PN-ABI-489
74462

GHANA

INVESTMENT OPPORTUNITIES IN THE FISH AND AGRICULTURAL CANNING INDUSTRIES

A PRELIMINARY SURVEY

DEL MONTE CORPORATION

SAN FRANCISCO, CALIFORNIA

APRIL 1968

A.I.D.
Reference Center
Room 1656 NS

TABLE OF CONTENTS

I

	Page
Introduction	1
Map - Survey Routes	2
The Country - In Brief	3

II

The Fisheries of Ghana	
Introduction	10
Present State of the Ghanaian Fishing Industry	
Fishing	12
Marketing	18
Processing and Handling Facilities	24
Government Policy	27
Summary and Recommendations	29
Exhibits	33

III

Food Canning and Related Agricultural Production	
Present State of the Fruit and Vegetable Processing Industry	
General	35
Processing Plants - Nsawam	38
- Pwalagu	43
- Wenchi	50
Summary and Recommendations	54
Exhibits	56

TABLE OF CONTENTS

	Page
Agriculture As Related to Investment Opportunities in Food Canning Industries	
Soils	57
Climate	70
Disease and Pests	76
Economic Factors	79
Agricultural Potential	82
Summary and Conclusions	86
Exhibits	88
General	
References and Reviews	96
Individual Contacts	99

GHANA

INVESTMENT OPPORTUNITIES IN THE FISH AND AGRICULTURAL CANNING INDUSTRIES

A PRELIMINARY SURVEY

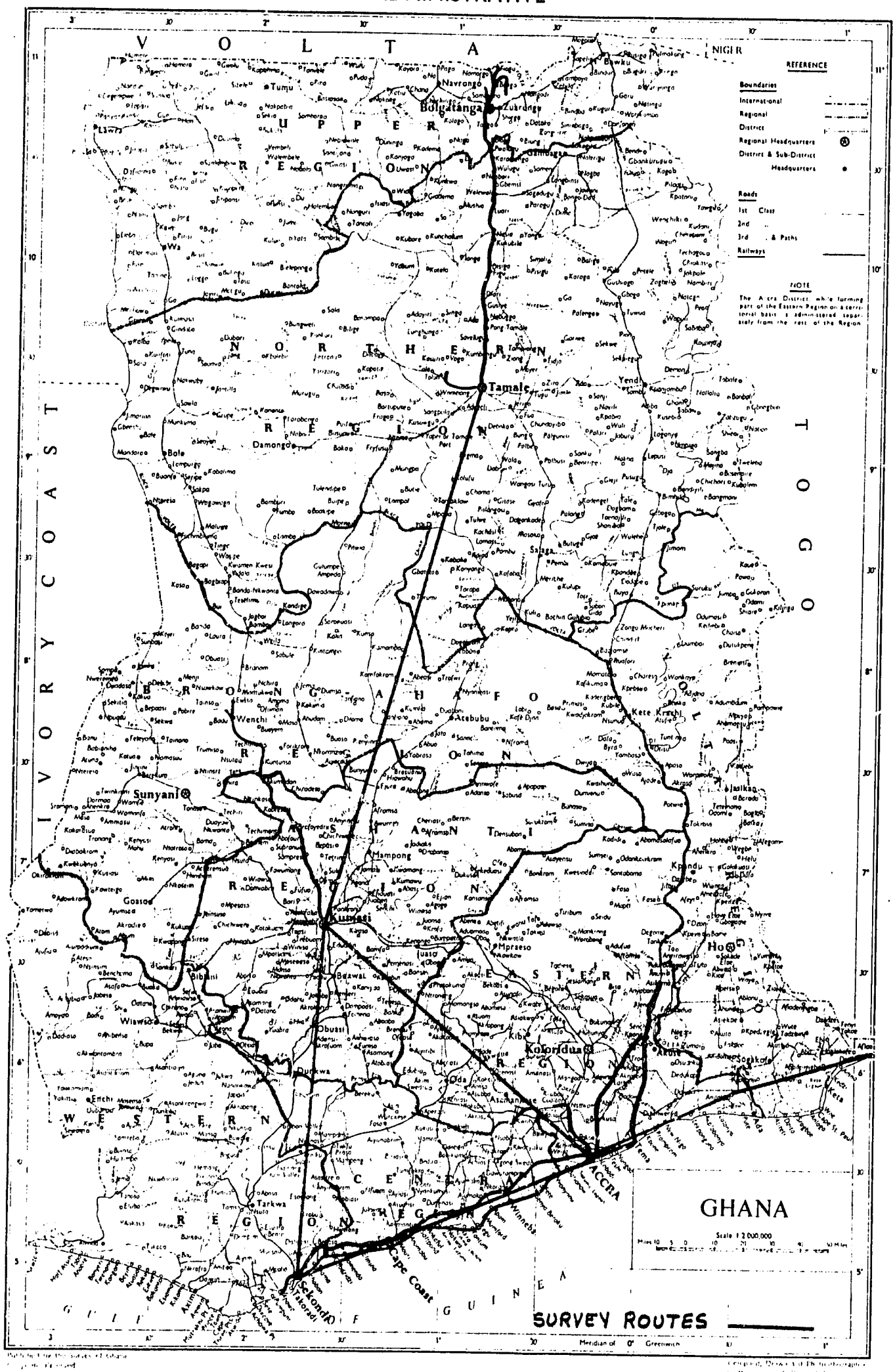
INTRODUCTION

This survey was conducted to examine the fish and agricultural food canning and processing industries of Ghana to determine (1) the present situation and (2) the possibilities for further development and the opportunities for private foreign investment. Various private and governmental organizations, as well as individuals, were contacted in order to obtain their views on the current situation and the opportunities for future development. Through these contacts, statistics and other vital information on fish and agriculture were obtained.

We are particularly indebted to the Food and Agriculture Organization of the United Nations (F.A.O.), the United States AID Mission to Ghana, the National Investment Bank, and numerous other individuals and organizations for their assistance in obtaining information and data on Ghanaian agriculture and fisheries. The names of those individuals and organizations contacted are included in the Appendix.

Details on the fishing, canning, and agricultural aspects of the country are contained in separate sections of this report, along with the respective summaries and recommendations.

ADMINISTRATIVE

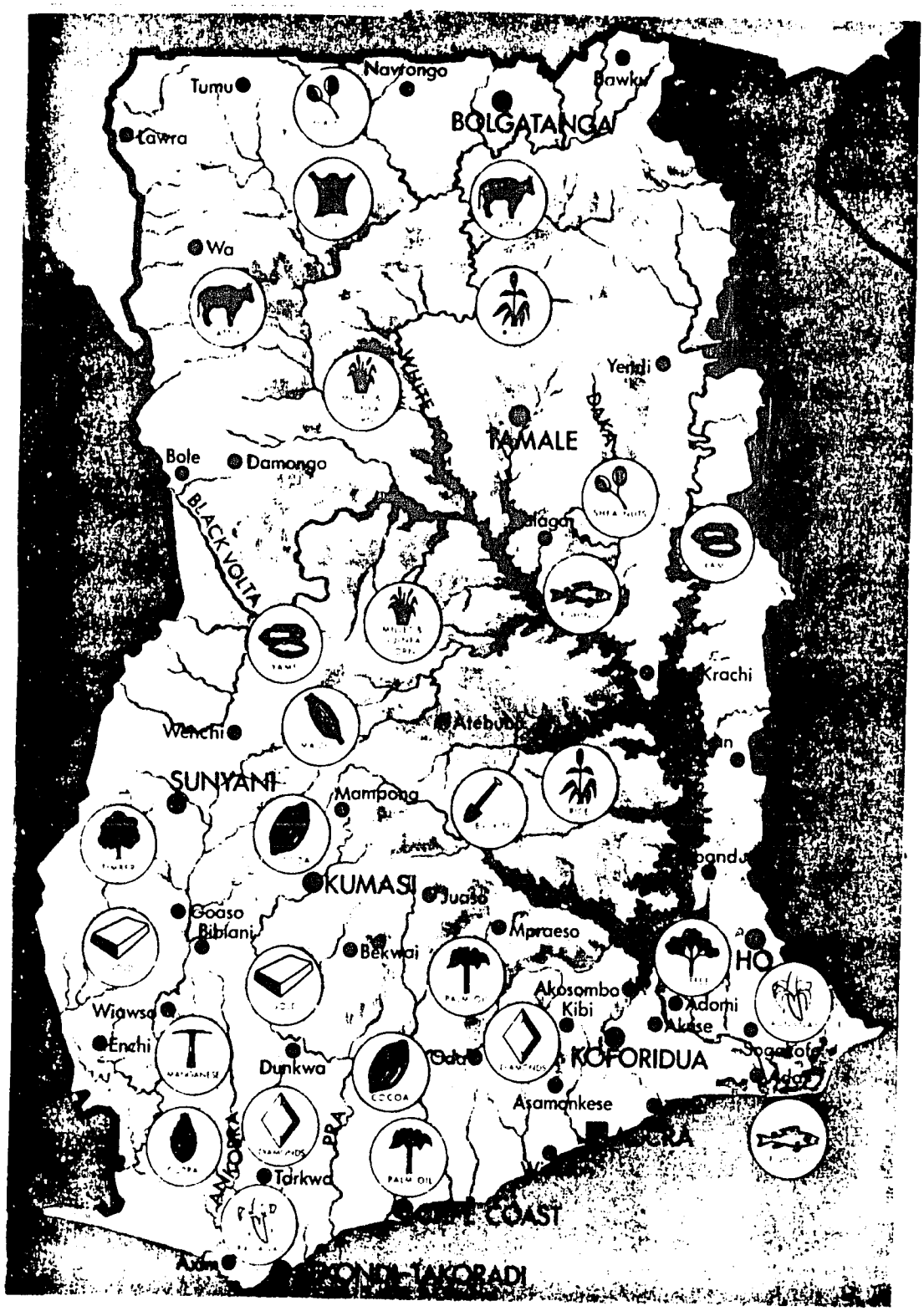


THE COUNTRY

Ghana became an independent country on March 6, 1957, after being a British colony deting back to 1821. The Convention Peoples Party (CPP) led by Kwame Nkrumah, controlled the government until February 24, 1966, when the National Liberation Council (NCL) took over the government of Ghana. The present leader of the NCL is Lt. Gen. Joseph A. Ankrah. The NCL is making progress towards forming a constitutional government with a separation of powers among the executive, legislative, and judicial branches.

Ghana is located in the Gulf of Guinea on the West Coast of Africa between 5° and 13° n. latitude and from 1° east to 3° w. longitude. It has a land area of approximately 91,819 square miles and a population of approximately eight million. The coastline of Ghana is approximately 334 miles long and the two principal ports are Takoradi and Tema. The capital city of Accra (population approximately 500,000) is on the coast near Tema. The other major city of Ghana is Kumasi in the Ashanti region of the south central area. The climate of Ghana is equatorial, ranging from warm to hot. It is hot and humid in the southwest, warm and less humid in the north. Ghana has a wet season from May through September and a dry season from October through April. Ghana's natural wealth is depicted on the following map:

GHANA'S NATURAL WEALTH



Capital Investment Board of Ghana

The natural resources of Ghana have assisted her in providing one of the highest per capita standards of living in equatorial Africa. It was estimated the per capita income in Ghana for 1967 was approximately $240. However, Ghana's progress in recent years has become retarded due to the indebtedness created by the Nkrumah regime during its tenure of office. At the time of Nkrumah's overthrow, the country was heavily obligated through external debts to other countries, and many express the opinion it will take Ghana many years to recover from the overspending by the Nkrumah regime.

