excess pineapples are squeezed with the resulting juice flowing from the machine to be packed as pineapple juice in tin-cans.

After the pineapples have been peeled and cored, the eye spots of the pineapple are cut out by hand using scissors or tweezers as they are transported along the trimming table.

The fruits are then sliced or cut into desired shapes and sizes such as rings, chunks or pieces. The product is put into tins and syrup is added. The tins are then vacuum closed automatically and sterilized. The cans of pineapples are stored at least seven days, in case there occurs any leakage, after which the product is checked and automatically labeled and packed for shipping. The tins which carry the pineapples around the world are mostly produced inside the canneries.

Thailand entered the fruit canning business since 1967. Presently there are about 8 or 9 major companies producing canned fruits. Total capacity of canned pineapples is approximately 10 million cases (24 x 20 oz). The actual production is about 50 per cent.

The major apparent problems are: the inability of the growers to raise their crops up to the quality standard required by the factories, lack of suitable fresh fruits and raw materials, the instability of raw materials' prices, etc.

Every major cannery tries to have its own plantation, where the growth and maturity of the fruits are scientifically regulated and controlled, to harvest the desired tonnages by using plant hormones. Even though the plant hormones are utilized to encourage off-season fruiting,

it proves impractical because of the weather. The pineapple packers continue to have problems with seasonal supply until now.

2.1.2 The annual canned pineapple output is approximately five million cases; more than 90 per cent are sold abroad, while the rest is catering to local demand. Local consumption is confined to meagre growth, since all kinds of fresh fruits are readily available in all seasons and at a lower price, thus making the demand for canned fruits unnecessary.

The high demand from overseas has been responsible for the rapid growth of pineapple industry.

The pineapple output of 6 major producers in 1975 was approximately 40 tonnes^{1/}, compared to 30 tonnes in the previous year.

Quality of canned pineapples produced by large canneries is up to standard. Throughout the operation, the samples are taken to check for size, thickness, sweetness and other general qualities.

The cottage scale canneries are in general unsophisticated, inefficient and unhygienic.

The production of canned pineapples for export has to compete in the world markets, and to meet the strict import restrictions of the customers like the United States Food and Drug Administration.

Quality control and sanitation of canned pineapples are very important not only to retain the product quality, but also avoid loss of business through foreign markets.

In 1973 The Thailand Industrial Standards Institute (TISI) published its standard on canned pineapples, of which everything is specified ranging from the sweetness to the required number of pieces in the can.

^{1/} 1 tonne = 74 cases

The exporting canneries are required to obtain licenses from TISI in order to export. Since USDA standards are very high, those companies that have successfully been exporting to the United States have no difficulty in obtaining TISI licences. At present there are more companies carrying the TISI mark.

Man-power requirement for the major canneries in 1973-1975 was approximately 6,000 persons. During the peak season of pineapples - from April to August - the labour requirement is increased (not including the people who work in the pineapple fields). For full capacity production, it would require about 10,000 persons in the pineapple canneries.

In the early stage of development of canning industry, the canneries were equipped with Taiwanese equipments because their prices were relatively cheap. In recent years, there has been a change in attitude. The new factories install more expensive and high quality equipment from Europe or the United States.

A large cannery, recently opened this year, has spent 170 million baht building the most modern canning factory in South-East Asia, with the production capacity of 2.4 million cases.

The small operators utilize semi-automatic or manual equipment to do the job.

2.2 World demand for canned pineapples stands at approximately 50 million cases per year. The main markets of Thai pineapples are Germany, the United States, Canada, Spain, etc. The competitors are South Africa, Mexico, Malaysia, Taiwan and the Phillipines, etc.

The production of Thai canned pineapples can meet only about 5 million cases. Presently, Thailand is the world's third largest exporter and the Asia's second largest supplier.

With the projected production of 3 million cases, the industry is still only working at about half of its capacity of 10 million cases. It is felt that if the industry could produce at full capacity, it would result in a world glut and a possible collapse of the local industry.

Many problems prohibit the achievement of full operating capacity. Besides the problem of raw material supply, it will be the security aspect on pineapple plantations and canneries - like the loss of a large quantities of fresh pineapples from the plantations, labour unrest, etc.

A preliminary study by the Applied Scientific Research Corporation of Thailand and the National Economic and Social Development Board in 1976^{1/} has shown the production cost of canned pineapples per case (24 x 20 oz), averaged from three major exporters as follows:

<u>Raw material</u>	<u>Value (US \$)</u>	<u>%</u>
Pineapples	1.91	40.83
Cans	1.58	33.73
Syrup	0.18	3.93
Labour	0.19	3.98
Labels and paper box	0.44	9.37
Others	0.38	8.16
Total	4.67	100

The production cost is approximately US \$ 4.67 per one case. The distribution cost for export in 1975 was US \$ 0.475 per kilogramme, or US \$ 7.40 F.O.B. per one case.

