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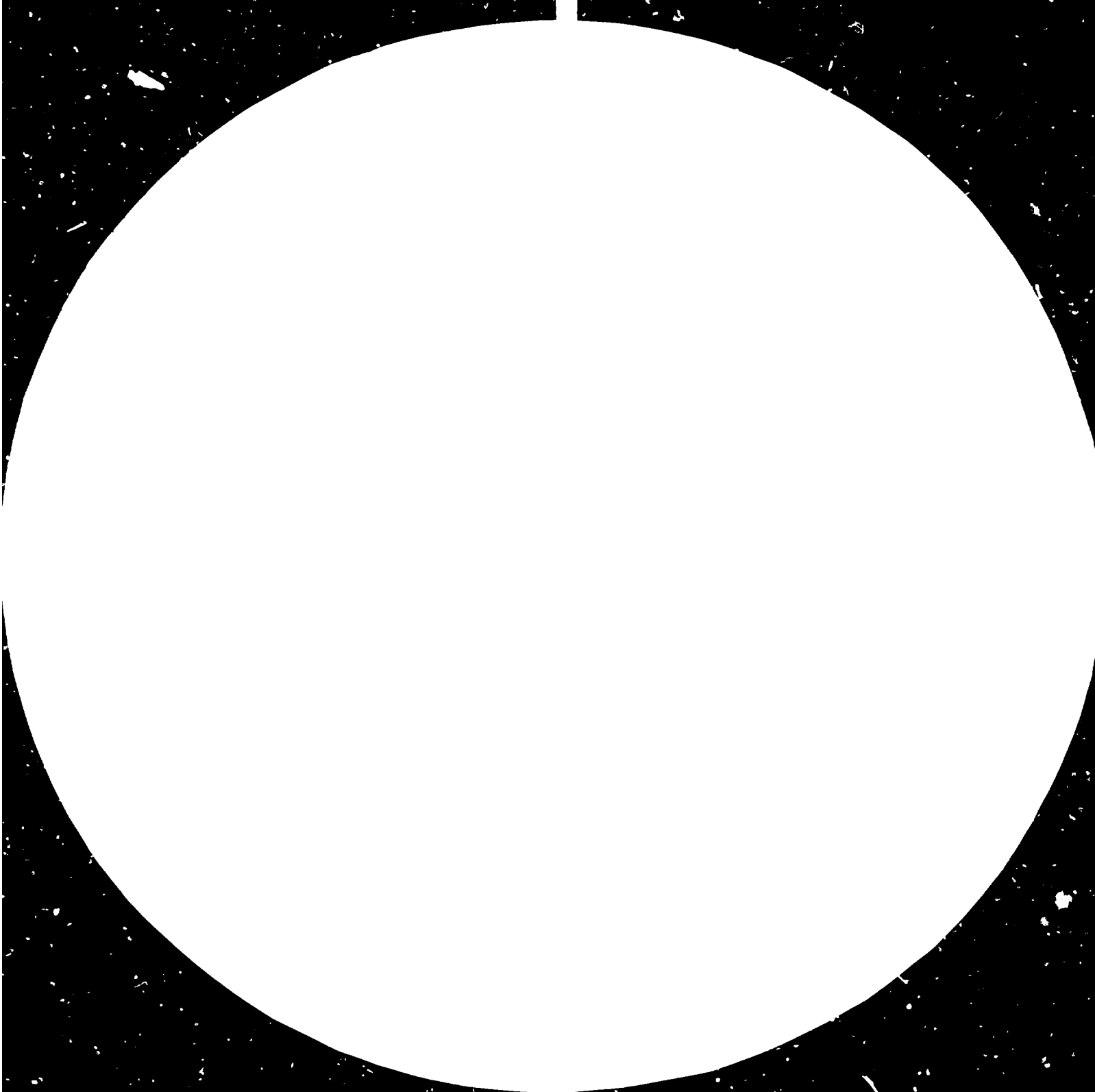
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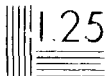
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REHABILITATION OF THE RAMIE INDUSTRY IN THE PHILIPPINES

DP/PHI/83/001

PHILIPPINES

Terminal report: Programme design for a new ramie industry *

Prepared for the Government of the Philippines
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Chien Thu, Expert in Ramie Processing and
Finishing and Min Li Lai, Expert in Ramie Fibre Production

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Vienna

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Abbreviations

NEDA	National Economic Development Authority
PTRI	Philippine Textile Research Institute
MCA	Ministry of Agriculture
RAMITEX	Ramie Textiles, Inc
RAMCOR	Ramcor Farms of San Miguel Corporation
FIDA	Fibre Inspection and Development Authority

Abstract

The project was to assist the government of the Philippines for rehabilitation of ramie industry on the basis of the fact finding and diagnostic studies undertaken under the SIS project. The experts served a period of one month which started in December 1982 to January 1983.

Main Conclusions

1. For rehabilitation of the ramie industry in the Philippines, there should be three directions of development:

- a) A primary ramie industry supported by the government for the propagation of selected varieties of ramie and supply of ramie rhizomes to ramie growers. A model nursery should be established for ramie breeding at the Institute of Plant Breeding, University of the Philippines. Commercial ramie nurseries for planting stock may operate as intercrop in coconut farm to share land cost.
- b) A secondary ramie industry for the production of degummed fibre for industrial use. A model ramie plantation can be promoted by MOA to demonstrate not only the economic growing of the plant but also the preparation of the degummed fibre. RAMCOR farms of San Miguel Corporation can be improved to serve as a model ramie plantation.

Ramie should be cultivated for multiple uses, i.e. ramie forage for hog feed and ramie shive for mushroom cultivation besides its major use as fibre from its bark. Land cost of ramie can be shared by interplanting with ipil-ipil tree for better fertility and draining control.

Multiple cropping with ramie will reduce fertilizer cost and weeding cost. In the first year of ramie a legume crop such as peanut or mungo bean will bring in cash return to ramie growers. A green manure crop such as sunn hemp or sesbania will enhance soil fertility before ramie cultivation.

A new ramie fibre degumming plant in Davao is needed. Extension of ramie to Mindoro Occidental province will save freight for shipping degummed ramie fibre to Manila market.

- c) A tertiary ramie industry for the processing of the degummed fibre into combed tops. A ramie processing research centre with a pilot plant should be established at PTRI. This centre will promote use of degummed ramie fibre in existing major textile mills.

2. A ramie industry development commission should be organized by the National Government for a full scale ramie rehabilitation programme in the context of the government plan for modernization of the textile industry.

3. Short term technical training programmes would be necessary for four trainees to acquire new knowledge in ramie breeding, ramie fibre production, and modern fibre processing technology. The existing Textile Training Foundation, Inc. can provide training programmes for fibre processing technology.

4. Estimated investments for two new ramie production plants in Davao and Mindoro would cost about \$ 6,000,000 for imported equipment. PTRI ramie research centre with Mindoro extension station would need imported equipment and technical assistance with a total cost in the order of \$ 1,500,000.

5. With a steady supply of degummed ramie staple and combed ramie tips, existing integrated textile mills can use ramie fibre as major raw material. This will save cotton import, which has reached 30,000 tons in 1982.

6. A new mill to produce combed ramie tops at 10 tons per day should be established to supply high quality combed ramie tops for processing with other fibres in this country. The investments would cost in the order of \$ 6,000,000 for equipment.

7. Improvement of fabric finishing in leading integrated textile mills to make ramie fabric of high quality will be necessary to develop the domestic market for ramie textiles and garments. This may need investments about \$ 10,000,000 for imported fabric finishing machinery.

8. Innovation of ramie spinning featuring twistless yarn in lieu of the hairy twisted yarn from ring spinning would need about one billion dollars for 10,000 spindles from U.S. and European machinery suppliers. Several leading integrated textile mills may venture into such investment providing supply of combed ramie tops or stapled ramie fibre can be assured.

9. A modern mechanized ramie plantation featuring three supporting crops, i.e. sunn hemp for green manure, peanut for intercrop and ipil-ipil tree for interplanting; and multiple uses of ramie plant, i.e. fibre for textile, forage for hog feed, shive to grow mushroom and rhizomes for propagation, can achieve gross income from ramie cultivation estimated at ₱ 89,000 per year per hectare based on 5 year replanting cycle.

<u>Products</u>	<u>Amount</u>	<u>Unit Price</u>	<u>Total Value</u>
Degummed fibre	2.0 tons	₱ 22/kg	₱ 44,000
Hogs	4 heads at 90 kg	₱ 22/kg	8,000
Sunn hemp retted fibre	500 kg	₱ 5.0/kg	2,500
Peanut 400 kg 1st year	80 kg/year	₱ 10.0/kg	800
Mushroom 4 crops	400 kg/year	₱ 10.0/kg	4,000
Rhizomes for 50 hectares	10,000 pcs/hectare	₱ 2,000/hectare	20,000
Ipil-ipil wood	40 tons in 8 yrs 5 tons/year	₱ 2.0/kg	10,000
	Total:		₱ 89,000

The degummed fibre has export market and can earn \$ 5,000 per hectare per year from 2.0 tons of degummed fibre. World market for ramie fibre is estimated at 130,000 tons. Export of 10,000 tons of degummed fibre for \$ 25,000,000 would need 5,000 hectares for new ramie farms.