Ghana's principal exports for the years 1960 through 1964 are illustrated in the following tables:

		Cocoa Beans	Cocoa Butter	Cocoa Paste	Cocoa Cake
1960	Unit	Tons	Tons	Tons	Tons
	Quantity	302,802	67	3,082	—
	Value	N¢132,867,834 (£66,433,917)	N¢20,992 (£10,496)	N¢2,090,110 (£1,045,055)	—
	Total Value	N¢134,978,936 (£67,489,468)			
1961	Unit	Tons	Tons	Tons	Tons
	Quantity	405,330	1,224	4,508	—
	Value	N¢138,548,338 (£69,274,169)	N¢833,576 (£416,788)	N¢2,075,946 (£1,037,973)	—
	Total Value	N¢141,457,860 (£70,728,930)			
1962	Unit	Tons	Tons	Tons	Tons
	Quantity	421,220	11,582	12,651	—
	Value	N¢134,045,650 (£67,022,825)	N¢5,665,930 (£2,832,965)	N¢1,823,046 (£911,523)	—
	Total Value	N¢141,534,626 (£70,767,313)			
1963	Unit	Tons	Tons	Tons	Tons
	Quantity	404,565	9,695	12,417	—
	Value	N¢136,194,070 (£68,097,035)	N¢6,894,810 (£3,447,405)	N¢391,670 (£195,835)	—
	Total Value	N¢143,480,550 (£71,740,275)			
1964	Unit	Tons	Tons	Tons	Tons
	Quantity	381,506	12,182	1	15,904
	Value	N¢136,233,342 (£68,116,671)	N¢8,872,810 (£4,436,405)	N¢458 (£229)	N¢454,002 (£227,001)
	Total Value	N¢145,560,612 (£72,780,306)			

COCOA

Cocoa is Ghana's most important raw material and the greatest earner of foreign exchange. Cocoa production is expected to increase in the near future by 50%—that is up to about 600,000 tons per annum; the opportunity exists therefore to establish local industries to refine and process this (previously entirely exported) commodity for domestic consumption and for new export markets.

The opportunity exists for more scientific aid in the form of fertilisers, chemicals and spraying equipment.

Export statistics for cocoa beans, cocoa butter, cocoa paste and cake for 1960 - 1964 see table:

TIMBER

The next most important agricultural raw product is timber. Average exports of timber and wood products are worth about £14 million a year, but it is hoped to double this figure by 1970. One of the main problems is that at present only about 20 of the 130 potentially commercial species of Ghana timber are being exploited. The intensification of industrial activity would lead to the marketing of a further 20 varieties immediately. Related industries would take up new species of timber for building, furniture and other wood products.

Export statistics for various forms of timber — logs, curls, sawn, veneer and plywood for 1962-1964 see table:

		Timber Logs	Curls	Sawn	Veneer	Plywood
1962	Unit	Ton. C. ft.	Ton. C. ft.	Ton. C. ft.	Cubic ft.	Cubic ft.
	Quantity	389,573 15,981,318	193 7,808	207,303 9,320,710	30,885	435,059
	Value	N¢11,588,762 (£5,794,381)	N¢17,664 (£8,832)	N¢12,869,404 (£6,434,702)	N¢83,990 (£41,995)	N¢1,539,086 (£769,543)
	Total Value	N¢26,098,906 (£13,049,453)				
1963	Unit	Ton. C. ft.	Ton. C. ft.	Ton. C. ft.	Cubic ft.	Cubic ft.
	Quantity	526,572 18,578,316	663 29,987	185,690 8,365,175	15,490	488,501
	Value	N¢14,432,240 (£7,216,120)	N¢119,992 (£59,996)	N¢11,611,992 (£5,805,996)	N¢71,226 (£35,613)	N¢1,616,510 (£808,255)
	Total Value	N¢27,851,960 (£13,925,980)				
1964	Unit	Ton. C. ft.	Ton. C. ft.	Ton. C. ft.	Cubic ft.	Cubic ft.
	Quantity	466,741 19,064,654	413 37,465	209,256 8,904,017	14,361	502,890
	Value	N¢16,154,262 (£8,077,131)	N¢66,492 (£33,246)	N¢13,330,278 (£6,665,139)	N¢73,972 (£36,986)	N¢1,694,504 (£847,252)
	Total Value	N¢31,319,508 (£15,659,754)				

MINERALS

There are excellent opportunities for the foreign investor in the Ghanaian mining industry which has a great potential in workable resources. The aim of mineral development in the next seven years is to enhance the promotion and performance of the industry in terms of production, exports, and employment.

The government invites foreign investors to aid in the exploitation of other mineral deposits such as limestone, clay, glass sands and rock salt, and to join in the prospecting for petroleum of which the geological reports in Ghana are favourable. The Export statistics for minerals between 1961 and 1964 see table:

OTHER PRODUCTS

In addition to cocoa, timber and minerals, Ghana produces other crops like palm oil, rubber, bananas and copra for export. The export statistics below indicate the size of potential industrial establishments which can make use of these raw materials.

		Gold	Manganese	Bauxite	Diamonds
1961	Unit	F.o.t. *	Ton	Ton	Carats
	Quantity	906,074	384,847	196,072	2,843,629
	Value	N¢19,996,296 (£9,998,148)	N¢12,122,004 (£6,061,002)	N¢927,668 (£463,834)	N¢14,297,022 (£7,148,511)
	Total Value	N¢47,342,990 (£23,671,495)			
1962	Unit	F.o.t.	Ton	Ton	Carats
	Quantity	908,849	476,379	286,798	3,327,961
	Value	N¢22,547,610 (£11,273,805)	N¢11,001,166 (£5,500,583)	N¢1,349 260 (£674,630)	N¢14 833,236 (£7,416,618)
	Total Value	N¢49,731,272 (£24,865,636)			
1963	Unit	F.o.t.	Ton	Ton	Carats
	Quantity	910,373	387,877	207,423	1,513,754
	Value	N¢22,576,606 (£11,288,303)	N¢8,031,616 (£4,015,808)	N¢973,860 (£486,930)	N¢6,654,614 (£3,327,307)
	Total Value	N¢38,236,696 (£19,118,348)			
1964	Unit	F.o.t.	Ton	Ton	Carats
	Quantity	830,839	497,993	264,458	2,569,376
	Value	N¢20,609,156 (£10,304,578)	N¢8,672,640 (£4,336,320)	N¢1,285,306 (£642,653)	N¢12,240,738 (£6,120,369)
	Total Value	N¢42,807,840 (£21,403,920)			

* Total Fine Ounces

		1960		1961		1962		1963		1964	
Product	Unit	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value
Bananas Fresh Fruits and Nuts	Cwts.	92,464	N¢306,134 (£153,067)	94,323	N¢242,342 (£121,171)	45,411	N¢116,770 (£58,385)	72,932	N¢179,760 (£89,880)	41,004	N¢79,892 (£39,946)
Coconuts Brazil Nuts and Cashew Nuts	Cwts.	34,790	N¢91,104 (£45,552)	39,028	N¢115,152 (£57,576)	32,061	N¢78,756 (£39,378)	626	N¢906 (£453)	5	N¢54 (£27)
Kolanuts	Cwts.	232,061	N¢2,399,812 (£1,199,906)	286,954	N¢2,087,282 (£1,043,641)	184,780	N¢2,857,094 (£1,428,547)	332,677	N¢1,718,536 (£859,268)	87,501	N¢696,812 (£348,406)
Hides of Cattle—Undressed	Cwts.	5,558	N¢99,868 (£49,934)	43,680	N¢63,338 (£31,669)	24,040	N¢34,902 (£17,451)	1,550	N¢29,322 (£14,661)	698	N¢10,228 (£5,114)
Copra	Cwts.	3,156	N¢380,582 (£190,291)	42,885	N¢220,348 (£110,174)	24,370	N¢97,372 (£48,686)	10,000	N¢29,500 (£14,750)	—	—
Palm Kernels excluding Flour and Meal	Cwts.	3,050	N¢276,812 (£138,406)	35,350	N¢133,840 (£66,920)	15,724	N¢70,228 (£35,114)	11,249	N¢62,610 (£31,305)	20,000	N¢96,226 (£48,113)
Oil Seeds, Nuts and Kernels nes	Cwts.	1,273	N¢81,212 (£40,606)	5,200	N¢46,414 (£23,207)	23,000	N¢287,130 (£143,565)	12,000	N¢170,400 (£85,200)	—	N¢136 (£68)
Natural Rubber and Gums	Cwts.	780	N¢134,144 (£67,072)	7,940	N¢127,600 (£63,800)	6,834	N¢104,364 (£52,182)	6,752	N¢111,432 (£55,716)	5,796	N¢91,002 (£45,501)
Fruit Juices	Galls.	801,545	N¢176,606 (£88,303)	870,758	N¢177,652 (£88,826)	944,897	N¢254,804 (£127,402)	766,309	N¢333,984 (£166,992)	611,981	N¢282,026 (£141,013)
Shea nuts	Cwts.	—	—	51,133	N¢143,756 (£71,878)	25,129	N¢94,342 (£47,171)	7,392	N¢17,288 (£8,644)	171,080	N¢551,886 (£275,943)
TOTAL			N¢3,946,274 (£1,973,137)		N¢3,359,724 (£1,678,862)		N¢3,995,762 (£1,997,881)		N¢2,653,738 (£1,326,869)		N¢1,808,262 (£904,131)

On February 23, 1967, Ghana changed her currency from the Ghanaian Pound to the New Cedi (N¢) and the New Pesewa (¢.p.) 100 Pesewas equal One (1) Cedi. One Cedi is equal to approximately One U.S. Dollar.

The Capital Investment Act of 1963 was created to encourage the investment of foreign capital in Ghana. This act provides for repatriation of capital and tax exemption incentives for individuals as well as corporations. All incentives granted under the act are subject to negotiations with the Ghanaian government and, more particularly, the Capital Investments Board. A general outline of the incentives granted under the Act follows:

THE CAPITAL INVESTMENTS ACT

The Capital Investments Act was passed in 1963. Its object is to encourage the investment of foreign capital in Ghana with a view to contributing to the development of the productive capacity of the national economy through the efficient utilization of its resources and economic potentials; through the full utilization and expansion of the productive capacity of existing enterprises; through saving imports, and an increase of exports and improvement of services which will assist the strengthening of the payments position of the country; and by promoting a high level of employment and the imparting of technical skill to Ghanaians.

An investment project which satisfies any or all of the above criteria may be granted approval under the Capital Investments Act, which guarantees it certain benefits as detailed below.

Any person who intends to invest in any sector of the national economy, and wishes to enjoy any benefits conferred by this Act, must apply to the Capital Investments Board—a statutory body charged with the administration of this law. The administrative procedure for making application is described on page 15 of this manual.

Main Benefits under the Investments Act

1 **Transfer abroad of profits, capital and foreign loan repayment:**

There shall be no restriction

(i) on the transfer of profits to the country of origin of an investment after the payment of tax due in respect of the investment

(ii) on the remittance of capital, including appreciation thereto, to the country of origin of an investment, in the event of a sale or the liquidation of the approved project

(iii) on the transfer abroad of payments in respect of principal, interest and other financial charges where a loan has been granted to a project by a non-resident for the purpose of a project in accordance with the approved conditions of the loan.

2 **Facilities for expatriate personnel**

Reasonable facilities will be provided by the Minister of Finance to expatriate personnel employed or engaged in an approved project for making remittances abroad in respect of the maintenance of their families and other contractual obligations such as insurance premiums and contributions to provident and pension funds.

3 **Income tax concession**

A company engaged on an approved project will be exempt from paying Income Tax on its taxable income for a period of up to 10 years from the date on which the approved project commences to produce in marketable quantities the product envisaged by the approved project. In the case of an approved project which aims at offering services, the period of exemption will commence from the date on which such services are actually offered.

4 **Capital allowance**

Capital allowances are granted in respect of buildings, plant, machinery, structures, roads, furniture, fixtures, and fittings used for the purposes of the approved project in the following manner:

(a) on machinery, plant, furniture, fixtures and fittings an initial allowance of 25 per cent. is made, thereafter there is an annual allowance of 15 per cent.

(b) on buildings, structures and roads an initial allowance of 20 per cent. is made, thereafter there is an annual allowance of 10 per cent.