^{1/} Menasuit, K.- The canned fruits industry. The National Economic and Social Development Board, 1977. (Bangkok).

It is learned that Thai pineapples can compete successfully in the international markets. Not only does the country have ample land, but its cheap labour pool and abundant supply of sugar additive allow Thai canneries to keep their prices very competitive with the rest of the world.

- 2.3 Pineapple factories are mostly located close to the plantation in the central area of the country. The raw materials are more readily available and can be transported to the plant in a matter of hours after harvesting.

The uncertainty of pineapple supply has led to the fluctuation of its price. The farm price of pineapples increased from US \$ 0.056 to US \$ 0.076 per kilogramme from 1968-1975. There is also a competition in price between the canneries and the local market for fresh consumption. This is good to the growers, since it helps to ensure a continuing high price for agricultural products.

The use of pineapples as raw material in the canneries boosts the farm sector and those industries associated with them. The long-term strategy is to find more jobs for unemployed rural residents. Even though labour requirement of canning industry is not as much as other industries like textile, but it increases a considerably income for the provincial people. At least 6,000 persons are employed in the canneries during the peak season of pineapples. For the full capacity it would require approximately 10,000 persons.

The canning industry also develops the relationship between the factories and the farmers. Frequently, food and agricultural experts from the factories go out to give advice and training to the farmers on the use of modern technology and facilities that would help increase their production and upgrade their income simultaneously.

The pineapple canning is mostly produced for export purpose which helps the economic development of the country. In 1975, Thailand exported canned pineapples at value of 345 million baht and 600 million baht in 1976. Only the first six month of this year, 53,910 tonnes of canned pineapples at value of 564 million baht are exported to various countries.

The country's infrastructure is an important aspect for the canneries. In many provinces the investors satisfy on most of the major factors. There are attractive investment incentives, ample of natural resources and a large pooled of easily trained labour.

There is a good network of national highways and they are strong and wide enough to take any sort of load. Those farm-to-market roads are considered vital at the present stage of development, since they are very important both to the farmer and industry to carry their produces to the market.

At least four major pineapple canneries are located on the side of the highway with good public power supplies.

Factories need power, although this is not so critical because diesel generators are installed to produce their own electricity. However, it is still important.

Thailand produces no oil of its own. Hydroelectric power from a number of dams supplies a largest percentage of power.

Distribution of electricity is improving rapidly. The factories located near a provincial capital would be able to buy supplies of electricity from the Provincial Electricity Authority. Within Bangkok, the supplier would be the Metropolitan Electricity Authority. The remote factories install their own generators.

Water supply comes from the factories' own well water with a good treatment system to ensure the supply of safe and suitable water for the production.

The security aspect on pineapple plantations and canneries is quite a problem. Frequently, a large quantities of pineapples are stolen from their plantations by organized gangs and most of them are armed. Besides, many poisonous snakes are always around the plantations and kill many workers. The lack of seasonal employment is another problem.

- 2.4 The supply of pineapples to the canneries comes from three sources; the growers which make contract with the canneries, factories' own plantations, a purchase from the growers.

The area of plantation for pineapples has increased every year to meet the need of the canneries. Frequently, sugar canes and coconuts are losing ground to pineapples. A total of approximately 400,000 rai of land is devoted to grow pineapples in 1977.

For social aspect, there has been development relationship between the farmers and the industries. The farmers who have come to work in a cannery plantation have passed through a fairly rapid shift, a socio-technological change of major proportion.

3. AREA DEVELOPMENT FACTORS

Of Thailand's total area of over 51 million hectares^{1/}, it is estimated that about one-third is currently farmed or potentially cultivable. A total of about 9.3 million hectares are now under cultivation. Of these, about 7.7 million hectares

^{1/} 1 rai = 16 hectares

are lowland paddy soil mostly suitable only for rice. The remaining 1.6 million hectares are upland soils used for a variety of crops. Another 9 or 10 million hectares are judged to be suitable for farming.

The population of Thailand was estimated at about 43 million people in 1977, of which over three quarters are engaged in agriculture.

The production of pineapples is concentrated in the central plain region such as Prachuap Khiri Khan, Chon Buri, Phetchaburi, etc.

There are seven major fruit canneries located in central and southern regions, another two factories are up north.

The factories in central part such as in Prachuap Khiri Khan and Phetchaburi are close to the pineapple plantation area, where as the factories in Chon Buri, east coast area, is close to the port. It saves the transportation cost from the factories to the port.

