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

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UF/SAM/78/176

SAMOA

Technical report: Evaluation of the possibility of establishing a plant for chocolate production

Prepared for the Government of Samoa by the
United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

Based on the work of Robert L. Kenny, expert in cocoa and chocolate production

United Nations Industrial Development Organization
Vienna

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Explanatory notes

A slash between dates (e.g. 1970/71) indicates a crop year.

A hyphen between dates (e.g. 1962-1976) indicates the full period involved, including the beginning and end years.

The following abbreviations have been used in this report:

EEC European Economic Community
WSTEC Western Samoa Trust Estates Corporation

Mention of firm names and commercial products does not imply the endorsement of the United Nations Industrial Development Organization (UNIDO).

ABSTRACT

Following a request by the Government of Samoa to the United Nations Industrial Development Organization (UNIDO) in August 1978 for assistance by experts who would advise the local personnel in some specific fields of the food processing industry, the project entitled "Food processing development" (UF/SAM/78/176) was approved on 27 September 1978.

The expert in the production of cocoa and chocolate took up his assignment of 6 weeks on 2 May 1979 and concluded it on 16 June 1979. According to his terms of reference he examined the supply of cocoa beans in terms of quantity, quality and price, and as a result recommends that a project for the processing of graded cocoa should not be considered. If Samoa continues to export good quality cocoa beans, the return will be greater, considering that (a) there is only a limited amount of cocoa available and (b) such a plant requires a substantial outlay of capital.

The quality of Samoan cocoa has decreased over the past years which is attributed to the lack of centralized fermentation and drying facilities. But since the cocoa is of the Trinitario variety for which a good premium is paid to other producing countries for blending in the manufacture of high-quality dark chocolate, it is hoped that both the quality and quantity of the cocoa will improve by the Department of Agriculture's Development Plan commenced in 1976 for village cocoa, including the rehabilitation and replanting of cocoa under shade and the application of fertilizer.

Better quality control is also needed and it is recommended to set up a laboratory which could check the essential characteristics required, such as moisture content, degree of fermentation, absence of mould etc. This laboratory would be part of a general control laboratory to monitor all the crops for which the Department of Agriculture is responsible. In addition, contacts should be

established with the overseas users of the cocoa to receive their views on flavour and to assess what they consider an improvement of the quality.

Processing of cocoa beans into cocoa products should be considered for the low quality cocoa after separation from the better quality. These rejects, separated into nib and shell, represent 20% of the entire production and have to be sold at a very low price. Thus it should be possible to get a better price for the cocoa products into which they are converted. The smallest plant, however, has a capacity of 1,000 tons and therefore the cocoa production would have to reach 5,000 tons per year before consideration should be given to the processing of the substandard beans. The process involved in producing cocoa cake from cocoa beans which could be utilized in future to make chocolate coatings and powder for cocoa drinks has been described.

The expert further recommends to install a chocolate coating machine to produce chocolate coated fruits and nuts. A local fruit processing laboratory has the necessary expertise to preserve or crystallize fruits and peel grown in Samoa. For this experiment, coating chocolate could be imported in small quantities from Australia and the cores could be covered using the hand-dipping method involving little capital investment. The samples produced could then be assessed for their market potential.

Finally the expert suggests that, if a small-scale plant was to be set up, he would favour sugar confectionary and snack foods. During a visit to such a private factory in Fiji it was realized what progress can be made in these two areas in the Pacific. In addition, much less technical expertise is required than for chocolate production and the marketing problems are far less acute.

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INTRODUCTION

A. Project background

The economy of Samoa is heavily based upon the agricultural sector. The volcanic islands which form the Independant State of Western Samoa possess a fertile soil, and are densely covered with tropical vegetation, including valuable timber. The village communities maintain an economy based on agriculture and fishing which makes them largely self-sufficient in most essential commodities, while they produce copra, cocoa, and bananas for export. These three agricultural products bring about 90 percent of export earnings. A large part of the cultivated land is devoted to subsistence crops, such as taro and other starchy tubers. Breadfruit and papaya additionally provide a substantial contribution to the local diet. The principal livestock are pigs and poultry.

Out of a total population in 1979 of 157,000 only 32,000 live in the urban area of Apia. The rest of the population is distributed over 362 villages where they derive their livelihood from the cultivation of customary village land. The distribution of the population reflects high birth rates of recent years with 69 percent of the population under 25 years of age.

Because of the comparatively small size and the large distance from major commercial centers, Western Samoa has retained many traditional values held by the people. Samoan society has been in contact with the European world

for more than a century, yet its traditional organization remained strong, and were only gradually modified by the various external influences to which they have been exposed. The importance of maintaining the village economy and way of life is fully recognized, and is integrated into programs for the growth and development of exports.

B. Purpose of the mission

The expert in cocoa and chocolate production was one of four experts assigned to the project "Food processing development" (UF/SAM/78/176). The purpose of his mission was to analyse the supply of raw materials in terms of quality, quantity and price, to review the export of cocoa beans with respect to quantity, price and destination and assist in the chocolate processing development, to make recommendations on the possibility for the local production of chocolate or other cocoa products from cocoa beans for the local and the export market.

I. FINDINGS

A. Production of cocoa

The acreage planted is not known exactly and estimates range from 12,000 - 20,000 acres. The problem is that the majority of the area is represented by village production which is farmed on a mixed agricultural policy along with Copra, Bananas, etc.

The production is divided into the following categories:-

1. Western Samoa Trust Estates Corporation (WSTEC)

By far the largest and most important, it is spread over four main plantations and several minor ones with a total area of approximately 2250 acres.

The total exports for 1979 calender year = 225 tons

Total export per acre " " " = 224 lbs

The yield per acre is not known but is unlikely to be much higher, which is very disappointing by world standards.

2. Private plantations

There are several of these carrying out their own central fermentation and drying. They sell directly to the Board who classify their Cocoa as consignment Cocoa and allocate a specific mark on the sack which identifies the grower.

3. Village plantations

This represents mixed planting producing small yields. No estimate of yield per acre is possible. Little attention has been given to maintenance and replanting in the past. As the land is customary owned problems arise in changing the general outlook. The trees are very old and have been planted without the shade cover generally accepted as essential for the long term health of the tree and for increased yields.

B. Processing of raw cocoa

1. WSTEC

At present, WSTEC carry out the best operation which involves opening the cocoa pods on removal from the trees, extracting the wet beans and sending them to a central fermentary where they are held for 5 days in wooden boxes, each being capable of holding 3,000 lbs. They are then transferred to a different box to ensure adequate mixing every 24 hours under controlled conditions.

The beans are then washed and dried by a combination of sun from above and hot air from below utilising a Samoan Drier with provision made for covering over in wet weather. The beans are then washed and redried in a mechanical McKinnon Dryer for a period of not less than 20 hours. This would appear to be carried out to add a polish to the beans.

They are then divided into two grades according to size and separated from any inferior beans or shell. The reject beans are then independently cracked and put through a machine at least three times to separate cocoa from shell by means of an air blast.

The separated cracked beans, referred to as nib, are exported as well as the separated shell, at much lower prices than that obtained for No. 1 and No. 2 Cocoa. The plant is very old but the quality produced is stated to be good because of the centralisation and control of the processing. Only two estates have central fermentation facilities but as most of the estates are on Upolu Island the rapid transfer of wet beans from the remaining estates does not present a problem.

2. Private plantations

The process does not differ basically in so far as the fermenting and drying process is carried out centrally using a McKinnon Dryer.

The grading also follows the same lines as WSTEC.

3. Village plantations

The Cocoa is fermented and then sun dried in the village in small quantities. The fermentation is usually carried out in a basket covered with banana leaves and mixed every 24 hours for 5 days. Because of the lack of uniformity in drying, all village cocoa is then sent to the Cocoa Board warehouse in Apia, where it is reprocessed by washing and drying in a McKinnon Drver for a period stated to be 10 hours. It is then graded in the same way as described for WSTEC.
It would be better if this reprocessing could be eliminated by the establishment of centralised fermentary and drving facilities.