10. A goal of rehabilitation should be set at 5,000 hectares of new ramie farms in three years and 10,000 new spindles for twistless spinning of ramie in three years. This will usher a new era of ramie industry firmly established in the Philippines.

Introduction

1. Ramie as a Textile Fibre

Ramie is an exquisite oriental textile fibre. It is distinguished for its luster, coolness for summer wear, superior wet strength and excellent weather resistance against ultraviolet light and mildew. The fibre size is about 5-8 denier. The length of fibre varies from 1 to 20 inches with a majority falling between 5 to 8 inches.

Ramie textiles have been appearing on the market as furnishing fabrics, grass linen and dress fabrics from blends with synthetic fibres for easy care summer wear. The market preference for natural fibres impels high demand recently for degummed ramie fibre, combed ramie tops and ramie yarn in the world market.

The current export price for degummed fibre is about \$ 2.50 per kg. Combed ramie tops command a high price of \$ 5.30 per kg, which is about the same price level of wool tops. World trade of combed ramie tops is very limited. People's Republic of China is the major supplier of combed ramie tops to the world market.

Ramie fibre is versatile in its various combinations with other fibres. The high luster of ramie makes ramie compatible with silk in fabric construction. Ramie weft and spun silk warp combination will reduce cost of silk fabric and give crease resistance to the fabric.

Lack of cohesion of ramie fibre in spinning and hairiness of pure ramie yarn are shortcomings of ramie processing. However, these shortcomings can be improved by blending stapled ramie fibre with rayon or acetate fibres for spinning to high counts. Ramie improves wet strength of rayon and acetate fabrics.

Blended with wool by as little as 25 percent, ramie prevents stretch and shrink and greatly improves wear. Knitted wool/ramie socks find favor for sport wear.

Ramie/jute blends have been applied in the production of fine cordage yarn in Brazil. Ramie processed on jute system with twistless spinning of coarse yarn has low processing cost.

Ramie/cotton blends make use of ramie noils and stapled ramie wastes on cotton spinning system. Cotton serves as a carrier fibre for ramie in spinning whereas ramie contributes to higher wearing quality.

Ramie waste fibre has been used to make non-wovens and composite yarn with filament core for coarse count yarn. Indeed the versatility of ramie has not yet been exploited to serve the textile industry in the Philippines.

2. Project Background

Ramie has been a commercial crop in the Philippines since 1930. Ramie is the perennial fibre which requires evenly distributed rainfall and humid climate like that found in Southern Mindanao. Abundantly grown in sandy loam soil, ramie has a maturity date of 60 - 50 days and can be cut for fibre every 45 days thereafter.

Because of the continuous cutting every 45 days throughout the year for as long as six to seven years, profitable ramie production can be realized. Acreage of ramie steadily increased with the second world war when interruption occurred. The growth resumed in the 1950's. By 1964 and 1965 exports of ramie fibre reached 4,500 M.T. Thereafter, synthetic fibres at lower cost than degummed ramie fibre caused decline of ramie production to only 1,647 M.T. by 1978. World favor of natural fibres helped revival of the ramie cultivation to 1,500 hectares in 1980 with 4,140 metric tons of crude fibre valued at ₱ 25,583,000.

Local production of ramie textiles is made only by RAMITEX since 1956 but has stabilized ramie fibre production. In 1966 there were two operational ramie textile mills, the Ramie Textiles, Inc. (RAMITEX) and the Davaco Ramie Textiles, Inc. (DARATEX). DARATEX was being operated for the Government NDC by co-operative group of ramie planters known as Davaco Fibre Producers Association. After two years operation, DARATEX sold its mill to RAMITEX. RAMITEX as a subsidiary organization of San Miguel Corporation continued to expand and today it has 23,500 spindles with integrated weaving and finishing. RAMITEX exports extensively combed ramie tops and yarn but encounters poor domestic market for ramie fabrics due to high production cost of ramie/polyester blends and competition from fabric of cotton/polyester blends.

Ramitex, nevertheless, enjoyed a boom in its domestic business especially during the years of 1972 to 1975 before the oil crisis and resumption of rampant smuggling, which hurt the whole domestic textile industry.

World consumer preference for natural fibres and high cost of synthetics due to oil crisis afford ramie industry an opportunity to increase export and to regain its prominent place. PTRI as the government textile research institute has requested UNCTAD/UNDP assistance for a programme to revitalize the industry. Such programme was carried out under SIS financing between September and December 1982 by two experts, one specializing in fibre production, the other in fibre processing and fabric finishing.

The SIS mission identified the basic problems, collected information and carried out short experiments and consultancy services. Now, a follow-up project is made to draw the conclusions from this work and design a programme for implementation.

Rationalization of ramie fibre production featuring multiple uses of the crop should bring down the cost of degummed fibre to a level, which should be competitive with imported long staple cotton. The country imported cotton totaled \$ 33.6 million in 1981. The Philippine Cotton Corporation launched the cotton production program several years ago. Under the program, farmers are provided low-interest loans by participating banks. Philippine Cotton Corporation buys the farmers' cotton at a guaranteed profits. The program has been successful that the country now produces 15% of its cotton needs.

Promotion of ramie fibre production may follow similar program as cotton. Ramie as dual crop for both fibre and forage feed should give ramie farmer higher return than cotton crop.

The cost of local cotton is about ₱ 15 per kg delivered to cotton mills. The price of degummed ramie fibre should be in the order of ₱ 15 per kg in the market in order to compete with cotton. Assuming a 25% profit allowed to the ramie farmers, the cost of degummed fibre should be under ₱ 11 per kg, which should be attainable if the crude fibre is produced at a cost not over ₱ 5 per kg (₱ 316/picul) and degumming cost not over ₱ 3 per kg of crude fibre. This is based on 74% yield of degummed fibre in degumming the crude fibre from corona decorticator. Present price of RD-2 crude fibre is about ₱ 7 per kg. Export price of degummed fibre is about ₱ 22 per kg. but the amount of degummed fibre available for export is very small.

Cost and return of ramie production per hectare indicate that the major cost lies in the first year of cultivation and land preparation cost as follows:

Rehabilitation of 1 Hectare of Ramie

A. Land preparation	₱ 2,060
B. Rhizome cost and planting	2,560
C. Fertilization	616
D. Pest and disease control	433
E. Weed Control	600
F. Ratooning (90-120 days after transplant)	300
G. Fertilizer and pest control	724
H. Harvesting (55-60 days after ratooning)	681
First harvest 250 kg	7,974
Total expenses up to 1st harvest (Ref. Oscar M. Castillo "Ramie Culture")	
Initial income from 250 kg crude fibre	1,750

The first year expenses should be amortized over five years unless an intercrop such as beans or peas is cultivated in the first year to bring in cash income. The amount from intercrop may reach 500 kg mongo peanut per hectare at ₱ 10 per kg or ₱ 5,000 per hectare. Cost of weeding and fertilization can be saved, but it is still not enough to break even in the first year.

A green manure crop of sunn hemp to precede ramie cultivation will yield 1 ton of retted sunn hemp per hectare in about 100 days with a value of ₱ 5,000. The green manure will increase yield of ramie and save fertilizer.

Moreover, a crop of mushroom can be followed after the first harvest. This will use the ramie shive as compost for mushroom. The amount of ramie shive can support production of 200 kg mushroom with a cash value about ₱ 2,000 at high price about ₱ 10-12 per kg. The spent compost can be recycled. Thus the fibre crop with three supporting crops will realize a profit in the first year of cultivation with a total income of ₱ 12,000 from four crops.

Ramie as a long term crop needs long term bank loan for five or more years especially for the first year rehabilitation.

According to the notations of Oscar M. Castillo, ramie grower can produce as much as 12 piculs or 760 kg of crude fibre per hectare in one harvest. Ramie is at the peak of its production when it is three to five years of age. Thus annual yield of 3.0 metric tons of crude fibre per hectare from six crops can be attained. By integrated degumming and corona decortication, annual yield of 2.0 metric tons of degummed fibre per hectare with a market value of ₱ 44,000 can be achieved. Present export price of degummed fibre is about \$ 2.50 per kg. The return from export of 2.0 metric tons of degummed fibre would reach \$ 5,000.

According to Mr. Arguelles experience, he obtained seven crops per year in his 45 days cropping with heavy fertilization and obtained 7-12 piculs of crude fibre per hectare per harvest. Intensive cultivation is truly productive.

Disposal of the shives from the central corona decorticating plant has been a problem due to the high cost of hauling the bulky wet wastes and composting with manure for several months. The situation can be improved by dewatering in a roller press the bulky wet wastes from corona flume. Experimental cultivation of mushroom with fresh ramie shives and wastes gives promise to use the fresh shive compost for mushroom cultivation before its disposal to ramie field. The cash income from mushroom will share the cost of composting. The sandy soil in RAMCCR needs organic compost for sustained high yield of fibre.

Ramie amounts to only about 6% of the total production of fibre crops in the Philippines. Abaca fibre production reached 60,000 tons in 1982 whereas ramie crude fibre accounted only 3,750 tons. Abaca and ramie are long term crops. Two main factors contribute to the low production of ramie as compared with abaca. Firstly, the currently low quality of crude fibre predominantly RD-2, and secondly, the high cost of degummed ramie fibre, which has very limited supply. Abaca is increasingly used for high grade pulp and paper in the United States whereas ramie is only exported as textile fibre to Asian countries such as Japan and Korea. Abaca is less labor intensive than ramie, which requires extensive labor year round for harvesting and extraction of fibre.