The canneries in the north such as, Chiang Mai and Lampang, about 70 per cent of the pineapple supply have to be loaded in truck from the central area to the north. The advantages for the factories in the north are: availability of labour with lower wage rate and many kinds of fruits and vegetables such as longans, rambutans, green and string beans, etc. are plenty during the off-season of pineapples.

Geographical location of some provinces which produce canned fruits^{1/}

Lampang: Northern region, about 600 kilometres north of Bangkok. Total area is 12,518 km², out of the total area, 9,760 km² is forest, 1,200 km² is paddy field, and 1,504 km² is prairie.

^{1/} The above information is supplied by the Economic Studies Department, Applied Scientific Research Corporation of Thailand.

The population in 1977 is 643,260 persons.

Income per capita is approximately 5,471 baht.

The province is rural structure.

There are sugar cane factory and canning industries in the province. It is also a good source of various kinds of fruits and vegetable.

Chon Buri: Eastern region, about 80 km from Bangkok. Out of the total area, 632 km² is under paddy field, 573 km² is for upland crops plantation, and 1,020 km² is forest.

The population in 1975 is 644,052 persons.

Income per capita/year is 8,700 baht.

The province is both urban and rural structure.

There are sugar cane factory, fruit and vegetable canneries, and many tapioca products factories, etc. in the province. A large area devoted to fruit, vegetable, and tapioca plantation.

Prachuap Khiri Khan: Central plain region about 400 km west of Bangkok.

The population in 1977 is approximately 344,127 persons.

Income per capita/year is about 7,000 baht.

The province is rural structure.

There are many pineapple conneries located in the province. It is a good source of fresh pineapple production, or a heart of pineapple belt.

Production figures testify to the new importance of pineapple in the economic life of Prachuap Khiri Khan Province. The province supplies pineapples both for canneries and the local market.

Employment pattern in all areas:

Age group: 18-60 years

Education:

unskilled - up to primary school
skilled - technical school,
university graduate,
foreign technicians or
experts mostly from south-east Asia.

4. COMMENTARY ON FUTURE TECHNOLOGICAL DEVELOPMENT

The impressive growth of canning industry, especially canned pineapples, in Thailand during the past three years, has established the country as one of the foremost suppliers in the world market.

Canning of pineapples is a highly competitive business. It is also labour and capital intensive. To be able to make profits, it is necessary to achieve economies of scale through high volume production; otherwise it is not possible to compete with other countries in the world market.

There are many factors that can hamper the future prosperity of the canning industry, such as the insufficiency supplied of suitable raw materials for canning, labour unrest, etc.

The prices of canned pineapples fluctuate widely and are influenced by the surpluses and shortages from major suppliers like Hawaii, the Philippines, and Malaysia, all of which have established markets in many countries.

Recently there has been a new dehydration technology applied to process the fruits for export purpose. It starts with the dehydration of green cayenne pineapples, papayas and bananas. The dehydrated pineapples be added with water, as the instructions on the package, and chilled in a refrigerator. Then it will be slices of pineapple in syrup.

Dehydration process can remove 80 per cent of water content from pineapple slices by using dry steam. The process leaves all the good flavour of fruits and food value, and merely takes away the bulk and weight of water.

The shelf-life of the product is expected to be about six months. If stored in a cool dry place, the period becomes considerably longer without the fruits losing any of its flavour after it is reconstituted.

When six tonnes of raw material are peeled, cored, sliced and screened for defects and go into the dehydrating oven, the product comes out about one tonne.

The weight of canned fruits is nearly triple the weight of dehydrated fruits.

With a capacity of 60 tonnes of finish product per month, the investment is six million baht for the plant, this includes the machinery, equipment and imported technological expertise from ^{a country in south-east Asia.} The plant employs about 50 local persons.

Many kinds of fruits such as seedless papayas have never been exportable as fresh fruits unless they are airfreighted at tremendous cost and the receiving end is very well prepared.

The dehydration process can be applied to all kinds of fruits at international level.

4.1 Potential development

4.1.1 Product diversification and maximization of production capacity.

For the canned product, the exports of other kinds of canned fruits are still small but prospects for the development have been promising. Large canning companies are adapting their lines to diversify and operated at full capacity year round. As the pineapple supply is gradually

being brought under planned control, some factories are contracting and shifting to the processing of other fruits. The diversified firms produce orange and tomatoes juice, asparagus, champignon mushroom, other fruits and vegetable which are available during the off season of pineapple for the maximum utilization of the facilities.