5 **Deductions for scientific research**

Where a person has incurred capital expenditure on scientific research for the purposes of the development or advancement of an approved project, in determining the chargeable income of such a person there shall be deducted from that income, every year for five years beginning with the year in which he incurred the expenditure, an amount equal to 20 per cent. of such expenditure.

6 **Exemption from indirect taxes**

An approved project engaged in producing goods for export and using local raw materials or producing goods that replace imports may be granted exemption from import and customs duties and from purchase tax for materials, spare parts, fuel and raw materials used or consumed in connection with the approved project and/or may be granted exemption up to 100 per cent. from export or excise duties on goods so produced provided that such goods are first cleared through Customs.

7 **Deferment of payment of fees**

Where the undertaking of a company having a share capital or an increase of the capital of such company is included in an approved project, payment of the registration fees and stamp duty on capital may be deferred for five years.

8 **Exemption from property taxes and rates**

Where a warehouse, factory or workshop has been constructed or acquired for the purpose of an approved project, or improvements made thereto, and the warehouse, factory or workshop is used directly for the purposes of the approved project, such premises will be exempt for five years from the payment of property tax and property rate.

9 **Protection of investments**

While the Capital Investments Act fully protects investments from expropriation, in rare cases where an established project first seeks government participation and subsequently government control, the Government undertakes to pay fair compensation for the take-over in the currency in which the investment was originally made.

Where there is a dispute as to the amount of compensation payable the matter shall be referred, if so desired, to an arbitrator appointed by the parties, and failing such appointment to arbitration, through the agency of the International Bank for Reconstruction and Development.

ADMINISTRATIVE PROCEDURE

Applications for approval of projects

Any person who has invested or intends to invest capital in any sector of the Ghanaian economy and wishes to enjoy any benefits conferred by the Capital Investment Board must submit detailed particulars of the project on Form CIB/1 to the Secretary, Capital Investments Board, P.O. Box M-193, Accra, Ghana. The person will be required to supply the following information, in as much detail as possible, on the prescribed form:

1 The industry to be established and the product to be produced.

2 An investment and financial plan showing the amount of investment in external or Ghana currency.

3 A production scheme indicating the volume and value of the production.

4 A services scheme indicating the creation of services and the volume and value of the services intended to be rendered.

5 An import and export scheme indicating the anticipated volume of imports and exports (for the product)

6 An employment scheme showing programme of training for persons who are citizens of Ghana to acquire the requisite skills in the particular enterprise.

7 The locality in which it is proposed to carry on such industry.

8 The day on or before which it is expected to make the services available or to commence production in marketable quantities of products specified.

9 The estimate of the rate of production of the specified product which is to be attained on or before the date of production.

Application forms CIB/1 are obtainable from the Secretary of the Capital Investments Board, to whom they must be returned when duly completed and signed. All enquiries must be addressed to the Secretary.

THE FISHERIES OF GHANA

A PRELIMINARY SURVEY

INTRODUCTION

This preliminary survey was made to determine:

1. The present state of the Ghanian fisheries;
2. The possibilities for foreign investments in these fisheries.

The major fishing ports were visited to determine the state of the existing fishery. The various governmental agencies of Ghana pertaining to fisheries were contacted for basic data and information on the country's fisheries. Also, the personnel of the Food and Agriculture Organization of the United Nations working on fisheries were contacted to obtain data on their work and their ideas relative to the Ghanaian fisheries and fisheries in general in the Gulf of Guinea area.

Since Ghana has extremely limited processing facilities other than freezing of fresh fish at the present time, the survey work was confined primarily to an assessment of marine fishing, which accounts for approximately 85% of the fish consumed in Ghana, based upon the preliminary 1967 consumption statistics. Ghana does have two processing complexes that were started several years ago, one by the Russians and

the other by German interests. These facilities have never been completed, consequently are inoperable:

The Ghanaian fishery is divided into three main categories:

A. A high-sea fishery for tuna by foreign flag vessels, which is transshipped from Ghana to other countries and generates very little income for Ghana.

B. A marine fishery composed primarily of canoes, set nets, and motorized fishing vessels, the latter being a recent development in Ghana.

C. A fresh-water fishery conducted in the lakes and rivers of Ghana.

THE PRESENT STATE OF THE GHANAIAN FISHING INDUSTRY

FISHING

Ghana has been one of the principal West African fishing countries for many years. Its two principal fishing ports are Tema and Takoradi. The Ghanaian adapted himself to an inshore marine canoe fishery from an early date and this fishery has supplied Ghana with a large percentage of their fish requirements. At the present time, it is estimated there are in excess of 50,000 fishermen manning over 10,000 canoes in Ghana.

Since independence, Ghana, through the government and private fishing companies, has been purchasing an offshore motorized marine fishing fleet from the Russians, Japanese, Norwegians, and British. Some of these vessels, after proving impractical, have been sold to other countries. In addition, small purse seine vessels up to 60 feet in length have been built in the Ghanaian shipyards at Tema and Takoradi.

While the Ghanaian fishermen were not able to operate modern and sophisticated gear by themselves, they have been rapidly learning the necessary techniques under the guidance of European experts and no doubt will eventually be able to operate modern boats and gear.

The growth of the Ghanaian fishing fleet is shown in

Exhibit I. This exhibit indicates the motorized fishing vessel fleet has been increasing while the canoe fleet has remained somewhat static. This growth in the motorized fleet has materially assisted in increasing the catch of fish for local consumption in recent years, and imports of fresh frozen fish have dropped from 47,000 tons in 1963 to 14,000 tons in 1967. Recent surveys indicate the Ghanaian fleet in 1968 may well produce more fish than will be consumed in Ghana, and the price of raw fish may decline to a point where the majority of boat owners and fishermen may be hurt economically. Some of the private fishing companies are investigating other fisheries in which to operate their large boats. Otherwise, they feel it will be necessary to lay up part of their fleet during the Sardinella season in order not to glut the market.

At the present time there are approximately 15 Russian-built side trawlers lying idle and 5 additional ones are being used spasmodically for the fresh fish market or experimenting in other fisheries. Another 18 boats, some with a carrying capacity up to 700 tons, are on order and scheduled for delivery between 1968 and 1970.

With the new additions, the Ghanaian fleet should be able to flood the fresh and frozen fish market. The excess catch might be sold in neighboring West African countries, provided costs are competitive with other foreign fleets such as the Japanese and Russians. The type of fish now being caught and the present method of handling by the Ghanaian fleet

would preclude its acceptance in the major world fish markets. Exhibit II shows the landings of marine fish in Ghana for the years 1961 through 1966. It has been estimated that the 1967 catch of marine fish would be approximately 95,000 tons and that Ghana had consumed about 124,000 tons of fresh and frozen fish, and imported fishery products.

At the present time, the Ghanaian marine fishing fleet fishes primarily for demersal fish and the pelagic species. The herring fishery (Sardinella aurita) is the largest single fishery. Herring fishing occurs primarily during the months from June through September. This is the period in which the major upwelling occurs off the coast of Ghana and the Sardinella aurita becomes available to the fishermen.

Dr. Miroslav Zei of the Food and Agriculture Organization is of the opinion that herring may be available throughout the Gulf of Guinea the entire year, even during the periods when upwelling in the ocean does not occur. He hypothesizes that this species of Sardinella remains below the thermocline and is unavailable to the fishing fleet during the periods when upwelling does not occur. At the present time, Dr. Zei is experimenting with light fishing and other methods to determine if the Sardinella aurita may be caught during the entire year. Dr. Zei has advanced the opinion that if his theory is correct, the Gulf of Guinea may have a population of Sardinella aurita that would yield a harvest of approximately 1,000,000 tons per year. Some of the other fishery scientists do not agree with Dr. Zei's theory and his

estimates of population abundance off the Gulf of Guinea.

The United Nations and Food and Agriculture Organization, in cooperation with other governments in the Gulf of Guinea area, are at the present time conducting a survey on population dynamics of Sardinella aurita and other species. This scientific research work will not be completed for several years, and, upon completion, there will no doubt be a better understanding of the population density of the various species of fish in the Gulf of Guinea.

Prices of fish are high in Ghana, in comparison with many other countries of the world. This is best illustrated by the prices paid to the so-called contract foreign fishing vessels (Japanese and Russian) that delivered fish to Ghana in 1965. At that time, the following prices were paid for the species indicated:

	Grade 1	Grade 2	Grade 3
	(In Ghanaian Cedis)		
Hake	128	---	---
Red fish, Snapper, Bream, etc.	124	104	80
Herring and Sardines	120	100	80
Horse Mackerel	106	92	72
Other fish	120	100	70
Mixed small fish	---	---	60

(Ghanaian Cedis per Metric Ton - 1 Cedi = US$1.00)

Since the above prices paid were for frozen fish, quite naturally this price was cheaper in general than that paid for fresh fish. In comparison with the above prices, hake on the West Coast of the United States commands a price by the fishermen of approximately $20 per ton, sardines in Southwest Africa approximate $12 per ton, and Rockfish on the West Coast of the United States sold on the average for $90 per ton in 1967. During February of 1968,

fresh caught small mackerel was selling for $270 per ton at Tema and Takoradi.

Since completion of the Volta Dam, it is anticipated that the catch of fresh-water fish will materially increase in Ghana during the coming years. It has been estimated by some ichthyologists that the Volta Lake area may eventually produce as much as 20,000 tons of fish annually. This of course will add to the supply of fish for consumption within Ghana.

GHANAIAN FISHERMEN'S WAGES

Most of the canoe fishermen fish on a share basis. They receive their shares either in money received for the catch or a portion of the fish catch itself, which in turn is generally sold to a "fish mammy" who has loaned the fisherman money to buy his share in the boat. The food, as well as the income, generated by this fleet, is important to the economy of Ghana.

Rates of pay for fishermen on the major motor fishing vessels as supplied by one of the private fishing companies are as follows:

Mechanics

Grade II	: N¢ 40.00	monthly	- 0.12	per ton fish bonus
Grade I	: 60.00	"	- 0.15	"
Head	: 80.00	"	- 0.15	"
Supervisory	: 112.00	"	- 0.20	"

Fishermen:

At Sea:

Grade II	: N¢ 60.00	monthly including fish bonus
Grade I	: 100.00	"
Chief	: 160.00	"

Ashore:

Chief	: N¢ 80.00	monthly
Rest	: 1.00	per day

Social Security Contribution:

Employer's Contribution = 12½% of Employee's gross pay.
Employee's Contribution is 5% of his gross monthly pay.

MARKETING

The bulk of the fresh and frozen fish catch is marketed by the "fish mammies", who buy the fish from the canoes, fishing companies, etc., and in turn sell it on the fresh market or smoke it for distribution throughout the country.

In certain instances, the fisherman is the husband of the "fish mammy", and in other cases, the "mammy" has advanced the fisherman the necessary money to purchase his share in the boat. Thus, he is obligated to sell his fish to that particular "mammy".

The coastal women have connections with the towns and villages in the interior of the country, and through this have established a regular marketing organization for fresh, smoked, dried, and salted fish. While this is an unusual marketing situation, it has worked surprisingly well in Ghana, as the average per capita consumption of fish, based upon the preliminary 1967 consumption figures, is approximately 34 lbs. per person. No doubt this distribution system could be augmented by improving the method of transporting the fish to the inland communities.

The State Fishing Corporation has established cold storage facilities and retail outlets in the cities and villages of the back country. This has proved to be a costly

operation to the government as the State Fishing Corporation has been unable to operate at a profit. The privately-owned fishing companies distribute the bulk of their fish through the "fish mammies".

It was reported that one enterprise had endeavored to establish a refrigerated truck service for the delivery of fresh fish to the inland markets. This enterprise contemplated selling its fresh refrigerated fish to the consumers in the interior area and to bypass the "fish mammies" for marketing purposes. The first two or three trips were quite successful. However, they were soon boycotted by the "mammies" and their venture collapsed.