C. Marketing of raw cocoa

All marketing, sales and shipment of cocoa is carried out by a cocoa board set up in 1974 with the exception of WSTEC cocoa who operate their own marketing. The Cocoa Board carry out the other very important function of stabilising the price to the farmer which has become more important than ever in recent years because of the wide fluctuation in price. Without this encouragement, some farmers would give up in years when cocoa commanded a low price on world markets.
Selling is carried out by inviting bids from various brokers in several countries where it is known from past experience that a demand exists for cocoa for blending. The Secretary is Mr Herman Thomson who also acts as Secretary to the Copra Board.
Shipping has to be linked with the export of copra and since the only line to call in regularly to Samoa (The Bank Line) ceased this part of its operation on the 1st January 1979, other lines have to be persuaded to call on an irregular basis when the need arises.
The average price achieved for cocoa in 1978 as reported by the Cocoa Board of WS$2222 per ton F.O.B. was spread over the sale of No.1, No.2 blends, Nib and Shell with different prices having been obtained in the order.
(See appendix 1 for a review of Samoan Cocoa Marketing Statistics 1962-1978, appendix 2 for price comparison against good fermented cocoa from Ghana, 1975-1978 and appendix 3 for Cocoa Production in Samoan Districts, 1975-1978).

D. Development plans - Ministry of Agriculture Plan 4 (1980-1984)

The Ministry have an extensive plan (Select Seed Cocoa Planting Project) directed mainly towards the improvement of village cocoa. The project is to complement the cocoa development project which provides for a 10 year programme started in 1976 in cocoa breeding and research for developing central processing facilities and for rehabilitation of existing areas of cocoa.

a) Project Objectives

Immediate (1-5 years)

1. Provide select seed for farmers with emphasis on the recommended cocoa zone (N and NW Savaii and Upolu) under a programme of bonus payments for following prescribed husbandry practices.

2. Set up for trained teams of specialist field technicians who will provide a package of assistance in cocoa establishment of farmers through the extension officer.

3. Planting targets are set at 500 acres for 1980 and 1,000 acres for each remaining year up to 1984.

Results to date are as follows:-

	Upolu (acres)	Savaii (acres)	Total (acres)
1976	-	7	7
1977	17	46	63
1978	7¼	226	233¼
			303¼

1979 is estimated at 300 acres.

The programme has concentrated effort on Savaii which is the least developed and which contains the majority of village cocoa.

Longer Term

Provide seed of improved strains (Disease resistant, particularly towards black pod which is the most common and higher yielding).

b) Project Benefits

Over the full 10 years it is hoped to obtain the following direct benefits from those areas accepted into the plan.

Cocoa Production

Year	1	2	3	4	5	6	7	8	9	10
Yield in lbs per acre	-	-	-	99	253	396	561	704	847	902

The present average yield per acre for all growing areas including WSTEC and private estates is only 224 lbs based upon an estimated 12,000 acres of planted cocoa. The success of this plan would greatly strengthen the export earnings of Samoa.

c) Other Technical Factors

1) Very little cocoa in Samoa has been planted under shade, which is the accepted method in other producing countries.
The plan specifies that all replanting must be carried out in this manner preferably under coconut trees.

2) Fertiliser must be used which will be provided on a subsidised basis. Its application will improve yields from the shade coconut trees.

3) Planting distance for cocoa is 10 feet on the square (435 per acre).
The 10 year plan also includes the provision of two nursery plantations, one already established 4½ years ago at Asau on Savaii representing approximately 5 acres.
The second is at present being constructed on Upolu at Nu'u, where it is planned that 100 acres will be available for research.
The two main functions of these areas will be -
To supply all the seed to the village scheme completely free from any disease and be high yielding.
To establish test plots where the advantages of growing under shade with and without fertiliser can be practically demonstrated against control plots.

The results so far obtained on Asau are very encouraging indicating that vields of over 800 lbs per acre will be possible if the conditions incorporated in the village plan can be implemented.

d) Central Fermentaries:

It is also planned to establish in Upolu on the site of the New Research Area a central fermentation and drying complex. The drying will be achieved by utilising forced hot air through the beans using an oil fired heat exchange principle with no reliance on sun drying.
The beans will be collected in pods from the plantation. Initially the project will have a capacity of 350 tons per annum, but if trials are successful, it would be extended to process all village cocoa. The scheme would eliminate all reprocessing at present carried out.

e) Cocoa Foreign Exchange Earnings:

The Department have taken a conservative average price over 10 years of WS$ 1,000 per ton to value the project. They have assumed it will earn a premium price because of the improvement in quality envisaged by the scheme.

Year	1983	1984	1985	1986	1987	1988	1989	1990
WS$ '000s	22	102	250	465	750	1057	1340	1570

f) Source of Funds ('000s)

	1980	1981	1982	1983	1984
Australian aid	46	40			
West Samoan Goverment	17.5	57.5	76.5	87	87
TOTAL	63.5	97.5	76.5	87	87

E. Assessment of price and quality of cocoa

1. Price

The average price achieved for Samoan Cocoa in 1978 as reported by the Cocoa Board (ref Appendix 1) of WS$ 2,222 per ton F.O.B. was spread over the sale of No.1 and No.2 grades, Nibs and Shell, with different prices for each obtained. Those in responsible positions were divided in their opinion as to whether Samoan Cocoa was still commanding a good premium on world markets as undoubtedly it did at one time.

It has now lost that premium and it is one of the aims of this report to clarify the issues involved which are very important to Samoa.

The fairest way to arrive at a conclusion is to compare the price obtained for Samoan cocoa against the recognised yardstick of good fermented cocoa from Ghana (Amelanado) on the London World Market both on a c.i.f. basis.

On this basis, there has been no premium on average over Ghanaian Cocoa for any type of Samoan Cocoa over the last four years.

Premiums could doubtless be obtained on Cocoa from WSTEC because the quality is likely to be better on account of the use of central fermentaries. If that cocoa was No.1 grade and was exported to New Zealand introducing lower shipping costs, then a premium may exist there over cocoa from Ghana for certain shipments but this market is small. But this could well account for the belief in some quarters that a good premium does still exist.

I suggest that it might be helpful to the Cocoa Board if the Secretary was able to include a more accurate comparison with Ghanaian cocoa on an F.O.B. basis where the present estimate of freight, insurance and carriage might be a little high.

Alternatively, both Cocoas should be compared on a c.i.f. landed London basis.

2. Quality assessment

This factor must inevitably be related to price.

Three criticisms have been raised by manufacturers concerned with purchasing cocoa for blending in the production of high quality dark chocolate.

1. Some consignments exhibit a smoky flavour.
2. There is lack of consistency of flavour between deliveries.
3. There is sometimes a proportion of mouldy beans.

Not all points relate to any one consignment.

The adverse comment on flavour might be attributed to the use of solid wood fuel to provide heat for some of the drying and reprocessing operations.

The lack of consistency of flavour could well be due to lack of central fermentation facilities. Good fermentation results in the beans developing a good chocolate flavour after roasting. Lack of flavour after roasting can be attributed to under fermentation.

The occasional deliveries with a proportion of mouldy beans might be attributed to the reprocessing operation which imparts to the beans a high external polish but could well sometimes produce traces of internal mould.

Proposals for Improvement in Quality:

If the development programme of the Department of Agriculture proceeds according to plan, it will:-

1. Eliminate the use of solid smoky fuel in enclosed atmospheres.
2. Guarantee consistency in central fermentation.
3. Eliminate the need for reprocessing.

It is for this reason that their plans have been described in some detail because they have an important bearing on future quality.

In 1962, Samoa produced over 5,000 tons of Cocoa. Since then the estates have gradually deteriorated through lack of attention to replanting, spraying and cultivation. This was mainly brought about by very low prices for Cocoa (ref Appendix 1) which resulted in farmers postponing any plans which had long term objectives and which increased their immediate costs.

Black Pod disease has increased and has not been cut out but the future could be hopeful.

Trinitario Cocoa from Trinidad is still commanding a premium over Amelonado Ghana on world markets and is in short supply at that level.

There is scope for Samoan Cocoa, therefore, provided the facts are recognised. It is hoped that the development plans of the Department of Agriculture as presented will produce the desired results in the course of time both with regard to yield and quality.

Every encouragement should be given to the implementation of those plans as being the best way of contributing to the balance of payment problems rather than processing the cocoa beans into cocoa products.

F. Processing cocoa beans into cocoa products

1. Definitions

a) Cocoa Liquor

Cocoa beans having been fermented and dried are subjected to cleaning, roasting, cooling, cracking, separation of the shell, husk, skin and germ. The resultant broken pieces of cocoa are referred to as Nib.