Another attractive pineapple product which seems to have a very good potential for export, a quick-frozen fresh pineapple flesh and concentrated juice.

The fruits supplied the frozen pack normally are carefully selected, fully riped, therefore the fruits retains their delightful flavour and aroma.

The frozen fruits have not been widely produced at present. There is a general lack of knowledge of frozen technology except where this can be obtained from abroad.

Investigation of quick-frozen process for fruits and vegetable aimed at the conservation of energy utilization has been planned at the Applied Scientific Research Corporation of Thailand (ASRCT). It has not started yet, due to the lack of certain essential equipments needed for the process.

4.1.2 By-products and/or waste utilization

The waste of pineapple is obtained from the fruit residue produced during the canning process, and from the leaves and stems of the plant. The progress in development of by-products from leaves and stems of pineapple has been very slow, at present it is used for land filling and, to a small extent, cattle feeding. The emphasis in utilization of waste is placed on the fruit residue.

The possibility exists that the product obtained by drying the pineapple waste after pressing can also be used as high-quality animal feed by mixing with other ingredients such as rice bran etc.

In addition, pineapple waste might become a commercial source of raw material for the production of protein-digestive enzyme, bromelain.

To utilize waste from the pineapple industry, further research and development are needed. A certain modification will be also required in the existing plant to upgrade the products from waste suitable for human consumption or other products of industrial use.

Preliminary investigations in this field have been conducted at the Applied Scientific Research Corporation of Thailand. However, due to the lack of suitable facilities - equipment, technical assistance, there has been insufficient progress made in this connexion. The support by foreign agencies for the research and development is needed. The results of the various research activities of these projects will encourage the industries which make a significant contribution to the economic development of the country.

4.2 Packaging technology: problems and prospects

4.2.1 Statement of problems

In a tropical country like Thailand where fresh vegetables, fruits, fish and meat are available all the year round, the domestic demand for processed or preserved agricultural products is naturally low. Numerous plants for processing canned fruits, fruit juices, meat products, milk products, fish products, frozen meat, seafood products and bakery goods are serving the domestic market on a limited scale. However, in the fruit product canning and frozen seafood areas, companies have established good foreign markets for their products.

Packaging is very important for the storage of food products during consecutive harvests, particularly those products that lend themselves to process and preservation. These products which have been processed and properly packaged to importing countries standards represent important sources of income to developing countries with the natural resources to generate surpluses of agriproducts which can be exported. Proper processing, preservation and packaging are particularly important in the meat, fish, fruit and vegetable areas, if distant markets are to be supplied.

With the exception of companies with established foreign markets or linkages with foreign technology, packaging technology in Thailand is in the early stage of development. Some industrial and government leaders have recognized the lack of technological capability, but it is only in the last few years that the development of packaging technology and the need for standards in the area of packaging have been gaining additional support. However, domestic research in the area of packaging is very limited as there does not exist a laboratory with the necessary equipment to conduct research and development in the packaging area. The problems in the packaging technology of Thailand as a whole are the apparent lacking in the quality control, technical development and packaging innovation.

As a result of the lack of technical knowledge and an appropriately equipped food packaging testing and development laboratory, there are numerous examples of product lost and damaged during distribution to export markets. The entire arrival shipments of products exported from Thailand have been rejected. These problems are evident in choosing the appropriate type of packaging based on the characteristics of the product, storage conditions, handling, transport, distribution and customers's requirements.

4.2.2 Technological development plan

- 1) Identification of retail packaging test methods.
- 2) Consumer package specification development.
- 3) Application of materials and packaging methods to improve consumer package.
- 4) Analysis of the distribution environment including packaging storage, handling and sales.
- 5) Development of shelf-life data for different packaging materials utilized for the same product, and product/package compatibility information.
- 6) Analysis of various packaging methods.
- 7) Transport package test methods, specification and standardization.
- 8) Analysis of foreign transport packaging systems for domestic adaptation.
- 9) Analysis of improved utilization of the packaging materials used in transport packaging.
- 10) Investigation of the applicability of special packing techniques.
- 11) Analysis of problems in transport packaging in a tropical environment.
- 12) Packaging material test methodology and specification.
- 13) Identification of the latest packaging material, manufacturing methods and potential for local use.
- 14) Provide expertise on packaging machinery system and consulting services on the selection of appropriate packaging equipment to local industry.