BOAT BUILDING AND REPAIR FACILITIES

The State Boatbuilding Corporation (government-owned) has two facilities for the construction of boats, one at Tema and one at Sekondi. These two yards average building 10 to 15 boats per year with a maximum capacity of approximately 30 vessels. The principal type of vessel built in these yards is purse seine boats not in excess of 60 feet long. They are generally powered with engines of approximately 80 h.p. This small power plant is satisfactory for purse seining, but would be insufficient for trawling or dragging.

The Railway and Ports Administration has constructed a large drydocking facility which is equipped to handle and repair any fishing vessel. In addition, one of the principal private fishing companies has a well-equipped machine shop and is able to do all engine and machine repairs for their fishing vessels. This facility is also available for use by other fishing companies. From a machine shop repair standpoint, this facility offers considerably more than the facility owned by the Railway and Ports Administration.

RESEARCH AND DEVELOPMENT

The Department of Fisheries is responsible for the research and development of the Ghanaian fisheries. This department maintains a small scientific staff and they in turn work very closely with the Food and Agriculture Organization scientists and others in the research and development of the Ghanaian fisheries. Likewise, the Department of Fisheries is also responsible for the training of the necessary fishermen for the manning of locally-owned fishing vessels. A training center for captains, engineers, and navigators is planned for the nautical college at Nungua.

Many Ghanaians have had training and study abroad in the operation of fishing vessels, particularly in Russia, Norway, East Germany, and Yugoslavia. In addition, the private and state-owned fishing corporations have employed expatriates from foreign countries as captains, engineers, mates, etc. to operate their fishing vessels and to train their Ghanaian crews, who will eventually assume the operating responsibilities.

PRINCIPAL FISHING COMPANIES

The following are the principal fishing companies operating in Ghana:

State Fishing Corporation (government-owned)
Ghana Cold Stores, Ltd. (government-controlled)
Mankoadze Fisheries, Ltd.
Ocean Fisheries, Ltd.
Soli Fisheries, Ltd.
Star-Kist International, S.A.

All of the private companies appear to be well operated and conduct an excellent fishing program in Ghana.

Star-Kist International, S.A. is interested primarily in handling tuna caught by foreign flag vessels under contract to them, (principally Japanese, Korean, and Taiwanese) and the storing and transshipment of tuna caught by European flag vessels, which in turn is generally shipped back to the respective country or to other world markets.

The State Fishing Corporation has recently entered into a contract with a Norwegian company for the operation of the Norwegian vessels purchased by Ghana. It was reported the captains, engineers and key crew members would be from Norway; the balance of the crew would be Ghanaian. The agreement also provides for the training of the Ghanaian fishermen to eventually replace the Norwegian crew members.

As previously reported, this corporation has continually operated at a loss and the Ghanaian government is endeavoring to place this operation on a profitable basis

through the Norwegians and the utilization of part or all of their Russian side trawler fleet in other fisheries. Ten of these side trawlers have lain idle in the harbor of Tema for over two years.

Mankoadze Fisheries, Ltd. and Ocean Fisheries, Ltd. are the two major private Ghanaian fishing companies. The success of these two companies is best indicated by their growth during the past few years and the efficiency of their operations. The government and private individuals were not hesitant in stating these two companies had greatly contributed to the development of the Ghanaian fisheries. Mankoadze is the larger of the two companies and delivers fish to both Tema and Takoradi. Tema is the city of their principal operation.

PROCESSING AND HANDLING FACILITIES

As previously stated, Ghana has no processing facilities per se. The only processing of fish at the present time that is being done in Ghana is by a privately-owned fish company aboard one of their large stern trawlers. This is a very limited facility and its production of canned fish and fish meal adds very little intrinsic value to the country.

Fish processing facilities were under construction at the time the Nkrumah government was overthrown. However, they have never been completed. These facilities consist of the following:

A. The Russian Complex:

1. Fish canning plant with an output of 20,000 cans per day. (The cannery is a 3-story concrete building, approximately 80 x 400 feet in length.)

2. The fish smoking facility to produce six tons of smoked fish per day. (The building is 80 x 350.)

3. A fish meal and oil reduction facility to handle 30 tons of raw fish per day. (All of the equipment for this complex is crated and stored outside in the cannery yard.)

B. The German Complex:

1. A wheat and corn flour mill with a production capacity of 63,000 tons per year.

2. An animal food factory with a capacity of 30,000 tons per year.

3. A complete fish cannery with facilities to handle 30,000 tons of fish per year.

4. A can-making facility with a yearly production capacity of 180,000,000 cans.

5. A fish reduction plant with capacity to produce 8,000 tons of fish meal per year.

6. An oil mill with fat hardening facilities and equipment for different types of oil utilization, with a total production capacity of 15,000 tons per year.

It was reported, during the visit to Ghana, that the German complex was going to be completed by private capital.

At the present time, the following cold storage and ice production facilities and their respective capacities are available in Ghana:

Cold Storage Facilities	Location	Tons
Ghana Cold Stores, Ltd.	Tema	5,500
"	Accra	1,500
"	Kumasi	300
Mankoadze Fisheries, Ltd.	Tema	3,000
"	Accra	800
Ocean Fisheries, Ltd.	Tema	1,000
"	Accra	1,000
Total of smaller cold stores for distribution by State Fishing Corporation		240
Total		13,340

Ice Production	Location	Tons per Day
Ghana Cold Stores, Ltd.	Accra	40
"	Tema	10
Mankoadze Fisheries, Ltd.	Tema	30
Accra Brewery	Accra	20
Total		100

While a fair tonnage of tuna is landed at the port of Tema each year, this is caught by foreign vessels and Tema is merely used for cold storage and transshipment purposes. The tuna is primarily stored at Ghana Cold Stores, Ltd., Tema, a government-controlled company. Star-Kist International, S.A. has an exclusive arrangement with the Ghanaian government for the handling of tuna in Ghana.

In addition to the above, the local people, principally the "fish mammies", smoke considerable quantities of fresh and frozen fish for distribution throughout Ghana. The Ghanaians are particularly fond of smoked fish; consequently a great portion of the fish consumed in Ghana is smoked.

GOVERNMENT POLICY

Mr. J. N. N. Adjetey, Chief Fisheries Officer of the Department of Fisheries, stated a foreign entity could only invest in the Ghanaian fisheries under the following conditions.

A. An investment in a tuna operation similar to that of Star-Kist International, S.A. could be made in partnership with the government on a 50-50 basis or in conjunction with a Ghanaian citizen on a joint participation basis, mutually satisfactory to the Ghanaian and the private investor. (Star-Kist has an exclusive agreement whereby they are the only foreign company that may conduct a tuna operation without benefit of Ghanaian ownership.)

B. A foreign entity may invest in the catching, processing, and marketing of fishery products through a 50-50 participation with the government or in conjunction with a Ghanaian citizen on a basis mutually satisfactory to both parties.

It was explicitly pointed out that existing Ghanaian laws prohibit foreign investments in the fishing industry unless the government or a Ghanaian citizen is a participant in the venture. Therefore, the only method by which a foreign entity may make an investment in the fishing industry in Ghana is either through the government or in cooperation with a Ghanaian citizen.

GENERAL

Dr. Eberhard Reusse, food marketing economist for the Food and Agriculture Organization, has made extensive studies of the operations of the Ghana State Fishing Corporation and the fishing industry of Ghana in general. Dr. Reusse in his report points out that, in his judgment, the present Ghanaian fishing fleet, coupled with the vessels yet to be delivered, will be able to produce more fish than will be consumed in Ghana. He further points out there is a possibility of alleviating this overproduction by improving the present methods of distribution and with the addition of commercial smoking and curing facilities. Dr. Reusse also mentions the possibility of exporting fish from Ghana to other countries.

At the present time, the cost of catching fish in Ghana and the price it commands on the Ghanaian market would make it impossible to operate a cannery or reduction facility. Likewise, the species caught and the method of handling would limit the export market to the neighboring countries.

If a prolonged glut should occur on the fresh fish market in Ghana, no doubt the indigenous canoe fishermen would be severely affected. Since this fishery alone employs in excess of 50,000 fishermen, this could prove damaging to the economy and food supply of Ghana.

SUMMARY AND RECOMMENDATIONS

SUMMARY:

Ghana has now developed her offshore fishing fleet to the point where, coupled with canoe and fresh water fisheries, she can produce more fish than can be consumed on Ghana's fresh and frozen market. Consumption can only be increased by (1) an improvement in the over-all economy of Ghana, (2) better distribution throughout the country at a cost cheaper than that which is now being done and (3) producing the various species of fish at a cheaper cost so that a cannery and reduction plant could operate on a profitable basis. The offshore fleet has the capability to produce an excessive amount of fish; however, the cost of production is high and it would be impossible to compete on the world fish oil, fish meal, and canned fish markets.

Many of the world fishery experts no longer consider Ghana a developing nation in fisheries. They express the opinion that Ghana is now self-sufficient as far as fishing itself is concerned.

The private companies, as well as the state-owned fishing corporation, are faced with finding other fisheries in which to operate a part of their fleet, in order to keep them productive and still not glut the market with fresh and frozen fish that cannot be sold profitably. The most logical fishery in which these vessels may be employed is one that would produce

foreign exchange for Ghana. The vessels involved in all probability could be converted and operated profitably as tuna longline fishing vessels provided experienced administrative personnel, as well as fishermen, were employed to teach the Ghanaians the tuna longline fishing operation. In all probability, it would be necessary to secure these experts from either Japan, Korea, or Taiwan. This would require a substantial expenditure to prove the Ghanaian could develop into an efficient longline fisherman and successfully compete with the other countries fishing tuna by this method. The government might support such a development program or an individual investor may be found who would be willing to risk the capital necessary to prove the feasibility of such a venture. All of the necessary facilities (privately or government-owned) such as cold storage, machine shops, drydocks, warehouses, etc. to support a tuna longline fishery, are located at the port of Tema.

The marketing and distribution of fresh and frozen fish throughout Ghana is being developed by the State Fishing Corporation and the private companies. It would be difficult for a foreign company to engage in the marketing and distribution of fish within Ghana in competition with the "fish mammies" and the existing fishing companies. The present marketing and distribution facilities can best be expanded through the utilization of the existing companies and the marketing organization developed by the "fish mammies". A commercial smokery such as that included in the Russian fishery complex could be developed and operated to assist the "fish mammies" in their smoking and distribution of fish.

Such a commercial smokery should be able to produce a smoked product more cheaply than that now being produced by individual "mammies".

The Russian fishery complex will be extremely costly to complete, and it is doubtful, after it is completed, that it will be able to produce canned fish, fish meal and fish oil as cheaply as other countries produce these products. Since the equipment has remained crated and stored in the open for several years, it is doubtful that it would be in first-class condition, and in all probability would not even be useable. The German complex envisions the canning of the Sardinella aurita as a luxury or gourmet pack. This particular species of the sardine family is not as good in quality as the Sardinops and Sardina species, and it is doubtful if a pack of specialty items can be produced from the Sardinella species caught off Ghana that could compete with the sardine packs produced in other countries of the world.

Tuna landings in Ghana are made by the Japanese, Koreans, Taiwanese, French and Spaniards for transshipment to Europe and the United States. This operation contributes little to the economy of Ghana. Only when a Ghanaian fleet catches tuna, sells it on the world market and generates foreign exchange will Ghana benefit from tuna fishing. Since Ghana is not a member of the European Common Market, it is doubtful if a pack of canned tuna from Ghana would be competitive with packs from European countries. Likewise, at the present time, it is doubtful if Ghana could compete with Japan in the production of a canned tuna pack for sale in the

European market. This certainly would be true until such time as Ghana demonstrates her capabilities in competitive tuna fishing.

While Ghana has passed the "Capital Investment Act of 1963" to encourage foreign investments in Ghana, the regulations and laws governing investments in fisheries require government participation on a 50-50 basis or a private Ghanaian citizen as a joint participant on a basis mutually satisfactory to the foreign investor and the Ghanaian.