The textile industry has 174 firms. They are concentrated in the greater Manila area. Most of them are small. Only 30 are fully integrated and 22 are semi-integrated. Integrated mills accounted for 82 percent of the industry's entire output. The country's eleven largest integrated mills are Artex Development Co., Alfa Mill, Central Textile Mills, P. Floro and Sons, Ramie Textiles, Riverside Mills Corporation, Solid Factor, Pacific Mills, Synthetic Textile Manufacturing Co., Inc., United Textile Mills and Universal Textile Mills. The per capital consumption of textiles is approximately 20 yards. Ramitex Mill concentrates on ramie textiles. Solid Mills have specialization in the production of indigo denim fabrics. The industry can supply practically all the need of textiles in the Philippines.

The industry is highly dependent on imported raw materials such as cotton, rayon and synthetic fibres. Local production of caustic soda, hydrogen peroxide, sodium silicate and corn starch has supplied the textile industry. The main problems confronting the textile industry are the lack of raw materials and their high cost, especially rayon and cotton, which are consumed in great quantity. Ramie holds the promise as the best fibre in the Philippines when a concerted action is taken for its development.

The Fibre Inspection and Development Authority (FIDA) has interest to extend ramie cultivation on Mindoro island for its proximity to greater Manila market. The FIDA has been considering a 1000 hectare ramie area on Mindoro. It is opportune to establish an extension station there by the government. This station can serve as a nursery and fibre production service centre.

The Government, through the Board of Investments, The Development Bank of the Philippines and a loan grant from the World Bank, has launched the Textile Rehabilitation and Modernization Program. This program with \$ 250 million budget will assist the textile industry in improving their existing equipment and in investing in new machinery. Eleven mills including Ramitex have made their applications for the loan. But only two mills have implemented their program. Market recession has caused retarded progress of the Program.

3. Objectives

This project was designed to provide assistance to the government in the modernization of the textile industry, which has not yet made significant use of ramie fibre and, in general, to assist the textile industry in the appraisal of ramie as a major native fibre to make unique Philippine textiles for tropical apparel.

Rehabilitation of ramie cultivation and fibre extraction integrated with degumming should make the cost of degummed fibre competitive against the imported cotton. A model fibre production farm featuring multiple uses of ramie crop is envisaged to reduce the cost of fibre. A modern mill for production of degummed fibre should be established in Davao.

Rehabilitation of the ramie industry will stress on improvement of fabric finishing for soft handle through the use of twistless ramie yarn and combinations with silk, rayon and cotton in fabric construction. The R+D Programmes for ramie development will promote extensive use of stapled ramie fibre in all integrated textile mills with spinning, weaving and finishing facilities. Investment needs for re-equipment at PTRI have been outlined. This includes a pilot plant and a ramie extension station in Mindoro Occidental province. The new area is typhoon-proof. Ramie has been cultivated there but no commercial development has been made. Investment promotion for a ramie combed tops mill in this new area should be stressed.

4. Institutional Framework

The Philippine Textile Research Institute (PTRI) is an agency of the Ministry of Trade and Industry and has three technical divisions undertaking activities on research and development: technical assistance and services; processing; consultancy and manpower training.

The Institute has excellent fibre and fabric testing equipment, new shuttleless Picard loom, cotton spinning pilot plant and modern fabric resin finishing pilot plant.

Studies on ramie focus on the development of finishing formulations to improve the quality of the fabric. The Institute has modern silk reeling equipment and three extension stations for sericulture development, which includes cultivation of mulberry trees.

The Institute has made extensive studies on non-wovens from waste fibres. Ramie wastes are applicable for non-wovens possibly in combination with cotton linter.

I. RECOMMENDATIONS

Development Objective

1. Export earnings from textiles and garments are expected to exceed the billion-dollar mark in 1983. The Philippine government had signed two textile agreements with the United States and the European Economic Community that will increase export revenue from these two sources by 22 and 20 percent respectively. The next objective is to insure an accelerated production of Philippine textiles and garments to fill up the new quotas in the U.S. and in Europe. It is opportune to modernize the textile industry with emphasis on unique Philippine native fibres such as ramie, cotton and silk. Rehabilitation of ramie should receive high priority to develop competitiveness in the world market. The policies at the national level must be geared towards the orientation and restructuring of the textile industry in the perspective of ramie development under the National Textile Rehabilitation and Modernization Program. A target of 5,000 hectares of new ramie farms and 10,000 new spindles for twistless ramie yarn in three years should be set by the government.
2. SIS project study indicated superior textiles from ramie-silk and ramie-cotton combinations with modern resin finishing. This can be realized by improved processing of ramie from fibre extraction to fine yarn production.
3. Ramie fabric from ramie/yarn and ramie/acetate blends will have good market due to the low cost of rayon and acetate fibres and their possible local production from dissolving pulp, which can be readily made from abaca wastes, cotton linter and ipil-ipil wood.
4. A ramie development commission under NEDA is proposed for co-ordination of development work by various agencies and industrial enterprises.
5. Specialization of ramie industry in three levels is proposed:
 - a. A primary ramie industry with MGA support for the propagation and breeding of superior varieties of ramie. A model nursery for ramie breeding should be established at the Institute of Plant Breeding, University of the Philippines. All ramie growers should get certified ramie rhizomes for planting from MGA nurseries. The Fibre Inspection and Development Authority will be instrumental to carry out this part of work.

- b. A secondary ramie industry for production of stapled and degummed fibre to supply domestic textile mills. A model ramie plantation should be promoted to demonstrate the economic growing of the plant and the preparation of stapled and degummed fibre. RAMCOR farm of San Miguel Corporation can serve this purpose very well by improving the existing operations. A new ramie fibre production plant in Davao should be established to supply stapled degummed ramie fibre.
- c. A tertiary ramie industry for processing the degummed fibre into yarn and fabric. PTRI should establish a ramie processing research centre with a pilot plant and a ramie extension station in San Jose, Mindoro Occidental for ramie propagation and modern fibre production. Thus PTRI should become an integrated ramie cultivation and processing research centre, which will co-ordinate all phases of ramie development under the Ramie Development Commission.

Immediate Objective

1. Improve ramie decortication with corona at RAMCOR by using butted big stalks without leaves and rapid degumming the stalks to soften the bast and clean the stalks for less fibre loss and better maintenance of the corona decorticator.
2. Degumming ramie in farm will save chemical cost and freight of fibre to spinning mills. Ramie degumming waste liquor contains phosphate and gum, which amounts to 25 - 30 percent of the crude fibre. The waste liquor can be mixed with molasses and other feed supplement as animal feed. Feed test should be conducted at RAMCOR under supervision of veterinary specialist.
3. Introduce corona decortication and field mechanical ribboning followed by in-line degumming in a new ramie processing station in Davao will save labor and improve fibre yield.
4. Integrate ramie harvesting and stapling the stalks into 3 to 6 inches length should be developed to save labor in harvesting and to facilitate separation of the stapled bast from shives.
5. Stapling waste ramie fibre such as RD-W into 1-1/2 to 6 inches length followed by screening to remove fines and shives will facilitate pressure degumming in the farm to produce degummed fibre for processing. This will eliminate dust from grading and brushing the crude fibre.
6. Ramie noils as a major waste in processing ramie fibre to combed tops should be utilized by blending with cotton and converted to yarn Nm 27 - 30 by cotton spinning system. PTRI has demonstrated the spinning and tested the yarn. Weaving test at PTRI and fabric finishing test at RAMITEX showed good quality.

7. Twistless ramie yarn by TNO jute system of Netherlands for coarse ramie yarn can be developed. TNO has proposed a joint research program for PTRI.
8. Cover spinning or wrap spinning for twistless fine yarn should replace ring spinning, which gives hairy twisted yarn. The use of twistless yarn in fabric construction gives a smooth surface and simplify fabric finishing by eliminating singeing and brushing operations.
9. Funds at \$ 1,500,000 PTRI ramie research centre would be required for imported equipment and international technical service.

II. PROJECT ACTIVITIES

1. Major Problems of the Industry

- a) Low production of fibre per unit area of land due to lack of organic compost for the sandy soil, improper fertilization, and mixed varieties of ramie.
- b) High cost of fibre extraction by raspadors with high fibre loss and extensive labor.
- c) Poor quality of crude fibre from raspadors due to residual shives and bark.
- d) High cost of degumming the dry crude fibre by a two-stage fermentation-alkali process followed by oil dressing with imported softening agent.
- e) High processing cost from fibre to yarn by carding, drawing, double combing, draft cutting, finishing drawing, riving and ring spinning involving 13 operations. About 25 percent noils and wastes are produced in the extensive process. These wastes have not yet been fully utilized but exported.
- f) Hairy twisted yarn from ring spinning impels singeing in fabric finishing and gives a rough handle. Extensive blending with 65 - 75 percent polyester fibre and dyeing with disperse dyes for polyester are expensive.
- g) From Davao and Cotabato to Manila market, the high freight for crude fibre and supplies affects the cost of ramie products.
- h) Existing dyeing and finishing facilities in most textile mills are inadequate to make superior ramie fabric with soft handle and easy care quality.

2. Improvement of Raw Material Supply

Ways of improving the supplies of raw materials should stress on recycling the ramie wastes to save fertilizer and on utilization of by-products for hog feed and mushroom cultivation.