If this nib is then ground between heated disc crushers, it forms a paste which is known as cocoa liquor, which can be solidified into hard blocks by using moulds to produce a minimum weight of 25 kilograms for export.

b) Cocoa Butter

Cocoa Liquor contains approximately 55% fat which is cocoa butter. The method of extraction is by using hot presses. Nibs can also be pressed directly without being first crushed to a paste.

c) Cocoa Cake

This is the residue left over after pressing cocoa butter from cocoa liquor. Pressing cannot produce a cake with a lower residual cocoa butter content than 10%. In practice, the content varies between 10% and 22% dependant upon the subsequent use.

d) Cocoa Powder

This is produced by pulverising the cocoa cake. The powder may be treated with alkaline substances to neutralise the acidity, deepen the colour and increase solubility to make it suitable for drinking purposes.

e) The Process:

Processing of cocoa beans can be carried out in two stages.
Stage 1 - produces cocoa liquor only and can be exported in this form although the world market is limited (see tables 1 and 2).
Stage 2 - is necessary to produce cocoa cake or powder and cocoa butter: Figure 1 sets out the operations involved.

2. The Market

There is considerable interest in developing countries in the process of converting Cocoa Beans into Cocoa Liquor, Cocoa Butter and Cocoa Cake or Powder.

The following tables (1 to 3) indicate the extent of such processing in some of the main producing areas of the world.

TABLE 1: Cocoa production in selected countries, 1973/74-1977/78

(thousand tons)

Exporting Country	73/74	74/75	75/76	76/77	77/78
Brazil	246	273	258	234	283
Ghana	350	377	397	320	268
Nigeria	215	214	216	265	205
Ivory/Coast	209	242	231	230	297
Cameroons	110	118	96	82	105
Ecuador	72	78	63	72	75

TABLE 2: Exports of cocoa liquor from selected countries 1973/74

(thousand tons)

Exporting Country	73/74	-	-	-	-
Brazil	7.51	-	-	-	-
Ghana	2.59	-	-	-	-
Nigeria	N.A.	-	-	-	-
Ivory/Coast	11.84	-	-	-	-
Cameroons	N.A.	-	-	-	-
Ecuador	-	-	-	-	-

TABLE 3: Combined exports of cocoa butter and cocoa cake, including powder, from selected countries, 1973-1977

(thousand tons)

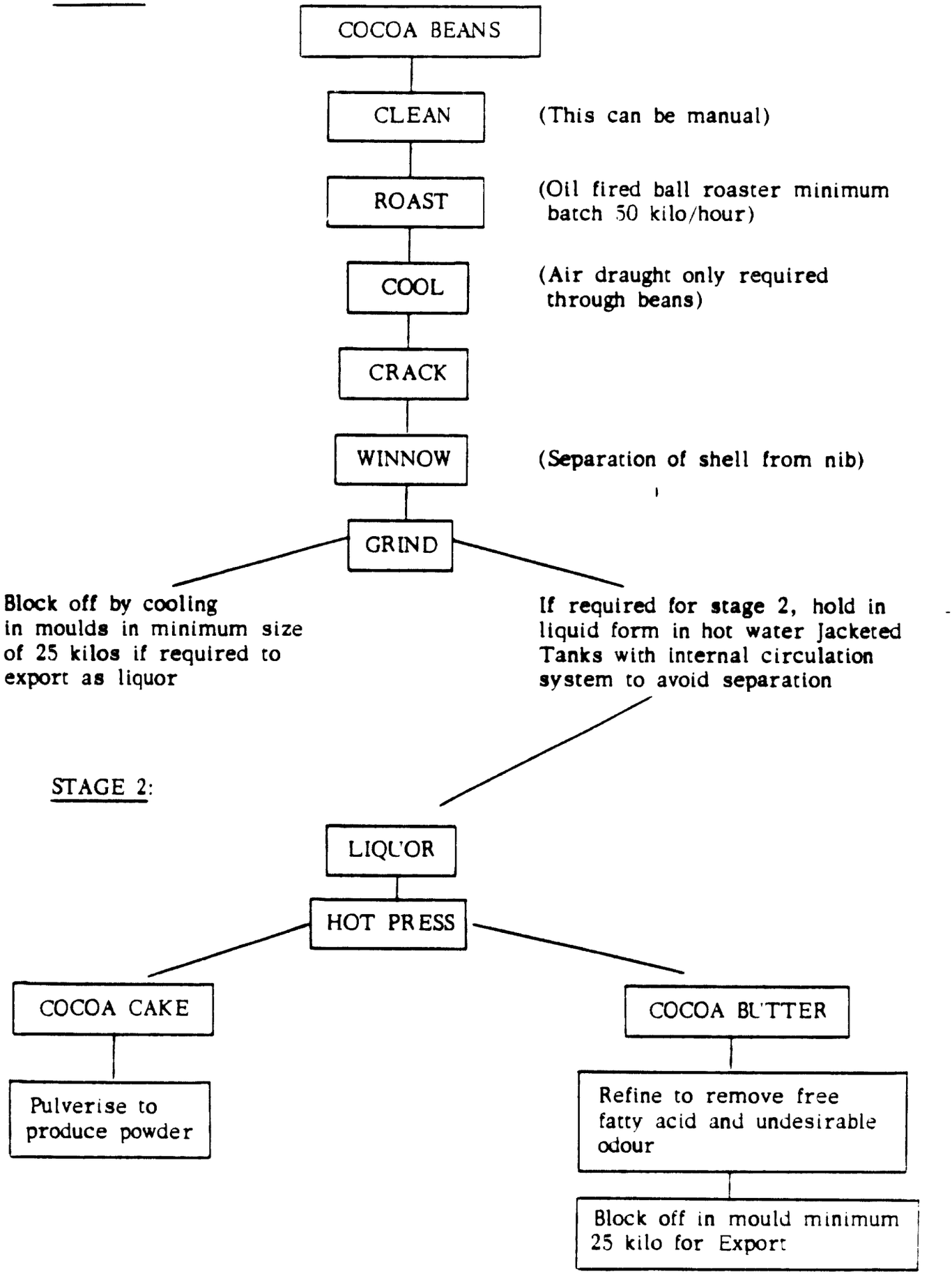
Export Country	1973	1974	1975	1976	1977
Brazil	51.4	53.9	46.5	48.5	36.0
Ghana	42.2	36.8	33.8	46.8*	34.7*
Nigeria	27.0	23.3	19.5	12.5*	14.6
Ivory/Coast	10.2	8.8	N.A.	N.A.	N.A.
Cameroons	15.1	18.3	19.2	17.1	18.1
Ecuador	2.2	3.5	3.5	3.1	3.1

* Provisional Figures

Source : Gill & Duffus.

FIGURE 1.

Flow diagram for the production of cocoa, cocoa cake and cocoa butter



The figures for Liquor, Cocoa Butter & Cake represent export only for the producing country and take no account of products processed for their own requirements which are not available for this report.

Nevertheless, two conclusions can be drawn.

1. The amount of cocoa required for pressing into liquor for export is less than 1% of the total production.
2. The amount pressed into Cocoa Butter & Cocoa Cake in producing countries is less than 12% when the two requirements are added together.

Each of the producing countries quoted in this report have several plants each with a capacity between 25,000 - 60,000 tons per year able to supply greatly in excess of the demand.

In a situation where existing plant in the growing area is large with spare capacity, the price obtained for both cocoa cake and cocoa butter could be less satisfactory to a new entrant into the field than that obtained for cocoa beans.

The situation could well arise where a subsidy had to be introduced to maintain a competitive price.

This is detrimental to the producing country who would find greater profitability in continuing to market cocoa beans particularly when the quantity available is small by world standards. Developing processes for marketing cocoa in different forms is not going to produce any more cocoa which is the greatest priority for Samoa in this area.

There is an increasing world demand however for cocoa cake and cocoa butter although it has been shown that the increased supply is not coming from the producing countries.

TABLE 4. World exports of cocoa beans, liquor, butter and powder/cake

(thousand tons)

	Average 1947-1951	Average 1972-1956	Average 1965-1968	Average 1969-1972	1973	1974
Beans	683	699	1137	1136	1097	1089
Liquor	6	16	18	22	30	35
Cocoa Butter	20	37	128	141	167	160
Powder/Cake	30	45	108	131	167	163

Source - Cocoa Products - Facts & Figures 1975.

The deficit between world demand for cocoa products and the amounts produced by the growing countries is supplied by the user countries who have established their own Cocoa Processing Plants (CONVERTERS). The Netherlands is the largest processor for resale in Europe. The United States is also a large converter where the main growth in the use of cocoa cake by chocolate manufacturers has taken place.

