3. ＩＤＣによるクエン酸プロジェクトPre-F/S の要約抜粋及び要約

3 -- 1 要約抜粋

INDUSTRIAL DEVELOPMENT CORPORATION OF ZIMBABWE LIMITED

CITRIC ACID PROJECT

INVESTMENT OPPORTUNITY STUDY EXECUTIVE SUMMARY

1. PRODUCT DESCRIPTION, CURRENT AND POTENTIAL USES

1.1 Product Description

Citric Acid is a colourless transluscent product obtained in crystal or powder form. It is odorless, nontoxic, combustible, has a strongly acid taste and is very soluble in water and alcohol.

1.2 Current and Potential Uses

The consumers of the products include:

Branch of Industry	Proportion (%)	Examples
a) Food & beverages	60	Soft drinks, sweets, jellies, ice-cream, fruit essence, baking powder, preservatives.
b) Chemicals	15	Synthetic resins, softening agent, citric acid esters.
c) Textiles and Leather	10	Textiles brightening (dyeing)
d) Pharmaceuticals	5	Ferrum citricum, blood preservative, tablets, ointments.
e) Metals	5	Metal surfacing, cleaning, pickling.
f) Various	5	Buffering agent, shampoos, animal feed suppliment, detergent preparations.

2. MARKET SCOPE AND PRICES

2.1 Domestic Market Consumption and Demand

From 1980 to 1986 consumption of the product in Zimbabwe has grown at a rate of 13% per year on average. The country is totally

dependant on imports. Central Statistical Office data indicate an average annual consumption rate of 500 tonnes for the period 1984 - 86. By the year 2000 AD consumption is projected to reach 2500 tonnes. This does not take into account the fact that the availability of the product in the market-place is constrained by foreign currency shortages.

2.2 Imports and Market Prices

By 1986 the FOB price was Z$3,17/kg, an increase by 260% over the price in 1976. The increase from 1980 to 1986 was by 173% (10% per year).

Currently wholesale prices vary from Z$5/Kg to Z$ 12/Kg

2.3 Sales Realisation Potential

Using the lower end wholesale market price of Z$5/Kg the project is expected to realise a sales turn over of about Z$10 million at 1988 prices. At average wholesale price (Z$8,50/Kg) the realisation would be Z$17 million.

3. PROPOSED SCALE OF PRODUCTION AND INVESTMENT

A producing capacity of not less than 2000 tonnes per annum is envisaged.

Investment cost is to be searched.

4. RAW MATERIAL AVAILABILITY

The product can be produced from cane sugar juice, sugar crystals, or molasses. The project would therefore be domestic resource based as sugar cane is already grown in the country and there is a project being studied to develop a vast sugar plantation at Chisumbanje. Average consumption figures for feedstock and chemicals are as follows per tonne of product (Citric Acid Monohydrate):

(a) Raw Materials

Cane Molasses	2,6 - 2,9 tonnes
(Sugar crystals)	1,29 - 1,32 tonnes)

(b) Chemicals

Limehydrate (70% CaO)	0,71 - 0,75 tonnes
HCl (30%)	0,17 - 0,19 tonnes
Sulphuric Acid (95%)	0,86 - 0,91 tonnes
Caustic Soda (50%)	0,14 - 0,16 tonnes

Ammonium Nitrate	0,002 - 0,018 tonnes
Magnesium Sulphate	0,007 - 0,009 tonnes
Interlacing Agent (Kg)	0,4 - 0,5 tonnes
Filter Aid (Kieselgur)	0,23 - 0,25 tonnes

The production process involves the use of a selected strain of Aspergillus Niger, common airborne contaminents in the general environment and in laboratory settings.

5. FOREIGN CURRENCY BALANCES

5.1 Gross Import Savings (GTS)

As current imports are estimated at 750 tonnes per year at a foreign currency cost of about Z$3,8/kg, the savings would be approximately Z$2,85 million.

When the project will have come on stream and domestic consumption will have reached 1500 tonnes per year the country will be saving about Z$5,7 million per year on imports at current prices.

5.2 Gross Balance of Trade Benefit (GTS + Exports)

No country in the SADCC/PTA region has a citric acid plant.

Zimbabwe is having to re-export the product, although in very small quantities (10 tonnes in 1986).