Ramie fibre production can be increased by improved ramie varieties, rational fertilization and efficient fibre extraction from harvesting to degumming in the farm. A green manure crop to precede ramie cultivation will increase fibre yield with less chemical fertilizers.

Ramie fibre production cost can be reduced by sharing land cost with interplanting, especially with a leguminous tree crop such as ipil-ipil tree. Also the first year intercrop with a legume food crop such as peanut will provide cash income to growers. Eleven improvement measures for fibre production are proposed as follows:

- a) Cultivation of green manure to precede ramie planting, transplanting selected seedlings, applying enriched compost and rotational irrigation with liquid fertilizer will assure uniform growth to big stalks. Intercropping with legume in the first year will save weeding, reduce fertilizer and provide a cash income to ramie growers in the first year.
- b) Development of mechanical harvesting integrated with stapling into 3 to 8 inches chips will save labor and facilitate decortication of the stapled ribbons.
- c) Field mechanical ribboning of full length stalks in lieu of the raspador decortication will save labor and assure better safety to operators.
- d) Make full use of corona decortication at RAMCOR by improved operation with large stalks and butted ends with leaves stripped. Partial degumming the stalks before decortication will reduce fibre loss and improve maintenance of the machines.
- e) Install a new corona decortication in Davao to replace raspador decortication and to facilitate integrated degumming. This will improve fibre quality and reduce labor.
- f) Cultivation of mushroom with ramie shives on multiple beds and canning mushroom should be made. Spent mushroom beds can be returned to ramie field as compost.
- g) The fibre brushing operation for dry crude fibre is dusty. A continuous wet brushing and washing machine should be developed to produce clean fibre. A design for the machine has been proposed.

- h) Stapling waste ramie crude fibre such as RD-W followed by screening and pressure degumming to produce degummed fibre staple will make full use of the low grade fibre.
- i) Interplanting ramie with ipil-ipil trees (*Leucena leucocephala*) at 10 m interval as a mark tree for harvest instead of cassava as practiced now in Davao. The tree can grow to a height of 20 m in 6 to 8 years. The leguminous tree saves fertilizer and improve drainage.
- j) Make full use of ramie forage for hog feed to generate hog manure for ramie fertilization besides providing a sideline income from hogs.
- k) Degumming in the farm will save labor, reduce chemical consumption and improve quality. The degumming waste liquor can be recycled in irrigation or mixed with molasses for animal feed.

3. Remedial Measures in Production Technology

Six measures are proposed to improve production technology.

- a) Use of stapled degummed fibre in carding will facilitate mechanical feeding in carding for more compact card web and sliver with less dust.
- b) Use of cover spun twistless spinning for fine yarn and twistless wrap spinning with filament core for medium count yarn will give smooth and lustrous yarn instead of the hard twisted hairy yarn by ring spinning.
- c) Use of silk filament or spun silk for wrap with fine ramie twistless yarn as weft will give fine silk fabric, which can be finished by simple scouring and resin finishing.
- d) Using waste ramie sheath with a synthetic filament core to make composite yarn will cost less than yarn from polyester blend due to less fibre cost and less dyeing cost with cotton dyes for the ramie sheath only. Such composite yarn will be cheap and can replace cotton yarn of Nm 10 - 30 for jeans and denim.
- e) Utilization of ramie noils and stapled ramie short fibre by blending with cotton or rayon staple in cotton system will give good fabric from ramie waste.
- f) Improve dyeing and finishing equipment in leading textile mills to enable their processing of ramie fabric for high quality in respect to handle and easy-care quality.

4. R + D Programmes for Ramie

Ramie cultivation is difficult to compete with short term cash crops for land use. Ramie needs supporting crops in lieu of the current mono-culture at great cost. Three supporting crops are deemed beneficial for ramie. In the first year, a legume food crop such as beans and peas as intercrop will provide cash return in the first year and save weeding. In the subsequent years with many harvests, it needs heavy composting for sustained high yield of fibre. Cultivation of mushroom with ramie shives and recycle the spent compost will share the cost of composting for ramie. Mushroom crop is labor intensive. The marketing of mushroom needs proper processing into frozen food or canned food with beans and peas. Waste mushroom can be processed as soup stock.

In a long range plan for ramie replanting in every eight years, ramie growers may find ipil-ipil tree (*Leucaena leucophala*) as a good energy tree crop planted at wide spacing of 10 m x 10 m to minimize shading to the ramie crop. The fast growing tree with deep roots will improve soil moisture and save fertilizer as a leguminous tree. It provides fuel wood for ramie degumming and forage dehydration for animal feed. With the support of the three crops, production cost of ramie fibre can be greatly reduced.

On the processing side, ramie fibre is stiff. Pure ramie fabric has survived as a minor blending fibre with synthetics. Ramie blended with polyester by 35 percent results in a fabric with the quality of linen and crease-resistance of an all polyester textile. However, it often requires complicated dyeing and finishing processes.

Poor cohesion and coarseness of ramie fibre make ramie spinning to high count a difficult proposition by conventional ring spinning. Consumers' reluctance to accept ramie-polyester textiles for wear due to pilling and itching has frustrated ramie textile manufacturers in marketing ramie-polyester textiles other than furnishing fabrics such as table cloth, napkins and curtains. The advantages of natural ramie for summer wear have seldom been developed.

Ramie will continue to contribute to the textile industry as a blending fibre preferably with natural fibres such as silk, cotton, wool, flax and rayon. Thus production of combed ramie tops can be developed to a large scale for its wide market.

New fibre technology such as twistless spinning, cover spinning, and composite spinning with filament core have enabled ramie manufacturers to produce various grades of ramie yarn economically with superior quality featuring softness and high luster. Also modern resin finishing has improved fabric handle of major ramie fabric. Thus a new era of ramie industry in Philippines is envisaged.

R + I Programmes for Ramie Cultivation

Part A. Demonstration farm of ramie in Ramcor Farms

- a) Propagating the legume plants for green manure Sesbania and sunn hemp as legume plants for green manure. It grows in Ramcor Farms well. The Sesbania has nutrition content N 0.47%, P_2O_5 0.12%, K_2O 0.41%, while the sunn hemp nutrition content N 0.37%, P_2O_5 0.0%, K_2O 0.14%. Before ramie planting, the field should be sowed the above legume plant. After two months, plowing the legume plant into the field as green manure. The Ramcor Farms need to devote in propagation of the legume plants for collection of seed.
- b) Propagating the excellent variety of ramie - "Miyazaki 112".
Both in Ramcor Farms and the farm of ramie in Davao and Cotabato, the ramie varieties were found mixed. The excellent ramie variety "Miyazaki 112" will be segregated from the mixed field in Ramcor Farms. Their propagating by rhizomes and stem cutting in the near future at Ramcor Farms will be made. The quantity of propagating rhizomes is as follows:
After the ramie planting one year, the rhizomes will be extended ten (10) times by rhizomes method and three (3) times by stem cutting method.
- c) Building a modern compost mill for production of a large quantity of compost.
The "Surge TRU Waste Management Systems" will be installed in Ramcor Farms. The ramie waste 22-25 tons/day, ramie leaves 10-15 tons/day and hog manure 20 tons/day can be treated as raw materials for making compost.
- d) Planting the best variety of ramie "Miyazaki 112".
The Ramcor Farms will be planted the best variety of ramie "Miyazaki 112" year by year.
- e) Using manure spreader, spread the hog manure or compost in ramie field.
Using two manure spreaders, spread 50 tons hog manure/ha. ($N-P_2O_5-K_2O = 225-130-165$ kgs/ha.), or spread 10 tons compost per hectare ($N-P_2O_5-K_2O = 45-26-33$ kgs/ha) in ramie field.
The ramie will grow well.
- f) Arrange the sprinkle irrigation period for ramie growth.
In Ramcor Farms have four sets sprinkle irrigation can sprinkle 1-2 hectares/day. During the dry season, after ramie harvest, the ramie field should have sprinkle irrigation within one week, then apply the fertilizers. If the ramie field has spread hog manure, sprinkle irrigation must be followed.

Part B. Research project on ramie cultivation in Ramcor Farms

Ramie has been a commercial crop in the Philippines since 1930. In Ramcor Farms, Davao and Cotabato have large ramie plantation but the production of ramie were unstable. There are no research and development project on ramie cultivation. The following project on ramie cultivation should be carried out in Ramcor Farms:

- a) Ramie variety test
Introduce some ramie varieties from other countries. Selecting some good varieties with the collected varieties for variety test.
- b) Different period of harvesting of ramie
Using the excellent variety - "Miyazaki 112" to carry out the harvesting test.
Choosing the adopted period of ramie harvesting in Ramcor Farms to improve the yield and quality of ramie fibre.
- c) Ramie density test
Using the excellent variety - "Miyazaki 112" to carry out the density test. Choosing the adopted density in Ramcor Farms to improve the yield and quality of ramie fibre.
- d) Herbicides test of ramie
Compare the effect of herbicides to control the weeds in ramie field. Choosing the best one to apply in first for ramie field.
- e) Ramie fertilizer test
Continue to carry out in Ramcor Farms.
- f) Test on ramie interplant with coconut trees
In Davao some ramie farm have interplanted the ramie with coconut trees. The yield of ramie fibre decreased 40%. In Ramcor Farms the test of ramie interplanted with coconut trees should be carried out.
- g) Ramie irrigation with rotation
During the dry season, the ramie field needs irrigation. How to irrigate with rotation for ramie should be tested.
- h) Test of ramie replanting
Some ramie field, after planting six to eight years needs to plow for replanting. Different methods on ramie replanting should be compared.
- i) Test on hog feeding with ramie forage
Continue to carry out in Ramcor Farms.