3. Reasons for increased demand

Cocoa Cake/Powder:

With higher prices for cocoa in recent years, manufacturers have been seeking ways of reducing the price of finished chocolate.

The most important development has been the increased use of cocoa cake and powder in conjunction with processed vegetable oils to manufacture into finished coatings. These products have the following advantages:-

1) They are cheaper than chocolate made with cocoa butter.
2) They do not require the same skill to be applied in use with regard to temperature control (tempering).
3) In the cake and biscuit industries where coating may be onto a flexible centre the right plasticity of coating can be prepared.
4) Keeping qualities are improved in hot climates.
5) In the ice-cream industry, freezing of a chocolate coating prepared with cocoa butter results in too hard a coating. Acceptable coatings can be prepared by utilising a blend of processed vegetable fats.

Disadvantages:

1) Does not have as good eating qualities.
2) The use of the word "chocolate" to describe the product is restricted in some countries, particularly in the European Economic Community (E.E.C.).

4. Marketing of cocoa cake and cocoa butter

First of all, the converter, whether in the user or producer area is dealing with a "twin product" in so far as once he converts into cocoa butter and cocoa cake, his prices for each cease to be directly related to the price of beans on the World Market. With the introduction of substitute fats, the ratio of demand can shift in favour of Cocoa Cake but in order to produce it, roughly the equivalent amount of Cocoa Butter must still be pressed and sold. The price ratio at which both products are offered therefore is changing even when cocoa is maintaining a stable price. The converter has to be sure of seeing that both products are sold and therefore the price of one must be reduced in relation to the other to maintain the balance if in surplus.

One way of maintaining a balance by means other than price is to offer a range of cocoa powders with residual Cocoa Butter contents between 10% and 22%. The purchaser then selects the one most suited to his particular need, dependant upon the use to which he intends to put the powder and on the proportion of substitute fat he is prepared to accept in his formulation.

Cocoa Butter is purchased on a technical specification which means that the supplier must ensure that the neutralisation of free fatty acid, refining and deodorisation is maintained at a standard with clearly defined acceptable limits. There is a greater chance of obtaining a premium for quality cocoa in the form of beans than in the form of Cocoa Cake and Cocoa Butter where the maintenance of a technical specification is more important than the country of origin. In this respect, if Samoa can improve the quality and uniformity of production it is better to concentrate on the marketing of cocoa in bean form bearing in mind the considerations outlined above.

If a producing country can produce high grade cocoa for blending, there is no need to be involved in projects for processing into cocoa cake and cocoa butter because it should command a premium price. The Trinitario type of cocoa grown in Samoa should come into that category.

5. Type of plant required for production of cocoa liquor

In view of the small amount of cocoa available and the large capacity of standard plants, attention has been concentrated on the minimum size of plant available. This would consist of the following:

		Estimated Cost
1.	Oil fired ball roaster with carousel cooler	20,000
2.	Winnowing machine to crack and separate nib from shell	45,000
3.	Cocoa nib refiner	30,000
4.	Water jacketed storage tank with stirrer and pump	6,000
	TOTAL WS$	101,000

Minimum capacity 1,000 tons per annum.

It has already been indicated that liquor demand for export would not justify plant and on this basis it could not be recommended.

It was necessary therefore to examine any other possible uses.

It could be used to make liquor from the beans which are rejected from the grading operation. These, together with the shell, amount to approx. 20% of the output of beans and are a quite significant factor to be taken into account.

The present method of separation is by passing unroasted beans several times by hand through a cracking unit followed by feeding to an inefficient air blast unit several times to remove as much shell as possible.

The average ratio is shell 46% : nib 54%.

Both these products are exported at prices considerably lower than that received for beans. The nib usually to the Federal Republic of Germany and the shell to the Netherlands where it is further processed either by expeller or solvent extraction since it still contains a proportion of nib which could not be removed by existing treatment in Samoa.

This is reflected in the price of WS$263 per ton at which the Cocoa Board are exporting this product.
The normal ratio of shell to nib after roasting and passing through a modern winnowing machine should average 14% shell/86% nib.
The quantity of nib and shell available for processing in 1978 was 206 tons which would be well below the capacity of a liquor plant but could perhaps still be justified if the liquor produced could be utilised locally. For that to happen it would have to be further processed into cocoa cake and cocoa butter.

6. Type of plant required for production of cocoa cake and cocoa butter

This is stage 2 of the process (ref Figure 1) taking chocolate liquor as the starting point.

Plant Requirements:-

1. Hydraulic Press.
2. Water Jacketed heated storage vessel with stirrer and pump.

The smallest available press offered by Manufacturers of Chocolate Machinery would have a capacity of 2,500 tons per annum which would be excessive and would rule out the project. It is possible, however, that by approaching general suppliers who specialise in producing presses to the Food Industry smaller equipment would be available.
On this assumption, the cost of this equipment is estimated at WS$ 18,000.
However, before investing in this equipment for stage 2, it would be necessary to ascertain whether the pressing operation could be carried out using the surplus capacity on the new press for the processing of Coconut Oil from Copra due to be installed shortly.
Although it is true to say that the pressing follows a very similar principle, it is likely that the cocoa might be contaminated because in the form of roasted liquor it is very sensitive to extraneous flavour or aroma which cannot subsequently be removed.
The use of such plant, therefore, could only be recommended after extensive trials had been undertaken. The possibility should not however be ignored.

7. Small Scale Plant for the Production of Coating

The conventional plants are too large to be considered but there is a way of making coating on a small scale plant. This is known as the MacIntyre or Goddard method.

The MacIntyre will produce good chocolate using liquor and cocoa butter. Such chocolate however is not suitable for hot climates. It is much more usual to find the plant used for the preparation of coating from cocoa cake and special hydrogenated substitute fats.

The Process:

Coatings made on large plants needs separate machinery to mix, refine and conch.

The refiner alters the texture by reducing the size of the particles.

The conching alters the flavour.

The MacIntyre carries out all three operations in the one machine in a processing time of 24 hours.

It is available in only two sizes (half ton and one ton).

The maximum capacity is therefore $2\frac{1}{2}$ or 5 tons, based on a 40 hour week.

Cost Estimate	WS$
MacIntyre One Ton Capacity	26,000
Water Jacketed Storage Tank with Stirrer & Pump	6,000
TOTAL	32,000

The points made in describing the various plants are summarised as follows:-

1. Chocolate made from liquor could not contain very much substitute fat because it is incompatible.
2. Chocolate made with cocoa butter and liquor would be unsuitable for hot climates, as it would bloom easily.
3. Coatings made with cocoa cake and substitute fats are suitable for enrobing but not for moulding.
4. Cocoa cake could be prepared from substandard beans and improve the quality of the export beans.

It will be necessary to look at small scale plant for use of a coating.

8. Small Scale Plant for Use of Chocolate as a Coating

Coating chocolate can be utilised for covering several products which are indigenous to Samoa and might very successfully be linked to the further development of the Fruit Processing Project. The products to be considered could be nuts and either preserved or crystallised fruit. Orange peel is successfully coated for example in Europe.

The equipment required in the first instance could be very small because the products can be hand dipped into the melted chocolate which only has to be maintained at a constant temperature if chocolate containing processed vegetable fats are utilised in the recipe.

The centres to be dipped are suspended in the coating by means of small wire forks or even several on a wire tray, and allowed to drain off and set in a cool air conditioned atmosphere. Any excessive humidity will cause a film of moisture to be deposited on the surface of the coating resulting in a dull appearance.

The dipping can be carried out in small bowls, containing as little as 2 lbs of coating, which are water jacketed and electrically heated.

The temperature of the chocolate need not exceed 95°F but it is usually better to take the temperature up to say 105°F when melting the chocolate to ensure good consistency and then cool to 95°F.

Type of Centre to be Coated

Nuts: Any form of nut can be coated directly with or without first removing the skin or blanching.

Fruit: This must be either preserved or crystallised. If preserved, it is necessary to first remove any surplus syrup from the surface by drying in a suitable hot room over-night on wire trays because surface syrup will cause incomplete covering. Leakage of syrup through the coating will lead to fermentation. With difficult fruit products, double coatings can be contemplated where the operation of chocolate coating is repeated after the first coating has set.

Crystallised fruit is easier to handle in that the surface is dry.