4.2.3 Current activities

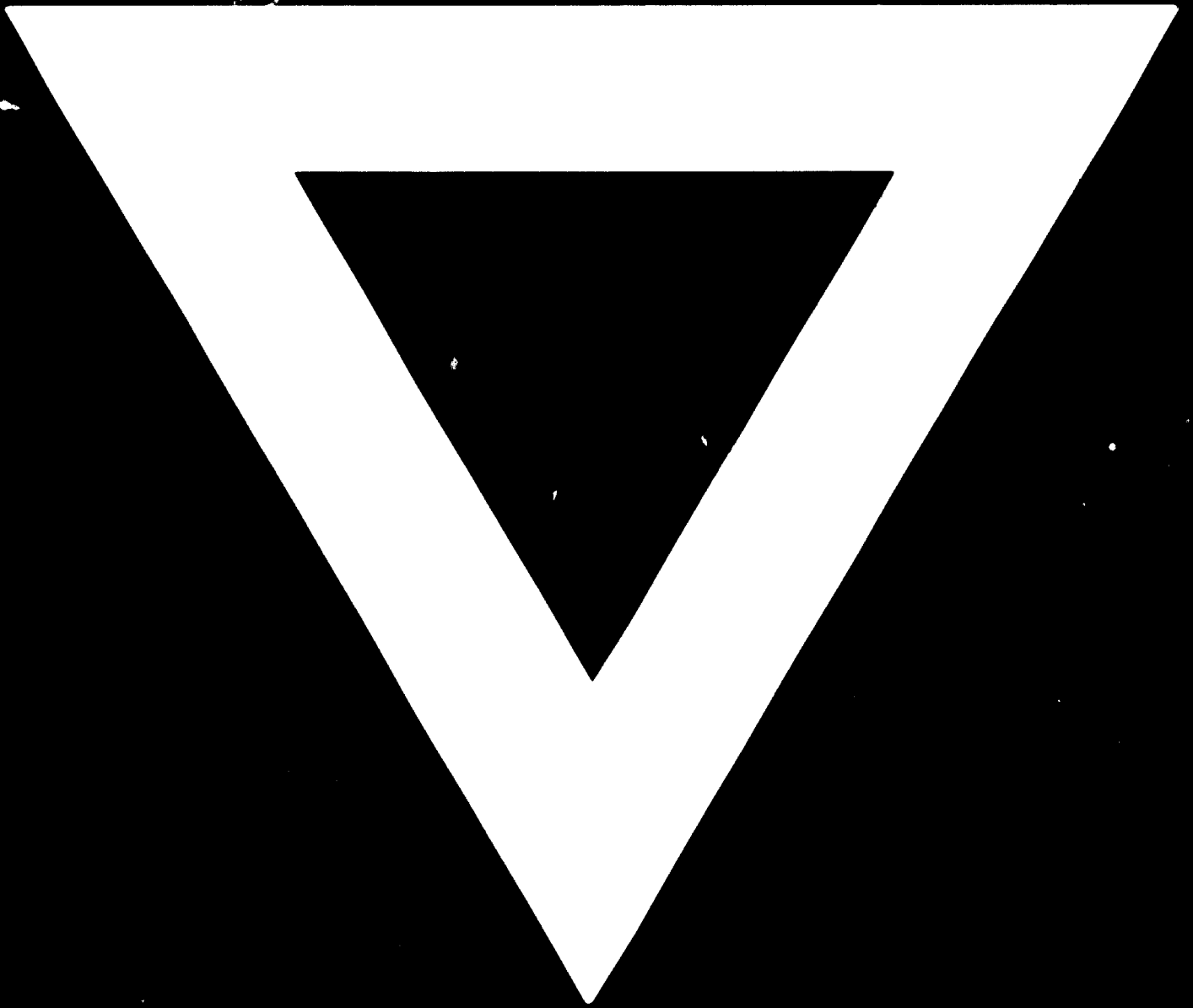
1) At present, the research in the field of packaging of fresh fruits and vegetables for export by airfreight has been carried out. The purposes of this study are to develop a standard container for fruits and vegetables and to promote the implementation of a dimensional standardization of paper packages for fruits and vegetables. The project is conducted by the Applied Scientific Research Corporation of Thailand (ASRCT), Industrial Research Service, Thai Airway International Limited, Market Organization for Farmers, Thai Packaging Association, Export Service Center and Bangkok Airport Custom House in order to try out some test shipment to evaluate the total packaging concept.

2) Another project "Application of flexible packaging materials to improve consumer packaged products" is being promoted by ASRCT. The research will cover the study of an absorption isotherm of the products, the measurement of the moisture resistance of packages, and the estimation of the shelf-life of packaged goods. The data concerning product, sales, packaging, climate and others could be used to estimate the type of moisture barrier films for the protection of a moisture - sensitive product. ASRCT has the basic infrastructure and capability required to launch the project at this initial stage. However, the success implementation will require additional assistance, technical as well as financial.



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