- 5) Straw mushroom (*Volvariella Volvacea*) cultivation on ramie waste

Mushrooms commonly called as "Kabute" has been considered not only as a delicacy fancied by many people in Asia but as a miraculous additive to other foods due to its complete nutritive and medicinal value. The "FNRC, 1965 Food Composition Value" recorded mushrooms to contain protein that surpasses most vegetable in quantity. Aside protein, mushroom contain other essential vitamin and minerals vital to the human body. Medicinally, these vitamins, minerals and other food values make this vegetable ideal for people afflicted with diabetes, high blood pressure, anemia, and it also checks constipation.

Straw mushroom needs higher temperature for growing. Usually, maintain the temperature of the bed at 32 - 37°C during incubation, 25 to 30°C during fruiting. Mushroom will not fruit if temperature drops at 20°C. Mushroom at higher temperature than required will be smaller and lighter in weight.

Rice straw and banana leaf are the bedding materials for straw mushroom. The Taiwan Fibre Crops Experiment Station has found that fresh sisal waste was the good bedding material for straw mushroom in Henchung, Taiwan. After the mushroom harvesting, the sisal waste became good compost for sisal and other crops. The fresh straw mushroom should be dehydrated for transport.

Unlike other vegetable which are harvested after 3 months, mushrooms can be grown for only 14 to 21 days depending on the environmental condition.

Mushrooms does not require also big space for them to grow. The vacant area under a trellish, for example, would serve as a good area for planting.

The Tropical Mushroom Research Lab., NIST. Extension Laboratory has indicated: planting 2 mushroom beds (4m x 0.76m x 2 = 6.08m²) a day would mean a net income of ₱ 1200 in one month.

In 1982 the average temperature in Ramcor Farms was 31.04°C. This area is adopted to cultivate the straw mushroom. Everyday it produced 22 to 25 tons ramie waste. Some wild mushroom were found in fresh ramie waste. Using the fresh ramie waste as the bedding materials to cultivate the straw mushroom will be tested in Ramcor Farms. After the mushroom harvesting, the ramie waste became good compost for ramie.

PART C. Ramie breeding in the Institute of Plant Breeding, U.P.

The Ramcor Farms and the ramie farms in Davao and Cotabato, have planted ramie for a long time. The Ramitex has tested different grades of commercial ramie fibre after degummed in different places. The denier data were 4.89 to 5.43. The Institute of Plant Breeding, U.P. has tested nine (9) varieties of ramie fibre after degummed in PTRI. The denier data were 6.46 to 7.35. The development of a ramie variety that will yield finer denier fibres through ramie breeding is necessary by the following procedures:

- a) Build a fumigation house.
- b) Fumigate the soil.
- c) Carry out mutation breeding

Messrs. Chu and Lai produced new ramie varieties through mutation induced by colchine in Taiwan. The best one was MC-60-2 with high yield of fibre and fine denier data (4.5).

- d) Select the excellent strains.
- e) Carry out the field test

Compare the yield and quality of fibre in different strains.

Comprehensive R + D programmes for fibre processing are outlined below in three parts:

Ramie Fibre Processing

Part A. Ramie Fibre Production

This part of R + D programmes can be assigned to RAMCOR of San Miguel Corporation. RAMITEX and PTRI can render some assistance.

- a) Ramie mechanical harvesting

There is no harvesting machine specially designed for ramie. All ramie harvest is made by manual labour on area basis, which is usually ₱ 3 per 10 M x 10 M square. Such practice is not only expensive but also includes poor stalks mixed with weed besides leaving high stumps with loss of fibre and causing lateral growth of small stems from the stumps.

Standard harvesters for other crops could be modified to adopt ramie crop. High crop harvester and hemp binder are applicable for full length of stalks with leaves. The bundled stalks can be hauled to a station for machine ribboning to produce ribbons of full length.

Sugar cane harvester can be modified to harvest ramie and produce ramie segments about 3 inches in length. Testing work could be made with M-F harvester agent in Manila to ascertain its performance.

Corn forage harvester can also be modified to harvest ramie and produce ramie chips about 3 inches in length. The forage harvester is cheaper than the sugar harvester.

b) Ramie fibre extraction

The present practice of raspador decortication is wasteful in labour with high fibre loss and poor quality. Field ribboning instead of raspador decortication should be introduced.

Extraction of ramie bast fibre from the stapled ramie stalks by the above harvesters should be tested with various types of fibre-producing machine. One hammer mill type was designed and developed by FORPRIDECOM (NSDB) engineers in College, Laguna. The machine was tested with abaca and kenaf chips with good yield. Testing with ramie chips should be made.

c) Improvement of ramie decortication with corona machines

Full use of corona machine for fibre production should be made in RAMCOR. Experimental work with large stalks and pre-cooked stalks showed good fibre yield. Further testing on various pre-treatment for stalks should be made. Recover waste stalks and shives in corona flumes by screening and dewatering with a roller press will reduce cost of hauling the shive and composting for cultivation of mushroom, which can use the fresh shive and share the cost of composting.

d) Ramie fibre degumming and stapling at farm level

Degumming tests on fresh ramie showed good result. More work on degumming ramie ribbons and stapling should be made. Disposal of the degumming waste liquor in irrigation or in forage silage with molasses will save chemical cost. Wet processing ramie in farm decorticating plant will eliminate dust and save freight of fibre to spinning mills. Use of ipil-ipil wood as fuel will produce ash as potash fertilizer for ramie. Also the ash containing potassium carbonate can be used in degumming formulation.

e) Wet brushing of ramie crude fibre

The present practice of dry brushing produces dust and involves extensive labor in manual operation. Wet brushing machines. To eliminate the dust hazard, wet brushing should be developed. A continuous wet brushing machine design has been proposed to RAMCOR and RAMITEP. Plans are being made to construct this machine by PTRI and RAMCOR. In order to carry out various tests with pre-urea treated ramie stalks or ribbons to effect efficient removal of hemicellulose and lignin shives. This will assure production of superior crude fibre for degumming and export.

- f) Utilization of ramie storage roots and seeds for animal feed

Ramie propagation with rhizomes produces a large quantity of storage roots and seeds in ramie nursery where harvests are usually made in 60 - 80 days for mature stem cuttings and rhizomes. Such wastes are valuable as animal feed. Feed tests with various supplements should be made. Shredding the storage roots and dehydration may be necessary.

- g) Improve fibre softening with coconut oil emulsion

Present practice of softening ramie fibre with imported softening agent is quite expensive. Laboratory study indicated that coconut oil emulsion may serve as a substitute. More study in this field with the aim of using industrial grade coconut oil should be made.

- h) Chemical modification of ramie fibre to make the fibre softer and increase resistance.

Although modern twistless spinning has improved softness of ramie yarn due to absence of hard twist, ramie fibre is highly crystalline and stiff. Chemical modification of ramie fibre by slack mercerization showed improved softness. Other processes including cross linking process should be investigated.

Part B. Ramie Fibre Processing

This part of research will be the major task of PTRI. PTRI ramie processing research pilot plant should be equipped to carry out the research. Eight items are proposed as follows:

- a) Improvement of production of ramie combed tops with stapled and degummed fibre.

The present practice of using full length of degummed fibre in carding and subsequent three drawings, double combing with one drawing between the combings, four finishing drawings, roving and ring spinning involves 13 operations. Improvement of processing machinery featuring high draft drawing and cover spinning for twistless yarn from stapled fibre can simplify the processing to eliminate the second combing and three drawings. Thus, less than 10 operations from fibre to yarn will be possible with less wastes and labor.

- b) Utilization of ramie noils and stapled R-W fibre

Present fibre processing at RAMITEX produces 25 percent noils. These wastes have not yet been fully used but exported at a low value. PTRI work on cotton spinning with blend of cotton and ramie noils showed good result as Nm 27 yarn. Fabric finishing at RAMITEX indicates promising quality for sheeting and jeans. Further dyeing and printing tests should be made to develop the market.

- c) Development of twistless spinning with TNC process of Netherlands

Preliminary test of TNC twistless coarse yarn with ramie roving from RAMITEX indicated further work and improvement required for finer yarn. TNC proposed a joint research project with PTRI.

- d) Development of cover or wrap spinning and composite spinning for twistless yarn with various filaments

Weaving and finishing tests of fabric from cover-spun yarn of Nm 68 showed good quality. More study would be needed to compare the performance of spinning with various kinds of filaments for wrapping. Also, ramie sheathing with a filament core has great potential for medium counts of composite yarn for jeans and denim. These composite yarn grades have great market than the fine ramie yarn.

- e) Testing shuttleless weaving and fabric finishing at PTRI

Shuttleless weaving has not yet been applied commercially to ramie yarn. PTRI has a new shuttleless Picanol loom. Testing for various fabric designs and finishing should be made at PTRI.

RAMITEX tested Sulzer shuttleless loom with polyester ramie 65/35 of Nm 68 for both wrap and weft with good result. Polyester staple of 1-1/2 denier will be required for blending with ramie to make high count of yarn.