The hand method tends to limit the size of articles to be coated. The processing of the fruit must be sufficiently thorough so as to prevent any fermentation developing and it is for this reason that it is considered that any production should be the responsibility of the Fruit Processing Department.

Centres: The next stage would be to manufacture centres which had a fruit or nut content. The use of coconut cream or dried coconut is one example.

Coating: The average % coating on the finished goods is likely to be of the order of between 30% - 40% dependant upon the density and shape of the centre. If the products can be exported then the importation of the chocolate would be justified.

Machine Manufacture: If output in excess of 1 ton per week of finished goods were contemplated then the hand dipping should be replaced by the introduction of a mechanical chocolate coater (subsequently referred to as an enrober). This basically passes the centres to be coated on a mechanically propelled wire belt through a continuous curtain of chocolate which is recirculated.
At the same time, a surge of chocolate is generated from beneath the wire belt to ensure that an adequate amount of chocolate is applied to the bottom of the centre.
The chocolates are then automatically transferred to an endless plastic belt which passes through a tunnel cooler. The speed of the belt can be adjusted to ensure that chocolates remain in the cooler for a minimum time of 15 minutes, as they cannot be cooled too quickly or moisture condensation will appear on the surface when they emerge.

Type of Enrober: Kreuter and Nielson specialise in making small enrobers, Sollich, Green and Baker Perkins specialise in making large ones. Although in earlier years these three companies made small enrobers which they no longer manufacture.
8" to 16" is considered small. 24", 32" and 42" are considered large.

Type of Enrober - Continued: It would certainly be worth considering the purchase of a reconditioned small enrober when required because large manufacturers using enrobers are having to discard good small enrobers to reduce costs and replace them with larger ones. A tempering machine would not be required if chocolates containing substitute processed fat were used. In that case, the machine could be fed from a water jacketed tank fitted with a slow speed stirrer capable of heating the chocolate and then maintaining a constant temperature.

Biscuits: Mechanical enrobing would permit larger items such as biscuits to be coated and thus help to support a local biscuit industry.

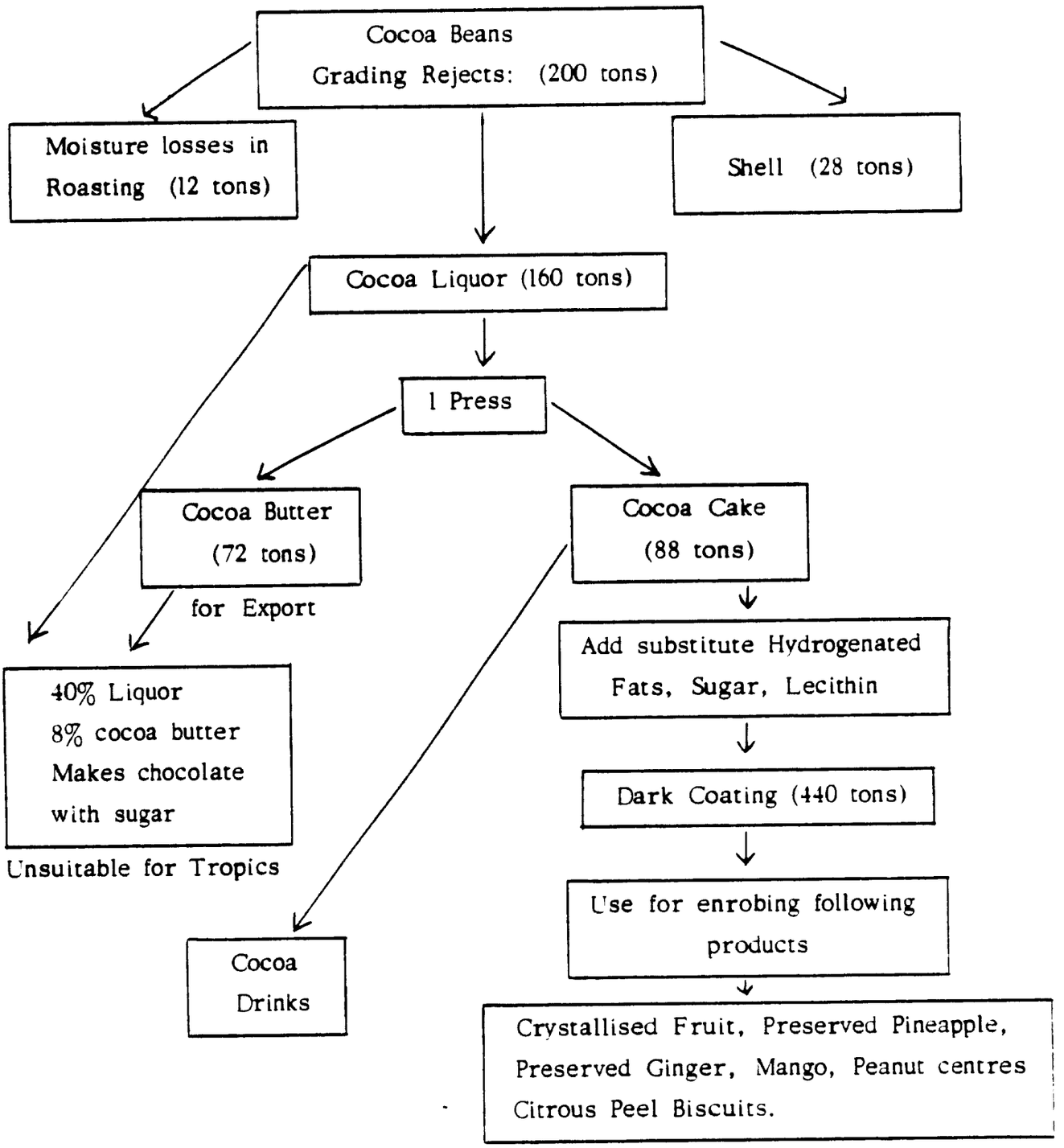
9. Summary of chocolate processing

It is considered that the smallest plants available are still too large to justify at this stage, and therefore cannot yet be recommended. Nevertheless, each stage of the process has been outlined so that consideration might be given to the project in the future when increased quantities of raw material become available.

However, in the meantime, it would be necessary to develop an experimental range of chocolate coated products which could be assessed for market potential and it is recommended that this should proceed without any commitment towards plant by importing in the first instance small quantities of chocolate coating from reputable manufacturers, such as Nestles in Australia and using the hand dipping method described for the production of the samples.

FIGURE II.

Scheme for the utilization of the present annual quantity of reject beans and shell



10. Importation of chocolate products

Year	Weight In Tons	Value in WS$
1976	5.69	10,065
1977	10.01	19,947
1978*	4.46	10,004 (* 9months only)

Source - Statistics Department, Government of Samoa.

Average 7.2 tons per annum.

70% import duty is levied on these products. It is sold in two broad categories:

1. In Milk Bar form with and without ingredients imported from Cadbury in New Zealand.

Retail prices of imported chocolate:

Description	Weight	Price	Price Per 1 lb WS$
Large Cadbury Milk	150 gram	91 sene	2.75
" " Fruit & Nut	135 gram	91 sene	3.06
" " Brazil Nut	120 gram	91 sene	3.44
Small " Milk	100 gram	61 sene	2.77
" " Crunch	100 gram	61 sene	2.77
" " Fruit & Nut	90 gram	61 sene	3.08

Apart from the ingredients, this represents 100% chocolate.

2. Coated bar again mainly from Cadbury's. These contain a variety of nut and caramel centres coated with milk chocolate. The chocolate represents only up to 40% of the weight.

The amount imported in each category is not known. The amount of imports would not justify setting up a chocolate plant for import substitution.

II. RECOMMENDATIONS

A. Price and quality

1. There has been no premium for Samoan Cocoa on average against good fermented Ghana for the last four years on world markets.
Other countries growing similar cocoa (Trinitario) can command premiums.
The main reason for loss of premium for Samoan Cocoa must be quality.
This is probably due to lack of centralised fermentaries and drying processes. The development plans of the Department of Agriculture are aimed at producing more cocoa and of a superior quality which it is hoped will eventually restore the premium. It is recommended that these plans should be implemented as a top priority as representing the best way of increasing the foreign currency earnings. Reservations are expressed as to whether the plans can be fully implemented for the following reasons:-

a) The village land is customary owned which is administered in accordance with the traditional practices of the Samoan people. Under this practice, no individual owns any specific part of the land, control being rested in the family groups (Aiga).
Customary land cannot be alienated but with the approval of the Government it is understood that leases can be arranged.

b) The village philosophy is one of mixed farming on small areas of land.

c) The recruitment of manpower on the scale necessary to succeed might be inadequate.

d) Benefits will take a long time to be apparent.