RECOMMENDATIONS:

1. Ghana no longer is deficient in her capabilities to produce fish for internal consumption. The problem yet to be solved is distribution within the country at a reasonable cost. This can best be done by Ghanaians themselves.

Therefore, we cannot recommend that a foreign investor consider this phase of the Ghanaian fishery.

2. Tuna fishing by Ghanaians may be possible but it still must be proved that they will be competitively successful in this fishery. Unless the government of Ghana or a private organization would be willing to risk the capital to prove the Ghanaian can successfully fish tuna, there would be little incentive for a foreign investor to consider a tuna venture in Ghana.

Therefore, it is recommended that the government of Ghana give consideration to financing and supporting an experienced private organization to conduct this experimental fishery program.

EXHIBIT I

STATISTICS OF FISHING VESSELS AND CANOES (1962-67)

TYPE	1962	1963	1964	1965	1966	1967
MOTOR FISHING VESSELS						
Overall Length up to 32'	195	183	129	182	223	228
" " between 33'-60'	22	50	44	66	92	107
" " " 61'-100'	10	18	19	*40	**39	39
" " above 100'	3	6	48	41	36	44
" " " 100' (Tuna Vessels)	38	54	52	26	22	21
Total	268	311	292	355	412	439
CANOES						
Non-motorized canoes	8,262	7,180	7,090	5,224	5,224	5,224
Motorized "	1,950	3,032	3,122	4,988	4,988	4,988
Total	10,212	10,212	10,212	10,212	10,212	10,212

* Including 9 Tuna Vessels

** " 7 " "

Fisheries Department, Ministry of Agriculture, Ghana

EXHIBIT II

MARINE FISH LANDINGS
1961-1966

	1961	1962	1963	1964	1965	1966
Total Landing (in metric tons)	34,595.8	63,726.0	90,928.0	93,217.3	90,315.3	99,344.0
1. Canoe Fisheries.....						
a) Herring Fishing.....	15,416.3	16,807.2	7,090.2	26,821.8	3,479.0	6,049.9
b) Line Fishing.....	874.6	2,041.3	2,445.0	1,017.4	7,022.6	1,508.5
c) Other Fisheries.....	11,678.5	14,563.7	26,819.0	15,483.1	6,418.2	17,664.3
Total Canoe Catch	27,969.4	33,412.2	36,354.2	43,322.3	16,919.8	25,222.7
2. Motor Fishing Vessels.						
a) Trawl Fishing.....	1,130.2	1,103.6	9,602.9	15,961.8	34,233.3	24,192.3
b) Purse-Seine Fishing (Other Fish)	-	-	-	-	-	7,244.4
c) Herring Fishing (Purse-Seine & Ali Fishing)	1,507.9	2,148.3	2,010.3	7,439.4	4,377.1	7,254.0
d) Line Fishing.....	359.4	556.3	485.2	149.1	117.0	68.5
e) Tuna Fishing.....	3,628.8	5,198.5	6,992.6	5,519.6	9,975.0	9,881.3
f) Other Species from Tuna Fishing.....	-	414.1	1,520.8	904.9	1,037.7	705.4
Total MFV Catch	6,626.3	9,420.8	20,611.8	29,974.8	49,740.1	49,345.9
3. Landings from Foreign Vessels on contract	-	20,893.0	33,962.0	19,920.2	23,655.4	24,775.4
4. Herring Catch						
a) Canoe Fisheries.....	15,416.3	16,807.2	7,090.2	26,821.8	3,479.0	6,049.9
b) Motor Fishing Vessels	1,507.9	2,148.3	2,010.3	7,439.4	4,377.1	7,254.0
Total Herring Catch	16,924.2	18,955.5	9,100.5	34,261.2	7,856.1	13,303.9
5. Other Species						
a) Canoe Fisheries.....	12,553.1	16,605.0	29,264.0	16,500.5	13,440.8	19,172.8
b) Motor Fishing Vessels.....	5,118.4	7,272.5	18,601.5	22,535.4	45,363.0	42,091.9
c) Fish Contract	-	20,893.0	33,962.0	19,920.2	23,655.4	24,775.4
Total Other Species	17,671.5	44,770.5	81,827.5	58,956.1	82,459.2	86,040.1
Fish Transhipped out of Ghana	3,628.8	4,727.2	6,701.4	5,894.9	6,993.7	7,794.3
Consumption of Marine Fish	30,967.0	58,998.8	84,226.6	87,322.4	83,321.6	91,549.7

Fisheries Department, Ministry of Agriculture, Ghana

GHANA

FOOD CANNING AND RELATED AGRICULTURAL PRODUCTION

A PRELIMINARY SURVEY

PRESENT STATE OF THE FRUIT AND VEGETABLE PROCESSING INDUSTRY - GHANA

I. GENERAL

The Ghanaian fruit and vegetable processing industry in terms of longevity has come into being in very recent years. The first privately owned orange squash factory started small scale operations about twenty years ago. Later, two or three small squash factories were established with various successes and replacement by others. The first fruit and vegetable canning factory, government owned, was started in 1956, processing tomatoes, pineapple and citrus initially on an experimental basis. Operations were initiated in 1962 and 1963 by two privately owned factories--one producing products similar to that of the government factory and the other restricting its production to citrus squashes and marmalades. In addition there is operating a lime juice manufacturer exporting lime juice in barrels and lime oil.

The preceding Ghanaian government administration on the 23rd of May, 1963, consummated an agreement for the building, equiping and furnishing of technical services for the establishment of three separate State processing plants as follows:

1. Pineapple processing plant located at Nsawam, Eastern Region;

2. Tomato and mango processing plant located at Wenchi, Brong-Ahafo Region;
3. Tomato processing plant located at Pwalagu, Northern Region.

The agreement between the government of Ghana at this time and Ingra, which is a Yugoslav business association for the manufacture of power and industrial plants and equipment, specified that Ingra would supply the following for each of the separate plants: 1/, 2/, 3/, 4/, 5/

1. Processing equipment;
2. Tin can manufacturing plant;
3. Building of plant structure;
4. Laboratory equipment;
5. Water supply including pumping stations, water treatment plant and holding capacity for water storage;
6. Boiler room and equipment;
7. Maintenance shops;
8. Diesel generating plant and equipment for electrical requirements;
9. Technical data, patented and unpatented inventions, confidential information and know-how, drawings, specifications and other information necessary to the processing of tomatoes, pineapple and mangoes respectively;
10. Drawings, flow plans, equipment and materials lists, including recommended spare parts and instructions;

11. Supervision of engineering;
12. Training of Ghanaian technicians in Yugoslav;
13. Erection supervision of the factory;
14. Test run operation of the respective factory.

Our interests related to the investigation of the overall feasibility of plant operations in respect to the new plants located at Nsawam, Wenchi and Pwalagu, and pertinent details concerning these plants will follow. These three plants, nearing completion at the time of the coup in February 1966, are being completed, but at the time of our inspection in February 1968 they were not yet in operation.

II. PROCESSING PLANTS

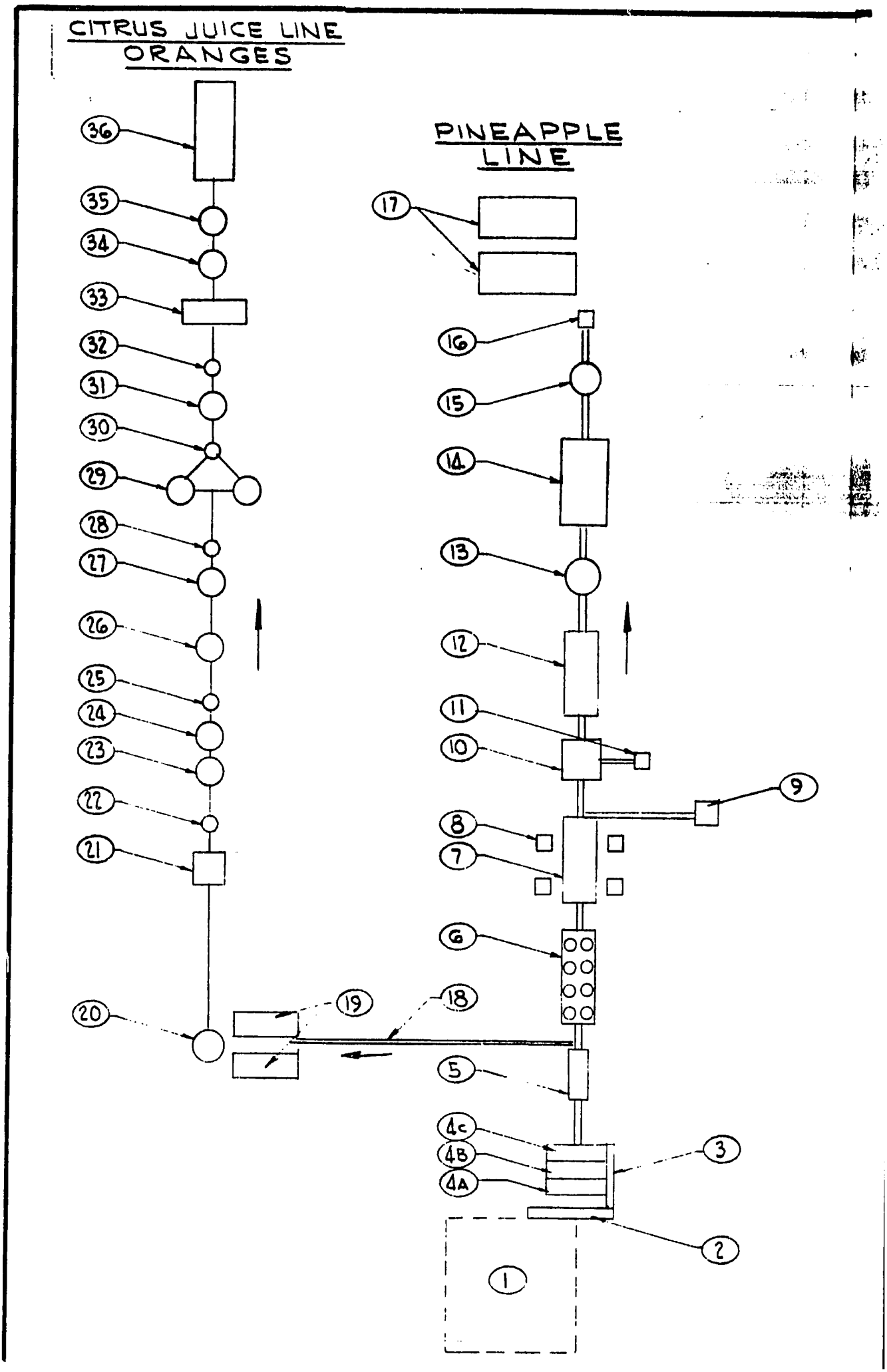
Nsawam - Pineapple Factory - State Cannery Corporation

The pineapple cannery, including a citrus juice line, is located on the periphery of the town of Nsawam, approximately twenty-five miles northwest of Accra. The projected designed capacity as quoted for this plant is 8,000 tons of fresh pineapple for slices, pieces and juice at a designed projected rate of five to six tons of raw product per hour.

The floor spaces of the various buildings composing this cannery are given as follows by the State Cannery Corporation:

1.	Main Processing Building (Including Receiving and Dispatching Platforms)	29,200 sq. ft.
2.	Office Building (Basement)	2,050 " "
	Ground Floor	8,920 " "
3.	Boiler House and Electrical Power Station	2,870 " "
4.	Garages and Maintenance Workshops	7,300 " "
5.	Cafeteria, Kitchen, Laundry	3,700 " "
6.	Employee Locker - Change Rooms	3,700 " "

The flow plan for processing pineapple and orange juice in this plant, with equipment designations, follows.