- f) Testing acetate and triacetate fibres as a blending fibre with ramie in spinning

Acetate and triacetate fibres are distinguished for their high luster. They can be produced from local fibres such as abaca, cotton linter, ramie wastes, sunn hemp, and ipil-ipil wood. Blending ramie with rayon and acetate should be explored.

- g) Co-ordination of sericulture development with ramie in fabric design

Fine ramie twistless yarn with high luster is compatible with silk in fabric design and will enhance marketing of silk due to improved wearing quality and lower cost. A fabric made of spun silk warp and ramie weft, which has acetate blend of 50% will give an easy care fabric for summer wear. Yarn from a blend of waste silk and ramie is especially valuable for its softness and luster. Silk filament can be used as warp with weft of ramie/acetate or ramie/rayon blends will make high quality fabric with good crease resistance and easy care by resin finish.

- h) Partial degumming of ramie ribbons or stalks by wet brushing for subsequent processing on jute system to make twistless yarn. Work in co-operation with a jute mill should be made.

Part C. Ramie Fabric Finishing

A finishing mill may have to handle ramie fabric of various blends. Such blends may include ramie/wool, ramie polyester, ramie acrylic, ramie cotton, ramie/silk and ramie rayon. Many existing integrated textile mills need improvement of their equipment to accommodate quite large varieties of ramie fabric. R + D in this area would be quite extensive. PTRI has fabric finishing pilot plants and can provide research services for leading finishing mills. Commission ramie textile finishing mills should be promoted to undertake finishing services for ramie weaving mills. In the government Textile Rehabilitation and Modernization Program, priority should be given to mills for improvement of fabric finishing equipment and training in this field.

For ramie fabric finishing, it often calls for slack mercerization, pressure dyeing, decatization, and resin finishing besides the usual singeing and brushing operations in the early stages of finishing. Modern finishing of cotton fabrics for easy-care quality should serve as a reference for treating ramie fabrics. R + D along this direction should be stressed.

Ramie fabric from RAMITEX was used by Levi Strauss (Philippines) for jeans. The Solid Mills specialize in denim fabrics would need ramie fabric from medium count yarn.

The high cost of ramie fibre and scarcity of supply impels RAMITEX to make fine ramie yarn of various blends for fine fabrics other than yarn for jeans and denim.

5. Re-equipment Required for R + D at PTRI

To carry out the above R + D programmes re-equipment will be needed for PTRI ramie research centre. The ramie research centre will engage in integrated research on ramie industry from fibre production to finished textiles. The centre will provide extension service to new ramie cultivation area in Mindoro. An extension station could be established in San Jose, Mindoro, Occidental. The equipment required for this station is proposed as follows:

1) Corona decorticator	\$ 60,000
2) Fibre stapling machine	10,000
3) Pressure degumming plant	50,000
4) Automatic boiler with fuel wood	60,000
5) Dewatering press for shives	60,000
6) Portable ribboner for ramie	40,000
7) Dryer for forage and fibre	140,000
8) Centrifuge	10,000
9) Deep freezer for mushroom	10,000
	<hr/>
	\$ 440,000

The station will have a ramie nursery. Ramie stalks will be treated in a Corona decorticator or field ribboner. The fibre or ribbons will be stapled and degummed under pressure in the degumming plant. The wet fibre is centrifuged and dried in a drier. Wet shives from the corona are pressed in a dewatering press to remove excess water and hauled to a compost house to cultivate mushroom. Ramie forage is dewatered in the press and dried to make composite feed. Mushroom will be frozen and marketed as frozen food in plastic film bags and paper cartons. Degummed fibre will be baled.

The ramie pilot plant will have equipment for processing ramie fibre to combed tops and roving including carding, drawing, draft cutting, combing, finishing drawing and roving. This will cost about \$ 530,000. Coverspun or wrap spinning machine for twistless yarn will be installed. This part will cost in the order of \$ 230,000.

The total cost of equipment for the centre would be \$ 1,200,000. Local expenses for installation and building are not included.

c. Description of PTRI Pilot Plant for Ramie Research Equipment for Textile Industry

The pilot plant will use degummed and stapled ramie fibre.

Opening and Carding

Opening the fibre can be accomplished by a single pass of the fibre through a wool-blending picker, followed by carding on the breaker section of a Davis + Furber two-cylinder roller-top worsted card with garnet breast and Bramwell automatic feeder.

The card with 3 workers and 3 strippers will deliver two 60-grain slivers.

For well opened short staple about 3 inches, a spreader machine with intersecting gills and a big winding drum can produce a continuous sheet for subsequent drawing on a setting frame to produce a sliver.

Drawing

The ramie slivers in cans from the card or the setting frame are drafted through one Testa Rotary Gill Box with 6 porcine rollers in series for three stage drawing, i.e. first drawing, second drawing, and third drawing. Three to five slivers are combined into one sliver with a draft about 6 to 9. Thus, the slivers become finer and more uniform. The drawing frames are available from Sant Andrea Novara, Italy.

Combing and Finishing

A drawing and crimping of the slivers from the above drawing operation will precede combing to improve fibre cohesion for better combing. The draft-crimper Mod. 3366 Machine is available from Tesseltechnica, Firenze, Italy.

High speed rectilinear combing machine Model PSD of Sant Andrea Novara or NSC PB-20 of N. Schlumberger and Cie can be used for ramie combing.

As the combed slivers are made from ramie ribbons stapled to 6 inches or more, it is desirable to reduce the fibre length to the usual working length of 2-1/2 to 4 inches for spinning on worsted systems. This is done on a Converter. The combed tops are creeled to the infeed of a Heltra Converter, available from Heltra, Inc. PA, U.S.A. The Converter system is a two-zone arrangement, the first zone to draw and parallel the fibres while the second zone stretches and break them. The Converter utilizes a stretch-break system, thus giving soft or "feathered" ends to the ramie fibres so broken into working length in the order of 2-1/2 to 4 inches. The machine has dual end delivery at the rate of 40 meters per minute. A final draft of the slivers from the Converter by a high speed drafter with automatic leveler is usually required with 4 or 6 doublings and 5 to 8 drafts.

The slivers as cross wound balls are conditioned in a room for a few days before packing. Packing of ramie tops in polyethelene film bags in paper board cartons will keep good quality in storage.

Blending and Spinning

Inherent weakness of ramie is its poor cohesion in spinning and hairy surface of ramie yarn and fabric. A carrier fibre such as polyester, acrylic, rayon, silk or acetate with ramie will improve continuity in ramie spinning and produce smoother yarn. Modification of ramie or fabric containing ramie/synthetics can improve fabric quality for easy care wearing.

Degummed ramie staple costs more than rayon or acetate staple. Thus, blending ramie with these artificial fibres will lower cost of ramie yarn and improve the spinning quality of ramie.

For blended ramie yarns of Nm 30 - 70 for dress fabric, many systems for blending are available. The French NSC system starts with blending tops of ramie and synthetics or wool on intersecting gill boxes with three passes of drawing. Then, a flyer roving frame and twistless spinning machine are followed.

To convert tow of artificial fibre or synthetic fibre into tops of stapled fibre, a Pacific Converter is usually very useful for subsequent blending of the converted tops with ramie tops.

Re-equipment Required for the Ramie Industry

Since the government embarked on the Textile Rehabilitation and Modernization Program with 400 million dollars loan grant from the World Bank, about 250 million dollars have been released for immediate projects. The slump textile market and quota restriction in exports have discouraged new investment venture by existing mills. Some of them are facing serious financial difficulties. RAMITEX has submitted a ₱ 150 million modernization and expansion project to the government. This includes transferring the degumming equipment to Davao to produce degummed fibre, improvement of fabric finishing and dyeing facilities, and installation of new wide looms and open-end spinning for ramie noils. Improvement of marketing through control of dumping and smuggling and trade organization for more rational production will encourage rehabilitation.

The acute shortage of ramie fibre impels strengthening ramie fibre production in Davao and RAMCOR. Re-equipment in these two areas for production of degummed fibre should have high priority. Transferring the degumming equipment of RAMITEX to these two areas could be done quickly with relatively small investment for improvement.

Extension of ramie cultivation in Mindoro through the establishment of an extension station by PTRI has been outlined with an estimated cost of \$ 440,000 for imported equipment. PTRI has two sericulture stations in Mindanao. One of the two stations can be transferred to Mindoro for both ramie and sericulture development.

A goal of ramie extension to 1,000 hectares in Mindoro and establishment of a new ramie degumming plant at 20 tons per day should be set by the Fibre Inspection and Development Authority. This may involve an investment in the order of \$ 3,000,000 for imported equipment.

A goal of establishing 5,000 hectares of new ramie farms in three years by interplanting in coconut farms is attainable through KKK project under promotion by the F I D A. The re-equipment needs are mainly agricultural machinery, decorticators, ribboners, degumming equipment and mushroom processing equipment. The total cost would be in the order of \$ 15,000,000.

The restructuring of the textile industry calls for improvement of fabric finishing and dyeing equipment in leading integrated textile mills. A survey should be made to ascertain their need with emphasis on ramie fabric finishing. A budget of 10 million dollars may be required for imported finishing and dyeing equipment.

Two new mills for production of combed ramie tops at 10 tons per day should be established to supply local textile mills.

Each mill would need about \$ 5,000,000 for imported modern fibre processing machinery. New ramie plantations of 5,000 hectares in total area must be established to support the production of combed ramie tops at 5,000 tons per year.