The increase in quantity planned can be monitored in Samoa and related to each activity in the programme.
The improved quality is more difficult to evaluate. It is recommended to set up a quality control laboratory which should examine representative samples of cocoa subjected to the different processes. A statistical assessment of any mould development and number of underfermented beans would be essential information required.

Such a laboratorv would have to be part of a general quality control laboratorv for other foodstuffs. The quality of flavour is dependent on good fermentation of beans which onlv develops after roasting. Quality control therefore should also have facilities for roasting beans on a very small scale and grinding to a thick paste.

It is further recommended that when a specific improvement is considered to have been made in the raw cocoa processing it be checked out bv sending air mail samples under code for flavour assessment to a user of high quality cocoa. Such a service from a British manufacturer could be organized by the expert if requested.

A start in this respect could be made by comparing WSTEC cocoa which has had the benefit of central fermentation with representative samples of village cocoa which at present lacks such facilities.

Subsequent recommendations are based on the belief that the quality of Samoan Cocoa can be improved.

B. Processing of cocoa into cocoa products for exports

It is not recommended that good quality cocoa (graded beans) be processed into Cocoa Products for the following reason:

The quantity of cocoa produced in small (1,182 tons in 1978) representing only 0.1% of world market.

The type of cocoa grown in Samoa (Trinitario) should command a premium on world markets which would be lost once it was converted into products where the origin of the cocoa is less significant than the technical specification of the resulting products. It would be a less profitable use of the limited amount of beans available.

What Samoa needs most is to grow more cocoa of better quality. Processing the small amount available will not achieve this objective but would only fragment the marketing operation.

It is recommended, however, that a project based upon the processing of substandard beans into cocoa products be considered for the following reasons:

a) The present arrangements for the grading of Samoan Cocoa into two blends results in the separation of beans which are unsuitable.

These are separated into Nib and Shell by using inefficient equipment and are then exported in this form at prices well below those obtained for beans.

Since the combined proportion represents 20% of the total export of beans, their affect on lowering the average price of beans is significant. It could well be more profitable to process these beans because in this case the price received for the products could well be higher than that obtained at present.

b) Part of the processing procedure would be to separate nib from shell on efficient plant after roasting which makes it easier than separating, as at present, on inefficient equipment.

c) It would provide some cocoa cake from which the preparation of chocolate coating could be considered for the covering of nuts and preserved fruits grown in Samoa.

Cocoa Butter would still have to be exported and therefore the project would have the same disadvantage of tending to fragment the marketing operation. But in this case, such fragmentation already exists in necessity of having to sell nib and shell so that the position would be much the same.

However, the smallest processing plant capacity is 1,000 tons per annum so production of cocoa would have to reach 5,000 tons before it was fully utilised on converting the 20% substandard cocoa.

Account will have to be taken of the probability that the plans for the improvement in the treatment of raw cocoa will result in the production of a smaller proportion of substandard cocoa.

It has not been possible to evaluate this project in the time available but it is recommended that this should be done to establish the break even point.

C. Small scale local industry

1. When the production of cocoa reaches a level to make a processing plant viable which is estimated at 5,000 tons per annum, then it is recommended that a project to convert cocoa cake into a chocolate coating should be considered, utilising imported sugar and special hydrogenated fats.
Hydrogenated coconut oil on its own would be unsuitable.
The surplus cocoa cake not required for this purpose would be exported, although a quantity could be utilised to produce powders suitable for a cocoa drinks industry, after pulverising and making soluble.
With the availability of a coating, the provision of a plant to enrobe (coat with chocolate) a number of natural products indigenous to Samoa should be considered.
Nuts could be used unprocessed but are better roasted.
Fruit would have to be first preserved or crystallised but that is within the scope of the existing fruit processing laboratory.
Ginger, Pineapple, Mango, Citrus peel and roasted peanuts are visualised as being suitable for consideration.
Biscuits could be coated if local industry produced a suitable type.
The whole of these recommendations are outlined in diagram form in Figure II.

2. It is considered that the smallest plants available are too large to qualify at this stage and cannot yet be recommended, but each stage of the process has been outlined so that consideration might be given to the projects in the future.
However, it is recommended that in the meantime an experimental range of chocolate coated products be developed which could be assessed for market potential, and that this should proceed without any commitment towards plant by importing in the first instance small quantities of chocolate coating from a reputable manufacturer in Australia and using the hand dipping method described for the preparation of the samples.

D. Importation of chocolate products

It is not recommended that these be replaced by local production in view of the very small quantity involved, averaging only 7.2 tons per annum, and the fact that the majority are moulded, requiring the use of specialised plant which it is not proposed to install.

If it is desired to start small scale industry, it would be more fruitful to consider two other areas which are more suited to development.

1. Sugar Confectionery

Although it would depend on imported raw material in the form of sugar and glucose, plants can be installed operating on as low an output as 50 tons per annum and there is no keeping problem similar to that experienced with chocolate in the tropics.
The sugar confectionery can be protected against humidity which is the main cause of deterioration, but it is far more difficult to protect chocolate against heat.

2. Snack Foods

This is a growth industry in any part of the world. It has the advantage of requiring only limited machinery to carry out the whole operation.
A variety of flavours can be produced to suit local taste by subsequently treating the manufactured base material in a very simple manner.
There is only one raw material involved, a form of corn which could probably be grown on the island. The report on Fiji indicates the success which can be achieved by combining these two small scale industries.
By contrast, chocolate processing requires elaborate plant with considerable capital investment.

III. REPORT ON VISIT TO LARGEST SUGAR CONFECTIONERY FACTORY IN FIJI

After the briefing in Fiji, it was necessary to wait one extra day for a flight connection to Samoa. At the request of the UNIDO office the expert therefore visited the only sugar confectionary factory in Fiji, Maganica Ltd., situated at Ba in the North-West of the island. This company, which is an Indian private enterprise run by four Raniga Brothers, one of whom is an engineer, wanted advice on whether they should start the manufacture and sale of chocolate.

The choice of Ba to set up the operation was sensible because the largest sugar mill in Fiji is located there and supplies the main raw material requirement. In the beginning the company made only curry powder; the production of sugar confectionery was started at a later time and more recently snack foods were added to their programme. They now wish to take up the production of milk chocolate.

The plant which was purchased for sugar confectionery represents the best available, although it consists of new and secondhand machinery which they are able to recondition themselves. The Hansella vacuum cooker and Rose Forgrove Rostoplant machines enable them to make a range of hard boilings and toffees.

The factory is now totally inadequate to produce the sales which have risen to 2 million Fiji dollars, 30% of which is exported. They have negotiated a new factory site of five acres, one mile outside of the town. In the first instance, a building of 45,000 square feet will be erected. The expert felt that this operation was worthy of every encouragement. A first step into chocolate production had been made by importing converture from Australia (Nestles) and then moulding it into small tablets. What was needed was technical expertise, and though the time available was rather short, the expert

made the following recommendations in addition to suggesting several minor improvements:

1. The manufacture of chocolate should not be contemplated at this stage because of the large plant requirements. Also, for chocolate production, cocoa cake, milk powder and specialized vegetable fats would have to be imported, the cost of which would be higher that that for importing converture.

2. The best of the convertures offered from Australia should be selected.

3. The coating of various centres with chocolate should be considered; the proportion of chocolate utilized could be as low as 30% to justify importing of 100% chocolate.

4. Polycarbonate rigid moulds should be introduced for chocolate depositing in place of the flexible plastic moulds to obtain a better finish.

Acknowledgements

Base during visit - ALAFUA Food Processing Laboratory I would particularly like to thank Mr Clive Pedrana, the Chief Food Technologist for arranging most of the visits and contacts and devoting the time to obtaining the information requested.
I would like to thank Mr Tauiliili Uili, the Director of Agriculture and Mr Dick Burgess, Chief Agricultural Economist of the Department, together with Mr Ken Newton, in charge of the Nafanua Research Station for all the help on outlining the Agricultural Development programs.
I would also like to thank Mr Tupai Lee, Assistant General Manager, WSTEC, for arranging visits to their estates.
I am also greatly indebted to Mr Herman Thomsen, Secretary to the Cocoa Board for all the Marketing Statistics provided, and for making available his monthly reports on Cocoa.