CITRUS JUICE LINE
ORANGES
PINEAPPLE
LINE
36
35
34
33
32
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4C
4B
4A
3
2
1

BASIC FLOW DIAGRAM - PINEAPPLE AND CITRUS JUICE LINES

NSAWAM PLANT

1 DUMP AREA
2 ELEVATOR
3 SORTING BELT FOR MANUALLY SORTING PINEAPPLE LARGE, MEDIUM AND SMALL SIZES
4A HOLDING BIN - LARGE SIZE
4B HOLDING BIN - MEDIUM SIZE
4C HOLDING BIN - SMALL SIZE
5 WASHER
6 TOP AND BUTT REMOVAL - BY MEANS OF MANUALLY HOLDING TOP AND BUTT OF PINEAPPLE AGAINST CIRCULAR ROTATING SAW
7 SERVICING TABLE TO HAND OPERATED GINACAS
8 (4) MANUALLY OPERATED GINACAS FOR SHELL AND CORE REMOVAL - STATIONARY CYLINDER
9 SHELL CRUSHER FOR MAKING SHELL CRUSH
10 SLICER - (2) UNIT
11 JUICE COLLECTION
12 HAND PACKING TABLE
13 6 VALVE SYRUPER
14 EXHAUST BOX
15 4 SPINDLE CLOSING MACHINE
16 RETORT CRATE
17 (2) 3 RETORT CRATE HORIZONTAL RETORTS
18 ELEVATOR
19 (2) JUICE EXTRACTORS
20 JUICE COLLECTION TANK AND PUMP
21 FIBER DISINTEGRATOR
22 PUMP
23 PULPER
24 FINISHER
25 PUMP
26 HOLDING TANK
27 CENTRIFUGE
28 PUMP
29 BLENDING TANKS
30 PUMP
31 DEAERATOR
32 PUMP
33 TUBULAR HEAT EXCHANGER (PASTEURIZER)
34 FILLER
35 SEAMER
36 LID PASTEURIZER - CAN COOLER

The water and steam supply lines are constructed and placed within the void of the floor drains. The electrical service lines lie under the cement floor. The processing section for both citrus juice and pineapple encompasses an area 47 ft. 4 in. in width and 162 ft. in length. The main factory building encompasses an area of 125 ft. 14 in. by 213 ft. 10 in. This does not include the office or service buildings previously specified.

The can manufacturing, imported plate, encompasses an area of approximately 40 ft. by 50 ft. The major can manufacturing equipment is that of M.A.I.E.R., Parma, Italy, including can end makers, slitters, body formers, soldering rolls, flangers and seamers. No conventional air pressure can testers were installed. No. 1 Tall and $2\frac{1}{2}$ size cans are to be the principal cans manufactured. The can making facility had not at the time of the visit been put into operation, and a technician from Italy was expected momentarily to complete the assemblage and put the equipment into operating line condition. The can making facilities could only be classified as slow speed.

The package oil-fired boiler has a rated steam capacity of 2300 kilograms per hour and each of the three Rade Koncar diesel generators has the specifications of 1500 r.p.m.-120 KVA.

The source of the water for operations is obtained from the river Densu, with filtration and purification facilities at the plant. Waste water is conveyed to an area near the plant where leaching and gravitation are the means of waste water disposal.

Several important factors in existence must be considered in evaluating the feasibility of investment in respect to this plant. Although agricultural considerations are covered as another section

of this report, those discussed here are considered of major importance.

1. Although the State Farms Corporation operates 405 acres of pineapple (Smooth Cayenne and Sugar Loaf varieties) adjacent to Nsawam, the major pineapple growing ranges from 70 to 140 miles coastal and westward from the present factory site.
2. Cost of raw product at the moment is closely equivalent to $36.00 (U.S.) per ton for pineapple at the field without transport charges. Transport charges, an expensive item, are detailed elsewhere in the report (pages 48 and 49).
3. Yields of three to eight tons per acre are presently reported, which are considerably below the pineapple yields in the major production areas of the world.
4. Observations of the pineapple production area adjacent to Nsawam and elsewhere indicate the requirement of supplemental irrigation as evidenced by the resorting to sectioning of Cayenne to obtain propagating materials. As rivers are the only source of water, this type of irrigation would be costly because of the rolling topography, the pumping expense and the necessity for installation of overhead sprinkler irrigation systems.
5. The major world pineapple trade, except in instances of very preferential duty treatment eliminating competition from major producing areas (not enjoyed by Ghana), has been built on a Brix-acid ratio and a

quality of fruit quite different from that grown in Ghana. From a review of Ghanaian growing conditions, indications are that Ghana cannot grow a pineapple of inherent characteristics suitable to the established world canned pineapple trade, irrespective of the quality handicap that would be additionally added through use of the equipment provided.

6. Ghanaian consumption of local pineapple products, juices and slices or pieces, amounts to 114 tons of processed products in 1966 as against one ton imported. Imports are now prohibited on pineapple.[6/, 7/]

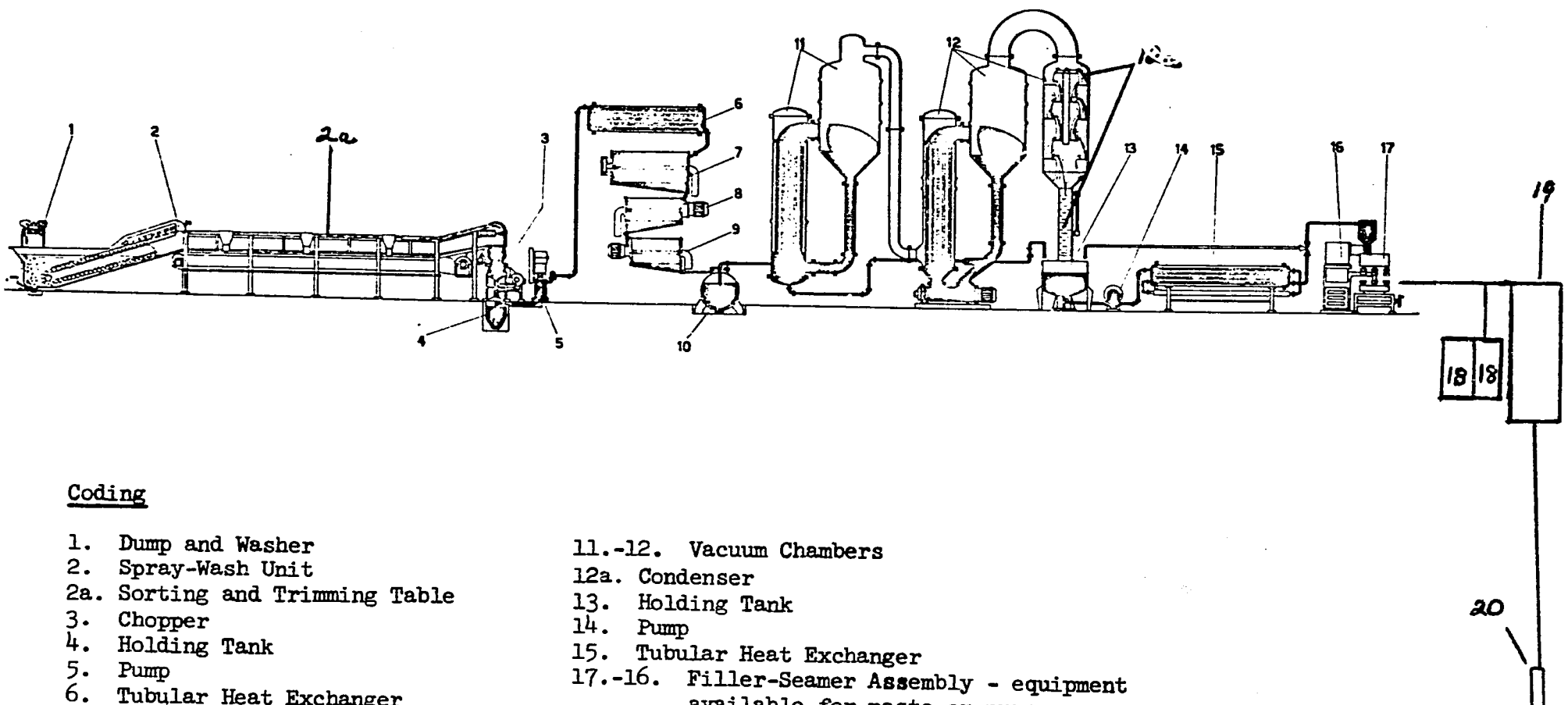
7. Fresh pineapple is a popular item of consumption in Ghana and the price relationship between fresh and preserved pineapple does not favor the consumption of processed pineapple products in Ghana.[6/] The Ghanaian pineapple is an excellent product for fresh consumption, and the marketing and distribution systems for such should receive attention toward the expansion of same.

Pwalagu - Tomato Plant

This plant is located at Pwalagu, approximately 490 miles north of Accra in the Upper Region. The plant is reportedly designed to have a capacity for processing 15,000-16,000 tons of raw product tomatoes into paste on a reported length of season of 150 days.[2/, 6/] The basics of the agreement for factory construction and building units comprising the factory complex have been described previously.

Operating 24 hours a day, the designated "AC100" concentrate line has a reported capacity of 100 tons of raw product per day in the conversion to 28/30% paste based on a 5% dry matter composition of the raw product.[2/, 8/] The flow plan of the tomato concentrate line incorporating the use of two double effect vacuum evaporators for continuous concentrate production follows.

Flow Plan - Tomato Concentrate Line - Pwalagu Plant



Coding

1. Dump and Washer
2. Spray-Wash Unit
2a. Sorting and Trimming Table
3. Chopper
4. Holding Tank
5. Pump
6. Tubular Heat Exchanger
7. Finisher - 1st Unit
8. Finisher - 2nd Unit
9. Finisher - 3rd Unit
10. Holding Tank

11.-12. Vacuum Chambers
12a. Condenser
13. Holding Tank
14. Pump
15. Tubular Heat Exchanger
17.-16. Filler-Seamer Assembly - equipment available for paste or puree
18. Two 3-Cart Horizontal Retorts
19. Cooling Canal
20. Labeler

The building complex consists of:

1. Main processing building,
2. Boiler and power house,
3. Employee locker and change room,
4. Cafeteria,
5. Gatehouse and weigh station,
6. Office,
7. Garage and shop,
8. Water filter and treatment,
9. 300,000 gallon water resevoir,
10. Clear water well and pump house.

The fresh water well has a capacity of 2,500 gallons per hour. The White Volta River system is the source of another 13,000 gallons per hour pumping capacity to the plant.

The main processing building is approximately 135 ft. by 150 ft. The can manufacturing facility is composed of two simple lines: slitters, body formers, soldering rolls, flangers and seamer. One end making machine is also installed. The can making facility is housed in an area 40 ft. by 60 ft. approximate. Can making equipment was of FMI, Napoli, Italy origin. Two can sizes of $2\frac{1}{2}$ and 4 oz. are contemplated. No conventional can testing equipment facilities were observed. These are slow speed lines.

Service lines of steam, water and electricity were designed into the plant as described for Nsawam.

A single oil-fired package boiler of 3,000 kilos of steam capacity per hour was provided as a source of steam. The boiler was of Yugoslav manufacture, Durodakovic-Steambloc, equipped with

Minneapolis-Honeywell controls--the same design as used in all three plant locations. Two boiler fuel oil tanks with 15,000 gallon capacity of fuel are also installed.

Three Gonz diesel generators of 200KVA rating were installed to provide electricity for the plant operation.

Notwithstanding the overbuilding of buildings satellite to the main processing building, the tomato concentrate line appears to be of good functional design and installation.

Comments as to the consideration of the inter-relationships of agricultural and horticultural production, markets and plant operations as related to the evaluation of an economically successful plant operation at Pwalagu follow:

1. Basic cereal agricultural production in the area is carried out on a small plot scale and technical knowledge and methods used in this general production are extremely rudimentary.
2. The plant was built on assumptions without having run the basic horticultural research trials necessary to develop (a) variety adaptability and yield potential; (b) disease problems, nematode and soil fumigation relationships; (c) fertility requirements; (d) planting schedules required throughout a planting season to supply the plant for 150 days; (e) percentage of total crop delivery per week to determine "peaking" correlated with plant capacity; (f) irrigation requirements; (g) fungicide spray materials and application requirements; (h) relationship of plants grown during rainy season to disease control and ultimate yield; and (i) production costs.