With export outlets already in existence it is anticipated the project would be able to export at least 500 tonnes per year which would increase the foreign currency benefit to about Z$7,6 million per year at current prices.

6. UPSTEAM AND DOWNSTREAM INDUSTRIES AND BENEFITS

6.1 The product is an imported item and local production would facilitate expansion of the user industries, particularly the food processing and drink formulation sub-sectors.

6.2 It would also become possible to develop a project to manufacture citrate salts for use in making dairy products, fruit preparation, meat products, detergents, medicines and pharmaceutical products etc.

LAM/tf
14/06/1989

CITRIC ACID FEASIBILITY INVESTIGATION

TERMS OF REFERENCE

1. To establish current markets for Citric Acid in Zimbabwe and the PTA/SADCC countries and project these to the year 2000. Provide an estimate of world wide acid production, consumption trade and price.

2. To determine the purchasing price for Citric Acid in each country identified as being in the potential market area and to estimate ex-works returns to the projected Citric Acid plant in Zimbabwe. The sales profile of processing countries to the market areas quoted should also be determined.

3. To establish the quality criteria and product specifications required for Citric Acid.

4. To define the technical processes required for Citric Acid production to the specification identified in terms of (3) above.

5. To undertake preliminary design and layout studies for a plant based on domestic market, but capable of expansion to tonnages indicated in terms of likely export markets in PTA/SADCC countries.

6. To determine economic input requirements and potential sources of supply for raw materials and chemiclas to enable viable production of the tonnages quoted under (5) above and also in terms of likely export potential at acceptable quality and with competitivity in PTA/SADCC markets and examine the feasibility of using such alternative raw materials as molasses, raw sugar, cotton waste, maize, etc.

7. To estimate the capital cost of the plant including costs of pollution control under a 'green field' type operation, with the proviso that there should be maximum fabrication of plant and equipment utilising Zimbabwean sources of manufacture and engineering expertise, thus minimising the need for foreign currency inputs.

8. To recommend the criteria for selection of a suitable location and site. The need for raw materials, adequate water supply, power and transport should also be considered.

9. To recommend by-products and down stream products manufacture which may be commercially practicable.

10. To produce an interim report prior to departure from Zimbabwe, making appropriate recommendations to the potential investor and to provide an estimate of likely financial returns.

11. To complete the feasibility investigation within a period of four weeks.

22/09/89

3－2 要 約

INDUSTRIAL DEVELOPMENT CORPORATION

PROJECT PROPOSAL : CITRIC ACID PRODUCTION

SUMMARY

Project Concept

The citric acid requirements of Zimbabwe and all the SADCC countries are met by imports.

It is therefore proposed to set up plant in the country to produce for the domestic market and for export.

The Market

The principal users of the product are the drink formulation industry, the food processing industry, the textile industry, the metallic products industry and the pharmaceutical industry.

In Zimbabwe the full extent of the applications and consumption of the product is constrained by the acute shortage of foreign currency the country has suffered over the years as far back as from before independence.

Nevertheless, as from 1980 to now, the rate of growth of consumption in the century has averaged 13% per year, and by the year 2000 the level is projected on this basis to be 2300 - 2500 TPA.

Scale of Production and Raw Materials

It is proposed that a 2000 TPA citric acid processing plant be installed in the country; and that molasses be used as the carbohydrate source of the product, failing which glucose or cane juice can be resorted to. For a 2000 TPA producing capacity the molasses requirement is estimated at 6000 TPA. On average, 120 000 tonnes of molasses are produced in the country annually and used mainly for making ethanol and for feeding livestock. With cane juice the requirement would be about 13 000 TPA.

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INDUSTRIAL DEVELOPMENT CORPORATION OF ZIMBABWE LIMITED

Project Proposal B3/R2SITC 513 900

CITRIC ACID AND CITRATE SALTS

1. BACKGROUND AND HISTORY

Staff have identified local production of citric acid and its salts as an investment opportunity. This is the first time at the IDC that the products are under investigation for a project. However, it became known in the course of market studies that Klochner Industries of West Germany were also studying the feasibility of setting plant in the country:

2. PROJECT CONCEPT

The IDC proposal is for a citrate processing plant to produce citric acid, as well as sodium citrate and potassium citrate for the domestic market and for export.

The citric acid production process consits of the following main stages:

(a) preparation of fermentation material

(b) preparation of raw material

(c) fermentation of substrate

(d) separation of acid from the fermentation broth and its isolation in crystalline form.