Innovation of ramie spinning to produce twistless yarn calls for at least 10,000 new spindles which need a budget about 1 billion dollars. The existing ring spinning can still be used for spinning ramie noils in blend with cotton or rayon.

At present, most cotton mills are operating under capacity due to market slump on cotton textiles. Adding ramie spinning for major ramie yarn, these mills can export ramie products. However, export of degummed fibre should be restricted. The present export price of crude ramie fibre is about ₱ 11 per kg as compared with ₱ 7 per kg for RAMITEX.

8. Training Programme in connection with the R + D Programmes

Training programmes will involve two parts. One part with two trainees from RAMCOR for 6 months will specialize in ramie breeding and biostatistical study in U.S.A. The other part with two trainees from PTRI for 3 months in Europe will specialize in fibre processing from fibre to roving and twistless spinning in Netherlands.

The National Government has established a Textile Training Foundation, Inc. as a part of the plan for rehabilitation and modernization of the textile industry. The two trainees for fibre processing could avail themselves of the existing training programmes available from the Textile Training Foundation, Inc. through the Board of Investments.

9. A co-ordinated Plan of Action

Organization of a Ramie Development Commission by the government with six members representing relevant organizations as follows:

- a) Board of Investments
- b) PTRI
- c) RAMITEX
- d) Fibre Inspection and Development Authority, MOA
- e) Federation of Textile Associations of the Philippines
- f) National Economic Development Authority (NEDA)

The Commission could be under the auspices of NEDA for government co-ordination with private sector.

The Commission will co-ordinate the work as outlined and carry out research programmes by respective institutions. PTRI will play the major role assisted by RAMITEX. The two trainees sent by SIS project may return in June 1983 and will assist the full scale project with their knowledge gained during their training in Korea and the United States.

A survey of all leading textile mills by a project team for one month will start the project development. Fabric designs will be oriented for ramie fibre and its blends with the assistance of the Federation of Textile Associations of the Philippines. Development of domestic market for ramie textiles will be promoted through improvement of finishing facilities in leading textile finishing mills.

Dyeing, printing and finishing of ramie fabric by commission finishing mills will be developed for domestic market. Machine printing of ramie fabric and transfer printing have not yet been developed in the Philippines.

10. Research Fund for Ramie

The ramie growers can have their lucrative harvest of 6 crops in accordance with the recommendation of multiple uses of ramie crop and multiple supporting crops to earn a gross overall income of ₱ 89,000 annually per hectare under the guidance of FIDA. They should be able to compete well against the brute strength of factory-made synthetics and imported cotton. They should be asked to contribute some for research.

In the United States, most cotton producers already paid \$ 1.2 per bale into a research foundation for research into how consumers can be persuaded to use more cotton products.

Since the early 1960's, the tough non-iron synthetics have crowded cotton out of more than 70 percent of the textile market. Cotton's long decline was continuous from 1960, which marks the downfall of the ironing board, to 1973 when the rage for blue denim helped stabilize cotton demand at about 29 percent of the overall textile market and at about 39 percent of the apparel market. The cotton producers in the United States spent \$ 30 million in research in 1974 to counter the \$ 230 million spent on advertising for synthetics. In the same period, Cotton Incorporated in the United States spent \$ 5.5 million on research and \$ 3.5 million on advertising.

FIDA's inspection service fee could include a research contribution by ramie growers for certain high grades of degummed fibre. In the initial stage, special research grant from various organizations and international agencies should be sought in a similar pattern of the successful Rice Institute. Since the introduction of ramie in 1930 to the Philippines, ramie research has seldom received any attention from the government and private sector. San Miguel has supported the ramie industry since 1960 and has suffered great loss.

Rehabilitation of the ramie industry certainly challenges the concerted effort by the government as well as private enterprises.

III. FINDINGS

1. Following the SIS project, improvement of ramie cultivation by selecting the best variety in lieu of the mixed varieties in the present practice in RAMCOR farm showed an increase of fibre yield by 38.0% with the variety "Miyazaki 112". An investigation of all varieties of ramie in the Philippines is described in the ANNEXES.

2. Intercropping ramie in the first year with mungo bean showed good yield at RAMCOR farm and provide cash income to the farm.

3. Field trip to Baguio with visits to several mushroom farms and cannery found three kinds of mushroom, i.e. button mushroom, banana mushroom and straw mushroom. The mushroom farmers there expressed their difficulties in meeting competition from imported canned mushroom. As mushroom canner has to bear the entire cost of composting, harvesting and canning, their investment return was very poor and even negative with loss. This is quite different from prosperous mushroom industry in Taiwan as winter side-line of rice farms.

The potential development of mushroom industry in the Philippines could be a sideline of ramie farms with ramie shives and wastes as mushroom compost and hog manure as fertilizer. The promising variety of mushroom appears to favor straw mushroom and banana mushroom for its good flavor and natural adaptation to warm climate. RAMITEX tested mushroom cultivation on ramie wastes. Experimental cultivation of straw mushroom has been introduced to RAMCOR farm in January 1983.

4. Progressive farmer may find ramie a highly profitable crop with government support. Besides a regular long term fibre yield of 2.0 tons of degummed fibre per hectare with a value of ₱ 44,000 from six crops, the two supporting by-products, i.e. mushroom from ramie shive at 4 crops a year with a value about ₱ 6,000 and four hogs (total 360 kg) per hectare from ramie forage with a value of 3,000. The ipil-ipil tree in the ramie farm as interplanting energy tree can be harvested for fuel or pulpwood in 8 years with a value estimated at 80,000 for 40 tons wood or an average of 10,000 per year.

A five-year old ramie farm can be extended to 50 times by rhizomes from the farm. The value of rhizomes is estimated at ₱ 2,000 per hectare or ₱ 100,000 for 50 hectares. The average annual income would be ₱ 20,000 per hectare of the old farm, excluding value storage roots for feed.

Intercropping in the first year of ramie with legume food crops such as mungo bean, peanut or garden pea would save weeding and bring in cash income in the order of 400 kg peanut at ₱ 10 per kg or a total of ₱ 4,000 per hectare in the first year or ₱ 800 annually for five years. The ramie crop should be preceded by a green manure crop such as sum hemp (*Crotalaria jancea*). The sum hemp can be harvested in 100 days and yield 500 kg of retted fibre with a value about ₱ 2,500. This brings a high income at about ₱ 89,000 per year per hectare. No crop in the Philippines can compare with ramie in total potential income per unit area of land with sustained yield and an export market at \$ 5,000 per hectare annually from 2 tons of degummed fibre.

Extensive rural employment can be secured by opening new ramie plantations in typhoon-free Mindoro Occidental province, where social economic environment is congenial for this industrial crop. FIDA has intention to open 1,000 hectares of land in Mindoro for ramie.

By recycling ramie shaves as compost from mushroom cultivation, ramie forage to generate hog manure and ramie gum for feed from waste degumming liquor, the inputs as fertilizer, degumming chemicals, animal feed and weeding chemicals are greatly reduced. But extensive labor would be required to handle these by-products and their processing.

5. Establishment of a compost mill next to a piggery to facilitate utilization of hog manure in composting will also provide generation of methane gas for household heating and ramie degumming. RAMCOR farm has demonstrated ramie forage dehydration with hot air from burning methane gas generated from hog manure fermentation. Application of compost in ramie cultivation at RAMCOR showed high growth rate with big stalks.

6. In a large plantation with thousands of workers, it is advisable to build a centralized residential area with gas heating facilities and a community activity centre. Backyard mushroom cultivation can be developed to provide cash income to workers as a family sideline short crop. Three to four crops of mushroom in year-round operation can be achieved. The spent mushroom compost should be returned to the ramie field.

7. Coconut farms may have ramie intercrop with government promotion. This will save land cost and is advantageous when the ramie is cultivated for propagation to supply rhizomes for transplanting. The farm is less labor intensive as harvesting is usually made in 60-70 days for full ripe stalks to make stem cuttings as planting materials. Hence, the farm is less productive as fibre yield is concerned.

Government subsidy is needed to support a source of ramie planting stock. Also, operation of coconut harvest will have less interference on a ramie nursery as an intercrop. A ramie nursery in a coconut farm is compatible especially for cultivation before transplanting when shading effect from coconut trees has little effect in the early growth of ramie seedlings. A nursery can bring in cash income after two years of operation and will support the coconut farm with plant residue as compost.

8. A green manure crop to precede ramie cultivation will increase fibre yield due to organic compost.

9. Cultivation of sum hemp (*Crotalaria jancea*) as green manure crop for harvest about 100 days could also be considered. With mechanical harvesting, sum hemp stalks can be ribboned with a field ribboner to get the bast fibre leaving all the plant residue for green manure. The bast fibre can be water retted and marketed as cordage fibre, which is valuable with a price about ₱ 5.00 per kg. One hectare can get about 500 retted fibre with a total value at ₱ 2,500.

10. Interplanting ramie with leguminous ipil-ipil tree as deep root tree by transplanting two-year old young plants will support ramie crop in saving fertilizer and improving drainage control. When ramie is replanted after five years, the ipil-ipil tree will have attained big size and tall, which will have little shading effect on the replanted ramie. Experimental interplanting should be made. The tree can be harvested when growth rate has reached maximum and lumber market cycle indicates the good return from the wood. Usually, a ten-year cutting cycle is made.