Appendix I

SAMOAN COCOA MARKETING STATISTICS, 1962-1978

Comparison of the cocoa production, copra exports, local consumption, population and the cocoa planting project:

(1) year	(2) production	(3) exports	(4) value (fob)	(5) per ton	(6) % trade	(7) local consmp.	(8) population	(9) acreage planted
1962	no records	T 5,248	$ 2.331 (m)	$ 442.4	(43%)		118,000	none
1963	no records	T 4,324	$ 1.671 (m)	$ 386.5	(33%)		123,000	none
1964	no records	T 4,460	$ 1.444 (m)	$ 322.4	(29%)		126,000	none
1965	no records	T 2,991	$ 0.904 (m)	$ 302.5	(23%)		132,000	none
1966	no records	T 2,723	$ 1.208 (m)	$ 443.8	(30%)		131,377	)
1967	no records	T 3,116	$ 1.461 (m)	$ 496.0	(46%)		133,000	)
1968	no records	T 2,587	$ 1.276 (m)	$ 493.3	(34%)		135,000	) ...
1969	no records	T 3,017	$ 1.808 (m)	$ 599.3	(39%)		138,000	1966/72) 197 acres
1970	no records	T 2,442	$ 1.036 (m)	$ 424.4	(31%)		141,000	)
1971	no records	T 2,890	$ 1.257 (m)	$ 435.1	(20%)		143,547	)
1972	no records	T 1,510	$ 0.896 (m)	$ 593.6	(26%)		146,000	)
1973	no records	T 1,225	$ 1.072 (m)	$ 873.8	(28%)		150,000	13 acres
1974	no records	T 1,816	$ 1.871 (m)	$1,030.3	(24%)		154,000	22 acres
1975	no records	T 1,457	$ 1.177 (m)	$ 808.7	(26%)		152,000	20 acres
1976	T1,747	T 1,796	$ 2,370 (m)	$1,320.4	(42%)		151,275	7 acres
1977	T2,167	T 2,157	$ 5.846 (m)	$2,710.5	(50%)		155,000	63 acres
1978	T1,180	T 1,182	$ 2.625 (m)	$2,222.0	(32%)		157,000	233¼ acres
	(?)	T44,964	$30.256		(34%)			555¼ acres
recast. 1979	T15/1,660	T 1,550	$ 3.400 (m)	$2,200.0				

no reliable information available

Average per year:

(1)	cocoa production	1962/78	– no reliable information available
(2)	cocoa exports	1962/78	– T2,645 per year
(3)	fob value	1962/78	– $1.779 (million) per year
(4)	fob value per ton	1962/78	– $673 per ton
(5)	% of export trade	1962/78	– 35%
(6)	new plantings	1962/78	– 555¼ acres (17 years)
			33 acres (per year)

Average per year:

(1)	cocoa production	1976/78	– T1,698 per year
(2)	cocoa exports	1976/78	– T1,711 per year
(3)	fob value	1976/78	– $3.611 (million)
(4)	fob value per ton	1976/78	– $2,111 per ton
(5)	% of export trade	1976/78	– 43
(6)	new plantings	1976/78	– 304¼ acres (3 years)
			101 acres (per year)

Appendix 2

PRICES OF GOOD FERMENTED COCOA FROM GHANA

Month	1979	1978	1977	1976	1975	Month
January	£1,842	£ 1,618.00	£ 2,404.00		£8,472.00	January
February	1,827	1,613.50	2,487.50	783.50	744.50	February
March	1,728	2,185.00	2,690.00	nom.	770.00	March
April		2,142.00	2,565.00	1,067.00	582.50	April
May		1,872.50	3,244.00	1,290.00	568.00	May
June		1,923.50	3,270.00	1,409.00	547.00	June
July		1,827.00	3,242.00	1,335.00	714.50	July
August		1,909.00	3,151.00	1,545.00	702.50	August
September		1,980.00	3,298.00	1,590.00	748.00	September
October		2,094.00	3,293.00	1,965.00	780.00	October
November		2,186.00	3,206.00	2,040.00	728.00	November
December		2,057.00	2,229.50	2,187.00	832.50	December
	£5,397	£23,407.50	£35,080.00	£15,995.00	£8,472.00	
Avge (CIF)	£1,799 (stg) $2,630 (Tala)	£ 1,950.52 (stg) $ 2,784.00	£ 2,923.33	£ 1,332.92	£ 709.00	
Avge (FOB)	£1,972 (Tala) (approx)	(approx)	(not available)	(not available)	(not available)	

PUBLIC LEDGER, LONDON - end of month cif spot quotations to UK - in £ sterling and in metric tons.

Basis used to calculate fob price conversion at ruling rate of exchange end March 1979 deduct 2% transit shrinkage, freight at say $80(Tala), insurance, storage, other charges at say 20%.