The processes employed are surface or submerged fermentation by mold (Aspergillus niger) or by yeast (Candida guillermondii, C Lipolytica), using a variety of substrates such as sucrose, molasses, maize syrup(glucose), enzyme - treated starch, normal paraffins, etc.

Citric acid is recovered from fermantation by solvent extraction or more commonly by precipitation as calcuim citrate, followed by treatment with sulphuric acid to convert the calcium citrate to calcium sulfate and citric acid. The calcium sulphate is removed by filtration and the citric acid solution is further purified Crystallisation of citric acid from a hot aqueous solution (above the transition temperature of 36,6ºC) yields anhydrous citric acid. Crystallisation from a cold solution yields the monohydrate.

As citric acid is a tribasic acid, it can form acid and neutral salts and buffers over a broad pH range. The more important salts which are readily available commercially are :

(a) trisodium citrate.
This is obtained by treating sodium sulfate solution with calcium citrate.

(b) tripotassium citrate:
This is obtained by acting citric acid on potassium carbonate.

(c) ammonium and ferric citrates:
specifically these are diabetic ammonium citrate and ferric ammonium citrate.

The co-products are calcium citrate, calcium sulphate and animal fodder.

As the raw material can be sugar cane juice or molasses, and as the containers used to handle the products can be drums, bags, cartons, barrels or bottles, the factory can be established at any one of the growth points which is near a raw sugar recovery plant (e.g. Mupandawana in Masvingo).

The benefits realisable from implementing the proposed project include:

(a) Self-sufficiency in products without which the food-processing and beverage and drink formulation industires as well as several other branches of the manufacturing sector cannot deliver the goods.

(b) Savings on imports which currently amount to approximately Z$1 500 000 and an export potential in excess of Z$1 million per year.

(c) Substantial employment creation. The envisaged scale of production would require approximately 45 employees.

The proposed project is resource-based and is therefore in line with the strategy of import substitution, beneficiating local raw materials into intermediate goods required by domestic industry, and exporting products with a higher added value.

3. THE MARKET

The consumers of the products include the following industries:

- drinks and beverages
- food processing
- Pharmaceuticals
- plastics
- textiles
- metals and metal products
- soaps and detergents
- animal feeds
- pulp and paper
- construction,etc

3.1 Product Uses

Citric acid and its salts have several important functions. Citric acid is mainly used in the preparation of citrates and, widely, in the drinks and beverage formulation industries, in food processing and in the pharmaceutical industry, as well as in eletroplating and alkyd resins. It is also used as an acidfier, as a sequestering agent to remove trace metals, as a mordant in dyeing to brighten colours, and as a cleaning and polishing agent for metals such as stainless steel.

In foods and drinks it is used primarily to produce a tart taste and to compliment fruit flavours in carbonated beverages, beverage powders, fruit-flavoured drinks, jams and jellies, confections,candy, sherbets, water ices and wine. It is also used to reduce pH in certain canned foods to make heat treatment more effective, and in conjunction with anti-oxidants to chelate trace metals and retard enzymatic activity, as well as for the conversion of sucrose into invert sugar.

In pharmaceuticals, citric acid provides the acid source in effervercent tablets in addition to being used to impart a tart taste and chelate trace metals. It is also used as a blood anticoagulant.

Because of its low toxity, relative non-corrosiveness and biodegradability, citric acid is also being used for applications normally reserved for the strong mineral acids. These include preoperational and operational cleaning of iron and copper oxides from boilers, heat exchangers and nuclear reactions;passivation of stainless steel tanks and equipment; and etching of concrete floors prior to coating. It is also used as a dispersant to retard settling of titanium dioxide slurries and as a sequestering and pH control agent in the textile industry.

Furthermore, as a triabasic acid, citric acid can form acid and neutral salts, and will buffer over a broad pH range. The salts which are readily available commercially are calcium citrate (tetrahydrate), trisodium citrate, (dihydrate and anhydrous), tripotassium citrate (monohydrate), diammonium citrate (anhydrous), ferric ammonium citrate and calcium sulphate.

Calcium citrate is obtained as a co-product in the production in process. It is a source of calcium either for dietary and nutritional supplementation or for functional purposes as a buffer and firming agent in foods. It is also used for medicinal purposes.