3. Growers' yields are forecast at five tons per acre. Production problems exist, with the serious problems observed of fusarium root rot, viruses, bacterial wilt, nematodes, and blossom-set.

4. Because of the small plot nature of production, a tremendous number of growers over a wide radius is required to furnish tomatoes to the plant. In contemplation of the plant running in 1968, a minimum of 1,500 acres were reported under cultivation involving 5,000 growers. The task and cost of administering this number of growers over this widespread area, controlling quality of deliveries and hauling the product to the factory are enormous.

5. It is reported that the total Ghanaian consumption combined of finished processed tomato products in 1966 was 1,257 metric tons, 29 tons produced locally and 1,228 tons imported.[6/, 7/] To satisfy this demand from local production, assuming a 5% total dry matter of Ghanaian grown tomatoes and if all the above were a 28% paste (which it would not be since juice, puree and catsup of lesser tomato concentration are involved), this would require 7,039 net tons of raw product. To operate both the Pwalagu and Wenchi tomato plants to capacity, a world market outlet would be required.

6. Ghana would be at a decided economic and quality disadvantage competing on the world market against a

considerable number of countries supplying world markets. For example, Spain and Portugal, both important suppliers, provide a quality product from tomatoes for which the grower is paid approximately $20.00 per ton. Portugal, in addition, has the same advantage as Ghana of duty-free entry into the U.K. for paste containing over 25% dry matter.

7. Present price structure set to be paid to Ghanaian growers equates to the approximate equivalent of $60 (U.S.) per ton at the farm--hauling cost a factory expense.
8. Because of production conditions existing in Ghana, the problems inherent in producing a quality tomato product are considerable if not overwhelming.
9. Since Pwalagu is located a distance of approximately 490 miles from Accra, materials from southern Ghana will have to be shipped by transport freight at considerable cost to and from the plant. Railroad transport extends only one quarter the distance of Ghana north from the coastal region, terminating at Kumasi in the Ashanti Region.

The motor transport freight rates in existence in Ghana during February 1968 as given by the State Transportation Schedule are as follows:

1. Cartage, 0-15 tons for the first 100 miles - 6.5 pesewas/ton/mile; thereafter 6.0 new pesewas/ton/mile.
2. Cartage, within a radius of 25 miles:
   a. 3 ton vehicle - goods and traffic of all kinds - new Cedi $11.00/trip or day hire, whichever is applicable.

b. 5-15 ton vehicle - new Cedi $2.00 to $3.00/ton, depending on goods to be carried and load availability.

c. Tariff for 3 tons long haul under conditions not applicable to above:

i. Outward journey - miles x 30 new pesewas

ii. Return journey - miles x 15 new pesewas.

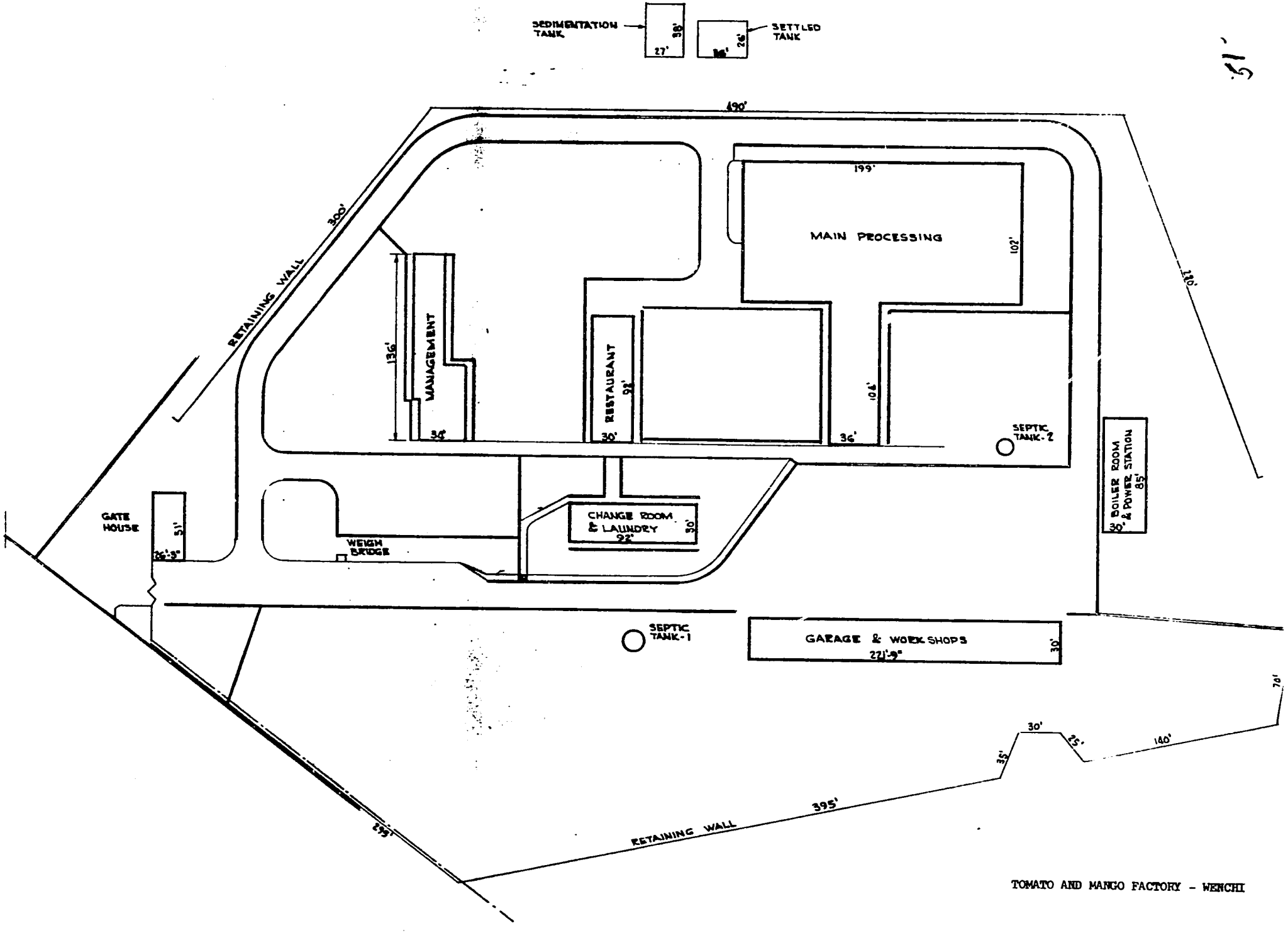
3. In addition there is a driver night allowance of 90 new pesewas per night.

On the basis of a 490 mile haul in category 1, the motor freight charge from Accra to Pwalagu would cost, allowing two night allowances, approximately $31.70 U. S. currency per ton. Further information indicated that rates may be negotiated with independent truckers at a rate at least 20% lower, equating to the approximate cost of $25.36 (U.S.) per ton. Hauling the finished product back to the heavier populated coastal area would impact additional costs.

Wenchi - Tomato and Mango Processing Plant

The plant located at Wenchi is about 260 miles from Accra in the Brong-Ahafo Region. The factory was designed on the premise of a processing period of 150 working days for tomatoes and 100 working days for mangoes, with a stated capacity of 7,650 tons of tomato raw product, working in three shifts, starting in July and ending in December. Four thousand tons of raw mango is the stated capacity, starting in March and ending in June.[3/]

This plant has essentially the same complex of buildings as described for the previous two plants. A plot plan of the buildings follows.



TOMATO AND MANGO FACTORY - WENCHI

The flow plan for the Wenchi plant is identical to that shown for the tomato concentrate and puree line at Pwalagu except the installation of the two double effect continuous vacuum evaporators is designated "AC50", meaning that on a 24-hour basis the equipment has a reported design to concentrate 50 tons of tomatoes to a 28/30% solids paste product.[8/] In addition, coming off at the chopper there is a by-pass to a pulper-finisher for tomato juice extraction and three juice mixing and blending kettles and related filling and seaming equipment. From this equipment layout, this same equipment in undoubtedly intended to be utilized in the mango juice and cream (puree) processing.

An artesian well of 7,000 gallons per hour is in existence with the added availability of 12,000 gallons per hour (from the Subin River) with its related settling and water treatment and a 65,000 gallon storage resevoir. In addition, a supply of water is available from the town's 200,000 gallon storage.

The boiler is a package boiler of 2,300 kg. steam capacity per hour. Three Rade Koncar diesel generators of 120 KVA spec. each provide the electricity to the plant.

Can making equipment as previously detailed for the other two plants is housed in an area of approximately 40 ft. by 60 ft., most of which is M.A.I.E.R., Parma origin. Can sizes to be utilized were reported as 8 oz., 16 oz., 32 oz. and No. 10. This equipment represents slow speed potential.

Tomatoes have not been grown commercially in the Wenchi area but at the time of the visit 3,434 growers had indicated an interest in growing tomatoes at a price equating to approximately

$60.00 (U.S.) per ton f.o.b. farm, with hauling at factory costs. The growers were located in a radius of 70 miles from the plant at Wenchi.

The considerations as to tomato operacions have been previously covered and the comments made pertaining to Pwalagu are also applicable here. However, A.I.D. agricultural experts predicted a lower yield potential for this area compared to Pwalagu.

International trade in processed mango is an extremely small item and a new item to Ghana. Established mango plantations are not presently found in Ghana and the scattered production is of types not commercially suited to canning, being small and very fibrous.

GHANA

INVESTMENT OPPORTUNITIES IN FOOD CANNING INDUSTRIES

A PRELIMINARY SURVEY

FOOD CANNING AND RELATED AGRICULTURAL PRODUCTION

SUMMARY

The Ghanaian fruit and vegetable processing industry has come into being in very recent years. The first of such operations started on a small scale about twenty years ago. The major capacity for processing, involving pineapple, tomatoes and mangoes, is possessed by the soon to be completed canneries owned by the Ghanaian government's State Cannery Corporation. These factories were initiated and brought to a major state of completion by the previous Ghanaian government administration. These factories are three in number--one located at Nsawam, Eastern Region, for pineapple processing; one located at Wenchi, Brong-Ahafo Region, for tomato and mango processing; and one located at Pwalagu, Northern Region, for tomato processing.

The principal problems confronting the economic success of operating these canneries with their related raw product production are:

1. The great distances from the plants involved in procurement of raw product and the hauling costs which are to be assumed by the plant;
2. The small acreages per grower in respect to tomatoes and the great number of growers which will be necessary to furnish raw product to the plant;

3. The inherent and operational handicaps and expense to maintain deliveries of quality raw products;
4. The expense and problems in developing a more sophisticated horticultural production in contrast to the present status of general agricultural development;
5. The handicap of having to initiate a plant operation without the assistance of prior related agricultural and horticultural research specific to a processing plant operation;
6. The high cost of raw product;
7. The rainfall patterns in production areas which necessitate supplemental irrigation and related costs for increasing raw product yields;
8. The existing soil variability and soil types. Acreages of prime agricultural land do not exist in large contiguous parcels;
9. The limited domestic consumption in comparison to the capacities for processing the above items and the added limitation of expansion of the domestic market because of the high production cost of the processed products;
10. The competitive limitations for entry into the world market based on cost of product and quality considerations.

RECOMMENDATION

As a result of the findings as outlined above, we would at this time have no further interest in progressing beyond this preliminary survey in Ghana into the investment feasibility aspects of canning and its related raw product production.