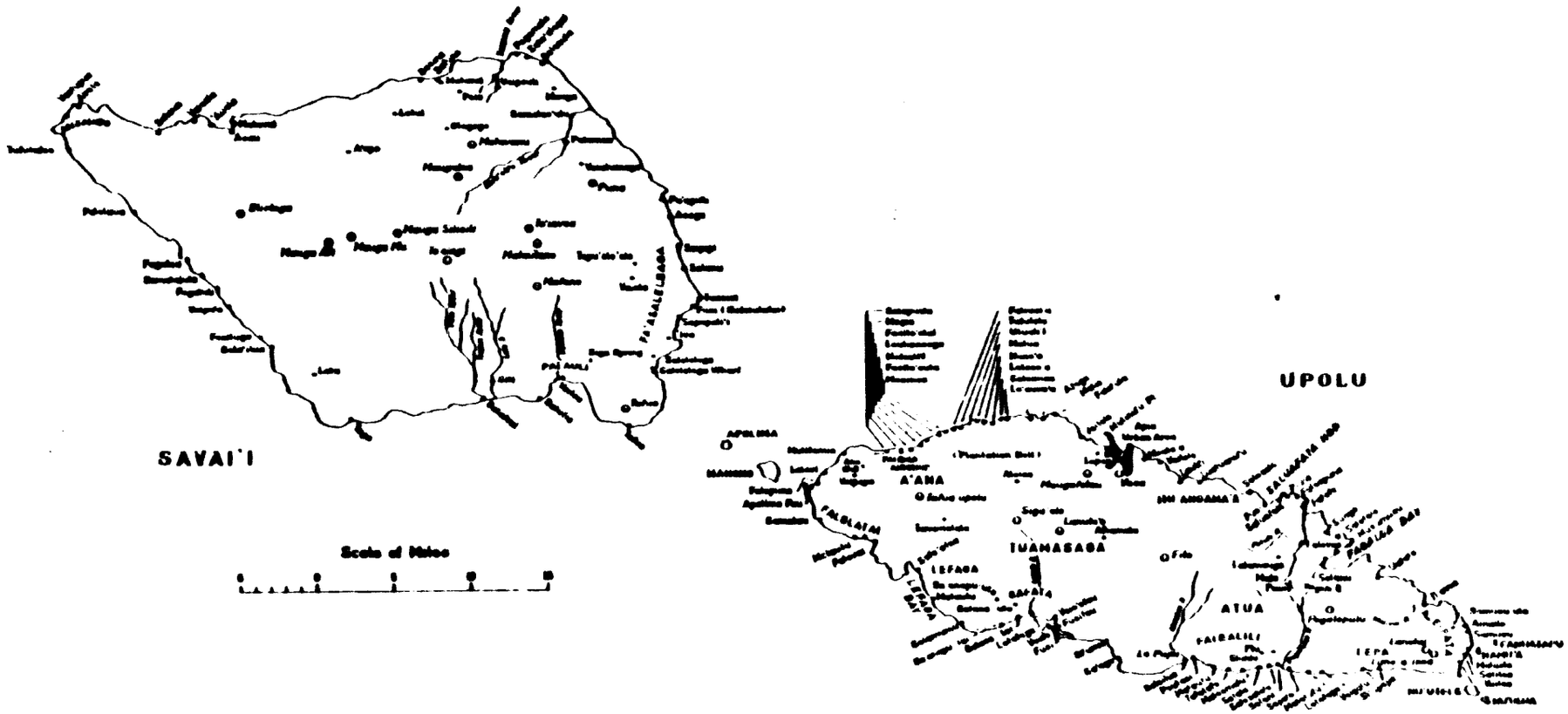
Appendix 3

COCOA PRODUCTION IN SAMOAN DISTRICTS, 1975-1979

	JUNE/DEC 1975	JAN/DEC 1976	JAN/DEC 1977	JAN/DEC 1978	JAN/FEB 1979	MARCH 1979	JAN/MAR 1979	
UPOLU DISTRICTS								UPOLU DISTRICTS
1. Aleipata	T –	T 22.6	T 2.4	T 0.3	T –	T –	T –	1. Aleipata
2. Lepa & Lotofaga	T –	T 4.1	T 1.3	T 4.0	T –	T –	T –	2. Lepa & Lotofaga
3. Falealili	T –	T 15.9	T 11.8	T 3.4	T –	T –	T –	3. Falealili
4. Safata	T 9.2	T 48.8	T 48.0	T 29.7	T –	T 0.1	T 0.1	4. Safata
5. Lefaga	T –	T 29.1	T 30.0	T 6.9	T –	T –	T –	5. Lefaga
6. Aana Sisifo	T 2.5	T 47.1	T 80.5	T 12.9	T 3.5	T 9.0	T 12.5	6. Aana Sisifo
7. Atgaifetai	T 2.5	T 17.9	T 22.0	T 9.1	T 0.3	T –	T 0.3	7. Atgaifetai
8. Aana Aloti	T 62.2	T 76.4	T 139.2	T 75.0	T 3.5	T 7.0	T 10.5	8. Aana Aloti
9. Sagaga	T 45.7	T 105.0	T 199.3	T 130.8	T 8.0	T 7.0	T 15.0	9. Sagaga
10. Faleata	T 85.1	T 139.5	T 130.9	T 83.6	T 11.2	T 6.0	T 17.2	10. Faleata
11. Vaimauga	T 1.0	T 18.4	T 5.8	T 2.8	T –	T 0.4	T 0.4	11. Vaimauga
12. Anoamaa	T 0.2	T 13.4	T 1.0	T 1.0	T –	T 0.2	T 0.2	12. Anoamaa
13. Fagaloa	T –	T 21.2	T 0.7	T 1.1	T –	T –	T –	13. Fagaloa
SAVAII DISTRICTS	T 208.2	T 559.4	T 672.9	T 360.6	T 26.5	T29.7	T 56.2	SAVAII DISTRICTS
1. Faasaleleaga	T 7.4	T 50.1	T 54.9	T 23.8	T 1.1	T 1.0	T 2.1	1. Faasaleleaga
2. Gagae Mauga	T 1.0	T 25.7	T 3.0	T 5.1	T –	T –	T –	2. Gagae Mauga
3. Gagaifo Mauga	T 3.3	T 39.9	T 3.4	T 13.7	T 1.0	T 1.0	T 2.0	3. Gagaifo Mauga
4. Vaisigano	T 77.7	T 173.0	T 42.1	T 60.5	T 10.4	T 7.0	T 17.4	4. Vaisigano
5. Lealataua	T 59.3	T 122.0	T 50.1	T 46.5	T 0.5	T 3.0	T 3.5	5. Lealataua
6. Satupaitea	T 111.0	T 158.0	T 60.1	T 28.4	T 0.5	T –	T 0.5	6. Satupaitea
7. Palauli	T 32.0	T 173.0	T 241.1	T 138.1	T 2.6	T 6.1	T 8.7	7. Palauli
SUMMARY	T 291.7	T 741.7	T 454.7	T 316.1	T 16.1	T18.1	T 34.2	SUMMARY
1. Upolu Districts	T 208.2	T 559.4	T 672.9	T 360.6	T 26.5	T29.7	T 56.2	1. Upolu Districts
2. Savaii Districts	T 291.7	T 741.7	T 454.7	T 316.1	T 16.1	T18.1	T 34.2	2. Savaii District
	T 499.9	T1,301.1	T1,127.6	T 676.7	T 42.6	T47.8	T 90.4	
3. W.S.F.E.C.	T 128.0	T 244.8	T 128.9	T 224.8	T 10.8	T14.6	T 25.4	3. W.S.T.E.C.
4. Consignment Cocoa	T 111.2	T 111.2	T 309.0	T 182.5	T 76.5	T 6.0	T 82.5	4. Consignment Cocoa
	T 739.1	T1,660.1	T1,565.5	T1,084.0	T129.9	T68.4	T198.3	
5. Adjustments	(+)T 797.0	(+)T 86.9	(+)T 601.5	(+)T 96.0	T –	T –	T –	
	T1,536.0	T1,747.0	T2,167.0	T1,180.0	T129.9	T68.4	T198.3	

Appendix 4

MAP OF SAMOA



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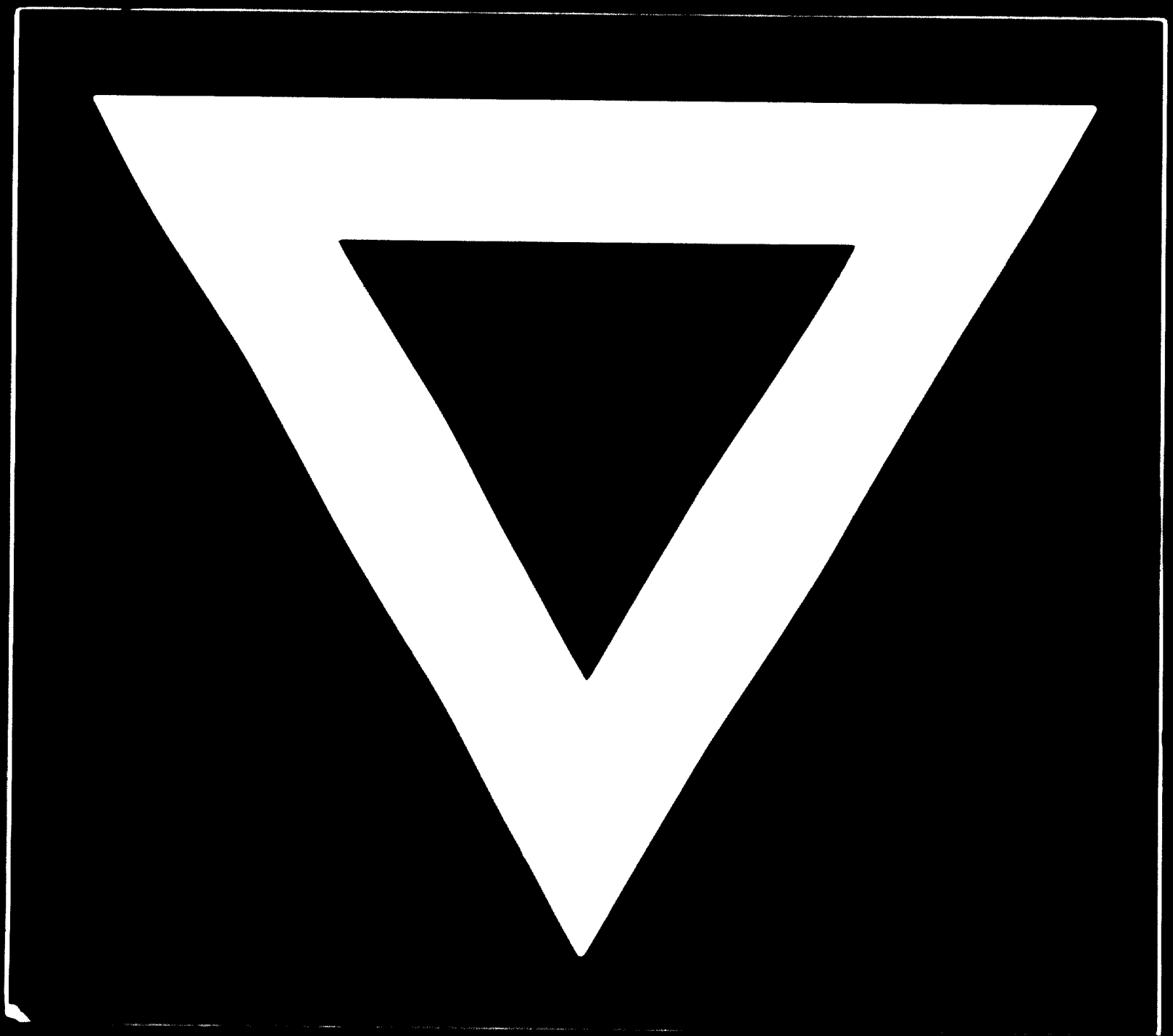

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