Sodium citrate, the salt which is most widely employed, is used as a emulsifier in process cheese products where it prevents fat separation, imparts goods melting down properties, and produces slices with proper flexibility. In other dairy products, such as ice-cream, whipping cream and evaporated milk it acts as a stabiliser and viscosity control agent. It is also used to mellow the sharpness of high-acid beverages, as a buffer to control pH in jams, jellies gelatin desserts and many pharmaceutical preparations, in meat products,

as a blood anticoagulant, and in eletroplating and photography. However, its largest single industrial use is as a detergent builder since it is rapidly biodegradable, environmentally acceptable and can chelate calcium, magnesium and other metal ions . The salt is also useful as a water conditioner, as a set-retardant for cement and as a scrubbing agent to remove sulfur dioxide from stack gases or process tail-gases.

Potassium citrate can be used as a substitute for sodium citrate in special food products where sodium ion is undesirable. It is also applied as a medicine and as a sequestrant.

Diabasic ammonium citrate is used in pharmaceutical preparations, dry formulations for metal cleaning, rust-proofing cotton printing and plasticising. And, ferric ammonium citrate is used as a nutrient source of iron in food and in pharmaceutical syrups and elixirs, as a feed additive, and for blueprint photography. Apart from calcium citrate, the co-products of citric acid are animal fodder and calcium sulfate. Calcium sulphate is used as a Portland cement retarder, as a soil neutraliser and as a nutrien supplement. It is also used in polishing powders, paints (white pigment, filler, drier), paper (size, filler, surface-coating), dyeing and calico printing, metallurgy (reduction of zinc minerals) and drying industrial gases, solids and many organic liquids.

3.2 Consumption

Everything being equal, it is the rate of consumerisation of society and the growth and development of the using industries which determine the level of consumption and the prices of citric acid and its salts.

This has not been the case in Zimbabwe over the years. The country is short of foreign currency and the consumption level and price of any imported item is determined by availability of foreign currency. So it is the case with citric acid and its salts; and the following consumption data are therefore not the measure of what the market would take in circumstances of uncontrained supply.

The data are for citric acid only.

	1983		1984		1985		1986	
	Q	V	Q	V	Q	V	Q	V
Domestic Production	-		-		-		-	
Net Imports	298	470	673	1045	489	1257	444	1425
DOMESTIC CONSUMPTION	298	470	673	1045	489	1257	444	1425
Exports	-	-	-	-	2	3	8	10
TOTAL AVAILABILITY	298	470	673	1045	491	1260	452	1435

Q (Tonnes) V (Z$000) - (nil)

The users of the product are numerous and many more could be using it. The major ones in the drink formulation and food processing industries are:

	PURCHASES	
	TPA	Z$000
United Bottlers	50 to 60	350 to 360
Schweppes 300-400	50 to 60	350 to 360
LEMCO	10	50
WILLARDS FOODS	10 to 20	50 to 500

Export markets are there as the 1985 and 1986 data indicate.

3.3 Prices

The FOB unit values of citric acid imports were as follows as from 1975:

	Z$/Kg
1975	0,88
76	0,92
77	0,75
78	0,83
79	0,97
80	1,16
81	1,04
82	1,06
83	1,61
84	1,55
85	2,57
86	3,17

Thus, from 1975 to 1986 FOB prices increased by 260% (12,5%p.a.) From 1980 to 1986 they increased by 173% (10%p.a.) Further increases are expected for the rest of the 1980s.

As for wholesale prices, they currently vary from supplier to supplier. They range from $5,00/kg to Z$12,00/kg. And depending on supply and demand, some companies are said to charge up to Z$16,00/kg.

4. SCALE OF PRODUCTION

A producing capacity of not less than 2000 TPA of citric acid is proposed. The grounds are:

(a) Projection of domestic consumption statistics on a 3 year annual average indicates a requirement of over 2000 TPA for the years 1999 - 2001:

	Annual Average TPA	Increase %
1975 - 77	139	-
1978 - 80	161	16
1981 - 83	216	34
1984 - 86	505	134
1987 - 89	737	46
1990 - 92	1054	43
1993 - 95	1475	40
1996 - 98	2020	37
1999 - 2001	2707	34

(b) Over the past five years or so, availability has been on a shoe-string owing to the acute foreign currency shortage facing the country.