The Forest Products Research and Development Institute has excellent facilities for pulp and rayon research. Ipil-ipil wood for pulp and rayon has been explored by this Institute (See Annexes for ipil-ipil wood chemical composition).

II. Ramie in blend with viscose rayon or acetate fibre improves wet strength, wearing quality and luster with linen character. Recently, this country imported 20,000 t/y viscose rayon. Production of viscose rayon and acetate fibres could be made with local or imported dissolving pulp. The consumption of raw materials for production of acetate fibre is shown in the ANNEXES.

IV. FURTHER TECHNICAL ASSISTANCE

The proposed R + D activities as outlined above would need long term technical assistance by experts with broad experience in industrial processing of natural fibres. Emphasis should be placed on mechanization of ramie processing from harvesting to degummed fibre.

Modernization of the textile industry of the Philippines needs technical advice to orient production to ramie textiles in blends with natural fibres of indigenous origin. The unique quality of ramie, silk, cotton, rayon and acetate fibres can be exploited in fabric designs and garment production.

Ramie needs a low cost carrier fibre in processing and spinning. The present use of polyester is expensive both for the imported fibre and fabric finishing. Rayon and acetate fibres from dissolving pulp should be developed for their low cost and local supply of raw materials for dissolving pulp. Further technical assistance in the development of a low cost carrier fibre of local origin is envisaged.

ANNEX I

LIST OF PARTICIPANTS

International Staff

Dr. Chien Chu, Republic of China, expert in ramie processing technology and fabric finishing, mission period was December 1982 to January 1983.

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ANNEX II

HISTORY OF RAMIE CULTIVATION AND RAMIE VARIETIES
IN THE PHILIPPINES

Ramie has been a commercial crop in the Philippines since 1930. It was stopped temporarily by the second world war but resumed its growth again in the 1950's. The ramie production was started on Kenram Plantation (Kenaf-Ramie) which was located on the island of Mindanao. More specifically it was near the municipality of Isulan, province of Sultan Kudarat. Seven hundred hectares on this plantation was used for ramie growing. The Corporation stopped growing kenaf in 1954 because of definite advantages in favor of ramie and other crops under Philippine conditions. In addition to ramie, 105 hectares were planted to valencia oranges, 98 to cacao, 75 to coconuts and 70 to banana.

In the early part of 1950's Don Vicente Araneta conceived his vision to establish a farm to cultivate ramie in Buluan, Maguindanao in Central Mindanao. He transported tediously the best farm machineries available then and went on to establish and operate what was to be known as RAMCOR - The Ramie Corporation of the Philippines. The decorticated fibre product was exported to Japan. At present the land area is 992 hectares, with 450 hectares planted to ramie and another 200 hectares being fallowed for planting eventually to ramie making a total of 640 hectares ramie plantation.

In Davao, small ramie farmers organized themselves into the Davao Fibres Producers Marketing Co-operative Association. In Cotabato, two corporations were set up to produce ramie - the Ramie Corporation of the Philippines, or Ramcor and Kenram (Phils.) Inc. These were mainly extractive operations, involving planting and decortivating or bark stripping. Fibre-processing facilities were non-existent and the fibre were exported in raw form to Japan.

At the same time, decontrol wrecked havoc on cultivation costs. Fertilizer costs shot up with the new exchange rate, equipment cost went up and labor costs were hiked by 50 percent in 1964. Compounding the problem was the operation of some machinery which proved inefficient.

Ramcor also invested substantially on research and development on cultivation techniques. Since pay-off from research and development were not immediate, this led to further cost increases in the extractive stages. The overall result was consistent losses for Ramcor from 1958 up to even 1971.

Kenram gradually withdrew from ramie and shifted to palm oil. In an effort to retrench, Ramcor gradually abandoned less productive fields and diversified to other crops, even to hog raising. Incidentally, ramie leaves, rich in protein, provide a good feed supplement for hogs.

The Ramie Textiles, Inc. or RAMITEX, was born in 1956. This was a project of the Araneta Investment group, capitalized at ₱ 10 million. The public sector through encouragement by then President Ramon Magsaysay responded to the same challenge of integration with the establishment of the Davao Ramie Textile Mill or DARATEX. Today RAMITEX is ranked among the leaders of the local textile industry.

Philippine ramie is considered the best in the world. But an excellent specie that can yield finer denier fibres will naturally be an added boost to the market position abroad. The Philippine Textile Research Institute in collaboration with NSDB has been successful in getting UNIDO funding for the experimentation and development of a ramie specie that will yield finer denier fibres. Perhaps, FIDA and the Philippine Council for Agriculture and Resources Research and Development can give impetus to this thrust with support.

The full development of export market for ramie, however, will give rise to a problem of supply. The ramie farms in Cotabato and Davao at present cannot supply a real expanded export market.

Ramitex has taken steps in this direction. To accelerate extension of credit to Ramie farmers, Ramitex is making representations with the Development Bank of the Philippines and the regional KKK Secretariat to accept ₱ 5,000.00 as the official loan benchmark for the cultivation of one hectare of ramie farm with a minimum of collateral.

In 1961, the area of ramie in the Philippines was around 2,440 hectares, and produced raw fibre of 4,444 metric tons, as compared with 1970 which produced raw fibre of 1,647 metric tons, the raw fibre has increased 168%.

TABLE I. The list of ramie varieties in the Philippines

Variety	Origin	Place
Kogai	Davao Exp. Sta., U.S.A.	IPB, UP, SMC B+C
Tatsutayama	" "	" "
Seikeiseiskin	" "	" "
Everglades (Florida commercial)	" U.S.A.	" "
Yilan	" "	" "
RV 53-47	" "	" "
RV 50-11	" "	" "
London	Japan	" "
America	" "	" "
Kagi-Sei	" "	" "
Kairakaya	" "	" "
Mansanitas	Davao	" "
Katifunan	" "	" "
San Miguel	" "	" "
Nan Hwa Green bark	Taiwan, R.O.C.	" SMC B+C
Tawa Nan No. 2	U.S.A.	" "
B P I	" "	" "
R-1452	" "	" "
R-1414	" "	" "
Hillshore	" "	" "
Miyazaki 111	Japan	SMC Ramcor
Green Slender	" "	" "

TABLE 2. Proximate analysis of dehydrated ramie leaf meal

Items	Mr. J.M. Dempsey	Ramcor Farms
Moisture %	9 - 10	
Protein %	24 - 26	24.9
Fat %	5 - 6	8
N.F.E. %	12 - 16	29.7
Phosphorous %	0.25 - 0.30	
Calcium %	5 - 6	
Carotene r/g	200 - 300	
Crude Fibre %		14.9
Ash %		23.2

TABLE 3. Analysis of organic material

Organic material	N (%)	P ₂ O ₅ (%)	K ₂ O (%)	Remark
Compost	0.45	0.26	0.33	
Liquefy fertilizer	5	-	2	"Hikari" mark
Sesbania	0.47	0.12	0.42	
Sunn hemp	0.37	0.08	0.14	
Fresh hog manure	0.57	0.19	0.28	Sample from Ramcor
Dry ramie leaf	4.18	0.29	1.32	
Dry ramie stem	1.26	0.19	1.02	
Ramie decortication waste	3.24	1.10	2.24	Air dry basis

ANNEX III

PROPOSAL FOR RAMIE CULTIVATION IN MINDORO

In 1981, Ramitex bought 3,569 tons of crude fibre from Ramcor Farms, Castillo, P.I. MINTRADE, TAG Cotabato and DAK Davao. The Ramcor Farms is located at Buluan, Maguindanao in Central Mindanao, 150 kilometers south of Davao City. The other ramie fibre production and trading firms collected raw ramie fibre from many small ramie farms in Davao North and South Davao.

The Ramitex is located at Bagbaguin, Valenzuela, Metro Manila. The distance between Manila and Davao is about 1,568 miles (2,523 km.). The freight of water transport for the raw fibre is very high. San Jose is the capital of the province of Occidental Mindoro. This region is outside the typhoon belt and had planted ramie before. The Fibre Inspection and Development Authority is making plan to cultivate ramie on 1,000 hectares in the province of Mindoro Oriental and to sell the raw fibre to Ramitex. The distance between Manila and San Jose is about 448 miles (721 km.). The cost of water carriage to transport the raw fibre is much lower. Choosing the best soil, planting the excellent ramie variety and making a new management for the new ramie plantation are very important for the ramie industry.

ANNEX IV

CHEMICAL COMPOSITION OF IPIL-IPIL WOOD FOR PULP 1-1/2 YEARS
OLD TREE

Holocellulose %	72.6
Pentosans %	20.1
Lignin %	22.7
Ash %	0.9
Fibre length, mm	1.04

(Source: Forest Product Research and Development Institute)

The wood has low ash which indicates good prospects of filterability for artificial fibre.

ANNEX V

CONSUMPTION OF RAW MATERIALS FOR PRODUCTION OF ACETATE
FIBRE, ONE KG

Dissolving pulp	0.65 - 0.7 kg.
Glacial acetic	0.65 kg.
Sulfuric acid	0.07 kg.
Acetone	0.15 kg.
Water	200 liter

(Source: Textile Handbook, Taiwan)

Acetic acid can be produced by fermentation of molasses. Dissolving pulp can be readily made from abaca and cotton linter. Alternate source of dissolving pulp is wood of fast growing ipil-ipil tree.

ANNEX VI

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