(c) The full scope and extent of the use of citrate prodicts has yet to be taken full advantage of. In the drink making industry for example, citric acid can, over and above the traditional utilisation, be used in the formulation of low-calorie beverages (citric acid content 0,01 - 0,13% w/v), thirst quenchers(citric acid content 0,28 - 5,83% w/w), reduced calorie dry beverage mixes (citric acid content 42,3-79,7% w/w)convenience teas (citric acid content 0,43%),cocktail mixes(citric acid content 4 - 7% w/w).More significantly, a substantial part of the proposed output could be put to use in the heavy metals area to a greater extent and in making sodium potassium and ammonium citrates.

(d) Export potential is there. Not one country in the SADCC region has a citric acid plant and there are many African countries which are importers. On average, an export performance of 500 TPA appears feasible.

The values of a 2000 TPA citric acid output at the price spectrum given earlier on would be as follows:

	Z$000
At 1986 FOB Price (Z$3,17/Kg)	6 340
At Current Minimum Wholesale Price(Z$5,00/Kg)	10 000
At Current Market Average Price (Z$8,50/Kg)	17 000
At Current Maximum Wholesale Price (Z$12,00/Kg)	24 000

For comparison 's sake, at current minimum wholesale price the realisation value of the output of 1984-86 consumption plant capacity (500 TPA) would be Z$2,5 million.

5. RAW MATERIALS AND PROCESSING AGENTS

As the table below shows citrates and citric acid occur commonly in animal and plant tissues, notably in molasses, sugar cane juice and citrus fruits.

CITRIC ACID CONTENT OF FRUITS AND ANIMAL PRODUCTS

ITEM	% CITRIC ACID
Lemons	3,8 - 8
Black Currant	1,5 - 3
Grapefruit	1,2 - 2,1
Blueberries	0,7 - 1,4
Rasberries	1,06 - 1,3
Cranberries	1,10
Strawberries	0,65 - 1,08
Apricots	1,06
Gooseberries	0,98 - 0,99
Oranges	0,98
Pineapples	0,84
Peaches	0,37
Bananas	0,32
Pears	0,24
Grapes	0,02
	% CITRATE
Tomatoes	0,25
Cabbage	0,05 - 0,07
Peas	0,05
Maize	0,02
Eggplant	0,01
Cow milk	0,08 - 0,23
Chicken organs	0,01 - 0,07

As all these items are produced locally and substantial volumes of some of them are exported, the proposed project stands on good ground.

Commercially, however, the products commonly used as carbohydrate sources of citric acid and its salts are: sugar cane and maize products.

5.1 GLUCOSE (SYRUP OF STARCH OR MAIZE)

This is produced through hydrolysis of starch using hydrochloric acid.

There is only one manufacturer in Zimbabwe and that is Chibuku Breweries Ltd of Harare. The company can produce and supply to specification. Some of its output is exported. The average price for the various types produced is Z$1000/tonne.

As a point of reference, the Miles Company of the United States uses glucose as the carbohydrate source for its citric acid product.

5.2 MOLASSES, SUGAR JUICE

Molasses is the syrupy mother liquid left after boiling sugar cane juice to produce sugar.

There are two sugar cane millers in the country: Hippo Valley and Triangle. Production is estimated as follows in thousands of tonnes:

	Sugar Cane Juice	Raw Sugar	Molasses
1980	370	273	77
1981	455	339	96
1982	494	370	104
1983	529	397	112
1984	545	410	115
1985	579	439	120
1986	635	480	135

Triangle produces half of its ethanol from sugar juice. The other half is obtained from molasses. The two companies, Triangle and Hippo, constitute roughly equal proportions of the molasses used i.e. approximately 120 000 tpa. A market for molasses as animal feed has also developed during the drought years.

In 1983/84 the price of molasses was Z$65/tonne. The International price was Z$95/tonne. Currently, the local price is Z$125/tonne.

The molasses from which no more sugar can be obtained economically contains about 30% sucrose, 20% reducing sugars, 10% ash, 20% organic non-sugars, and 20% water. And the sucrose content of the cane juice of Zimbabwean low-veld sugar cane is on average 13,79%.

According to Corporation engineering staff, one tonne of citric acid is obtainable by reacting 0,891 tonnes of sucrose wit yeast.

Thus, the molasses requirement for the proposed citric acid output of 2000 TPA would be 6000 TPA. With cane juice as feedstock the requirement would be 13 000 TPA.

the problem of molasses availability can be resolved by offering a more attractive price, say $150 tonne. For the project this would mean a raw material cost of about Z$900 000, which would be 9% of the value of the proposed output at Z$5/t realisation value.

Processing agents

The production process involves the use of a selected strain of Aspergillus niger, or yeast; and sulfuric acid.

Aspergillus niger, as species, are common airborne contaminents in the general enviroment and in laboratory settings.

Yeast is produced locally,mainly by Chibuku Breweries. About 60 000 tonnes of different types are manufactured per year. The prices are Z$0,805/Kg for baker's yeast, Z$4,37/Kg for dried yeast, and Z$4,80/Kg for brewer's yeast.

Sulfuric acid is also made locally by Chemplex Corporation. The prices are Z$0,69/Kg for 50% chemically pure, in 30Kg polycans, Z$1,10/Kg for98% chemically pure in 45 Kg polycans, and Z$0,50/Kg for 98% industrial in 43 Kg drums.

CONCLUSION

1. The market is ripe for the project. The prices of the product are viable; and there are more applications of it than the present ones to be taken advantage of.

2. The growth of consumption over the past ten years or so indicates a demand by the years 1996 - 98 of about 2000 TPA on average; hence the proposed production scale of 2000 TPA.

3. The feedstock options are several. The first is molasses, followed by glucose. Sugar cane juice and raw sugar can also be used. All these are produced locally.

4. 本格調査の目的と範囲（調査団案）

4. 本格調査の目的と範囲（調査団案）

I .OBJECTIVE OF THE STUDY

The objective of the study is to formulate project alternatives with respect to the production of citric acid by using domestically available raw materials in Zimbabwe.

II .SCOPE OF THE STUDY

JICA shall conduct the Study based on the Terms of Reference proposed by GOZ and submit the Final Report including recommendations on a number of project alternatives for the purpose of GOZ's appraisal.

The outline of the Study shall be the following:

1 Economic and policy background

1-1 National and regional development policy

1-2 Industrial sector policy and programmes

1-3 National and regional socioeconomic parameters

2 Market study(only on the domestic market)

2-1 Review of existing data

2-2 Statistical analysis

2-3 Current market and marketing analysis

2-4 Demand forecast

3 Legal constraints

3-1 Environmental protection

3-2 Others(tax,employment)

4 Raw materials and product transportation

4-1 Raw material collection method

4-2 Product packaging methods and specification

4-3 Railroad transportation

4-4 Road transportation

4-5 Warehousing facilities

5 Project site analysis and infrastructure

5-1 Public utilities

5-2 Maintenance shop

5-3 Housing and living conditions

5-4 Soil and meterological conditions

6 Basic project plan

6-1 Process selection

6-2 Plant equipment and materials

6-3 Mass balance

6-4 Heat balance

6-5 Process plant

6-6 Raw material processing plant

6-7 Utility facilities

6-8 Off-site facilities

6-9 Environmental protection devices

7 Construction plan

7-1 Manufacture and import of materials and equipment

7-2 Applicable industrial standards and regulations

7-3 Plant installation

7-4 Field labour

7-5 Cost estimation

8 Plant operation and maintenance

8-1 Organization and staffing

8-2 Staff recruitment

8-3 Training

8-4 Technical supporting system

9 Economic analysis of project alternatives

9-1 Financial analysis

9-2 Economic analysis and social evaluation

9-3 Scenario/sensitivity analysis

5. 主要入手資料リスト

5. 主要入手資料リスト

(1) Schweppes(Central Africa) Ltd. 会社概要

(2) Triangle Limited 会社概要

(3) Quarterly Digest of Statistics
(March, 1989) Central Statistical Office

(4) First Five-Year National Development Plan (Volume II)

(5) Faculty of Science, Department of Biochemistry University of Zimbabwe(1990)

(6) Traditional Brewings Methods in Zimbabwe

(7) Citric Acid Project Investment Opportunity Study Executive Summary (IDC)……参考資料3

(8) Project Proposal : Citric Acid Production Summary (IDC)…参考資料3

(9) 地図①Administrative Areas
②Natural Regions and Farming Areas
③Rainfall
④Hydrological Zones

(10) The Promotion of Investment : Policy and Regulations

JICA