EXHIBIT I

Structure of the Ghanaian Fruit and Vegetable Processing Industry - 1966

Factory	Ownership	Output in 1966 (metric tons)	Assortment (Main Products)
A	Government	214	Tomato products (puree, juice, ketchup, whole tinned), citrus products (juice, marmalade), pineapple products (jam, juice)
B	Private	76	Tomato, citrus, pineapple products
C	Private	34	Citrus products (squash, marmalade)
D	Private	13	Citrus products (squash)
Others	Private	13 1/	Citrus products (squash)
	Total:	350	

1/ Estimated

Reference Source (6) and (7)

Ghana Consumption of Processed Tomato, Citrus and Pineapple Products of Local and Foreign Origin in 1966 (in metric tons)

Products	Locally Produced	Imported	Total
Tomato Products	29	1228	1257
Citrus Products	110	125	235
Pineapple Products	114	1	115
Total:	253	1354	1607

Reference Source (6) and (7)

Utilized, Existing and Nearly Completed Capacities in Ghana Fruit and Vegetable Canning

Output 1966	350 tons
Existing Capacity 1966 1/	2,000 tons
Capacity Completed by 1968 1/	14,100 tons 2/

Reference Source (7)

1/ The capacity has been estimated under assumption of a two shift operation in season.

2/ The planned capacity will be distributed as follows: 6,800 tons pineapple products; 3,600 tons mango products; 3,700 tons tomato puree.

GHANA

AGRICULTURE AS RELATED TO INVESTMENT OPPORTUNITIES IN FOOD CANNING INDUSTRIES

A PRELIMINARY SURVEY

I. SOILS

Soils in General

"The soil comes first. It is the basis, the foundation of farming. Without it nothing; with poor soil, poor farming, poor living; with good soil, good farming and living. An understanding of good farming begins with an understanding of the soil." This quotation from Professor Henry L. Ahlgren of the University of Wisconsin is prominently displayed in the Soils Section of the Ghana Academy of Science at Kwadaso. It is as true today as it was when it was written in 1948. It must be understood, however, that good soil does not automatically confer success upon an agricultural venture. Productive, efficient agriculture requires in addition to good soil, a good water supply, good climate, good management, and good markets for the produce.

Soil formation is a complicated process involving the action of climate, topography, and organisms (including vegetation and man) on parent material over differing periods of time. In Ghana, soil formation is dominated by the interacting influence of climate and vegetation. Most of Ghana can be divided into two zones--the forest zone of the southwest and the Volta basin extending through the northern savannah. A separate, small zone is formed by

the Accra and Ho-Keta plains in the southeast corner of the country where the Volta river enters the ocean. North and west of the Volta basin is another small area only slightly different than the Volta basin. It is underlain by igneous rock rather than the Voltaian sandstones and shales. The topography is similar to the Volta basin but there are more hills and gullies.

The soils of the forest zone are heavily leached but contain considerably more organic matter in the surface horizon than do the soils of the other regions. Drainage is best near the tops of the numerous rolling hills and becomes a limiting factor towards the bottom of the slopes. The alluvial soils of the river bottoms in the forest zone are poorly drained and can be considered only for limited agriculture. The soils are acid throughout. Intensive farming in this zone must guard against the loss of organic matter and erosion once the forest cover is removed. Intermediate depth soils support better tree growth than do deeper soils because the leached soil cannot supply sufficient nutrients when roots are unable to reach the nutrient supply of decomposing parent rock.

The soils of the interior savannah, covering two-thirds of Ghana, are much lower in organic matter than the forest zone soils. This is due in part to the amount of rainfall, but primarily to its distribution. Northward through the savannah the two-peak rainy season weakens to a one-peak season resulting in a wet period and a long dry season. The long dry season results in open grassland with only scattered tree and brush growth. The limited organic matter content renders these soils less able to retain nutrients against the leaching action of the seasonal rains. The leaching and deposition of iron hydroxide has resulted in the formation of

iron pans that greatly restrict drainage in much of the northern region. These soils are generally waterlogged during the rainy season but lateral flow is usually good. When erosion removes the surface soil, the iron saturated layers harden to a rocklike structure. These groundwater laterites have little agricultural value. The better soils of the savannah area are those in the transition between the forest zone and the savannah, and the alluvial soils of the smaller streams.

Control of flood waters is essential to the expansion of agricultural soils. The alluvial soils of the larger streams are little used now because of the danger of flooding and human diseases such as river blindness and sleeping sickness.

The soils of the northwest region have never been studied extensively although brief studies indicate extensive ironpan formation. There are also indications of loamy brown friable soils on some of the steeper hills with similar more clayey soils in the valleys. These valley soils contain carbonates in the subsoil. With mechanized cultivation and additions of nitrogran and phosphorus these soils would offer good potential for grain production.

The soils of Accra and Ho-Keta plains have been studied in considerable detail. This is especially true of the soils capable of irrigation along the lower Volta. The better soils are the old terrace soils consisting of neutral sands over slightly acid sandy clays, the Tropical Black Earths consisting of heavy slightly alkaline black clays, and some of the Acid Gleisols of the Volta alluvium. There are some very poor claypan and hardpan soils closely associated with the better soils, and careful soil mapping will be necessary before intensive agriculture is undertaken.

Soil Fertility and Nutrition

The soils of Ghana are generally depleted of nutrients. Most of the clay is of the kaolinitic type which has a lower nutrient holding capacity than does montmorillonite clay. Organic matter, the other major nutrient holding reservoir of the soil, is low in all but the forest zone soils. Organic matter is quickly depleted under intensive agriculture even in the forest zone.

Nitrogen and phosphorus are the major nutrient deficiencies of Ghanaian soils. The need for potassium is variable. Potassium response increases with the length of time a soil is cropped, and more deficiencies are likely to be found. Lime is needed in the heavily leached areas. A sulfur response has been found on peanuts in the savannah soils. Due to the generally low nutrient status of the soils, care must be taken that additions of one nutrient do not accentuate the borderline deficiency of another.

Relatively little commercial fertilizer is used in Ghana. Minimal fertility is maintained by crop rotation, fallowing for several years, and the burning off of natural vegetation. Any intensification of the existing agriculture must guard against causing nutrient imbalance, depletion of organic matter, and soil erosion. Native farmers have reached a satisfactory compromise with their environment. Potential for improvement is great, but serious hazards exist for agronomic changes that do not take into account the unique features of the soil and climate of Ghana.

Soils of Specific Areas

Nsawam

The town of Nsawam is about twenty-five miles north of Accra. The surrounding area consists of gently rolling hills with

vegetation ranging from dense coastal thicket to moist semi-deciduous forest. Rainfall varies from 40 to 55 inches in a two-peak season.

The soils of the upper and middle slope are moderately well drained sandy loams to sandy clays over mottled sandy clays to light clays. Soil acidity increases with depth. The surface soil pH ranges from 5.5 to 6.5 and the subsoil pH varies from 5.0 to 6.0. Occasional areas have pH values below 5.0. These soils are represented by the Boamang, Kumasi, Bawjiase and Adawso series.

The soils of the lower slope are less well drained. They consist of sandy loams to sandy clays over coarse sands to sandy light clays. The surface soil pH ranges from 6.0 to 7.0. The subsoil pH ranges from 5.0 to 6.0. These soils are represented by Nta, Ofin, Opimo and Akroso.

The levee soils at the edge of the river are represented by the Chichiwere series. The soil is extremely sandy and subject to flooding.

The alluvial soils of the river bottom are poorly drained heavy, grey clays. These soils are so poorly drained that corn and cassava grow with great difficulty. Soils in these areas have little agricultural value. These soils are represented by the Densu and the Nyantina series.

The better soils for the production of pineapple are the Adawso, Bawjiase, Opimo, Akroso and Nta series. Nta is fairly sandy and may be droughty. The soils of upper slopes and hill tops tend to be shallow although this varies from area to area.

Much of the pineapple for the Nsawam cannery is produced 80 to 90 miles away near Cape Coast. Detailed soil surveys of the area were not available, but visual appearance of the soil and

similar rainfall and topography indicate similar soil types. Pineapple appears to be grown exclusively on the slopes indicating that the bottom land is poorly drained. Good drainage is essential for pineapple production.

Wenchi

The town of Wenchi is about 90 miles northwest of Kumasi at an elevation of about 1,100 feet. It is on the edge of the forest zone with the production area in both forest and transitional soils. The topography is moderately undulating with good drainage except in the stream beds. Crops produced in the area include cocoa, bananas, rice, tobacco, mango, tomatoes, kola and general food crops.

The better soils in the area are the Damongo and Murugu series. These soils are formed on the middle and lower slopes on colluvial material. Damongo is a deep, red, well drained sandy loam over a sandy clay subsoil. It has a surface pH of 6.0 decreasing to 5.0 in the subsoil, then increasing to about 5.5 over the parent material. These soils are low in nitrogen and phosphorus. The Murugu soils are deep, moderately well drained, grey to yellow brown sandy loams over brown, sandy clay. The pH is 5.6 at the surface and decreases to 4.6 with depth. Internal drainage is slower than the Damongo soils.

Soils less suited to intensive agriculture are the Tampu, Tanoso, Chichiwere, Wenchi and Techiman series. The Tampu soils have formed from colluvial material in drainage ways. They are clayey and are usually waterlogged during the rainy season. The Tanoso and Chichiwere occur in the flat floodplain. Tanoso is a very fine sandy loam over a greyish yellow sandy clay with

occasional silty layers. The pH ranges from 5.0 at the surface to 4.6 in the subsoil. It is a permeable soil, but waterlogged during the rainy season. Chichiwere is an alluvial fine sandy loam over fine sand. The pH ranges from 4.6 to 4.8. These soils are too sandy for agriculture in this area.

The Wenchi and Techiman soils have little agricultural capability. They occur on the higher ground and are shallow, ironpan soils. They are poorly drained and range in pH from 5.0 to 6.2. The Wenchi series has less than 12" of soil over the ironpan. The Techiman series is deeper and has slightly better drainage. It could be farmed, but it is not recommended.

Pwalagu

The cannery at Pwalagu is located about 85 miles north of Tamale and 15 miles south of Bolgatanga. The immediate vicinity of the cannery is hilly with rock outcrops and sparse brush, but the surrounding area is flat to gently rolling grassland with scattered trees. Rainfall varies from 30 to 40 inches in a one-peak season. The proposed production area for the cannery is north of Pwalagu through Bolgatanga and Navrongo to the Upper Volta border. Another production area is northeast of Pwalagu around Bawku. Numerous small earth fill dams have been built on the smaller tributary streams. The water stored behind these dams is primarily for the villages and cattle, but a small portion could be used for irrigation. The limited irrigation water has confined the tomato production to the alluvial soils of the river bottom. At the present time work is progressing on the Vea dam which will have the capacity to irrigate approximately 3,500 acres.

Siare, Dagare, Pani and Kunkwa are the major alluvial soil series. Siare-Dagare complex of soils are moderately well-drained, brown sandy loam soils over a yellow brown clay loam. The surface soil pH ranges from 5.5 to 7.0 with little change in pH with depth. These soils can be quite good, but variations in texture and drainage exist. The Kunkwa series is a sandy clay over a sandy clay loam. Drainage of this soil is marginal. The Pani soil is a dense black clay that is poorly drained and not suited to tomato production. The sandy levee alluvial soils are represented by the Sirru series.

Much of the level to gently rolling soils surrounding the river alluvium are poorly drained ground water laterites (ironpan soils) not suitable for intensive agriculture. The better drained savannah Ochrosols occur on the tops of the gently rolling hills. Although these Ochrosols are better suited to intensive agriculture, irrigation water would have to be pumped from as-yet-to-be-constructed irrigation systems to the tops of the hills. Except for a limited expansion of agriculture in the alluvial soils, little intensification of agriculture can be expected without a carefully planned scheme of irrigation water distribution and flood control.

An FAO team has made a preliminary survey of the Upper and Northern Regions. (Land and Water Survey of the Upper and Northern Regions, Ghana Vol. 1, Oct. 1962 to Nov. 1966.) Five areas of this vast area were selected for semi-detailed study. The Bolgatanga area was studied along with the Tono, Tamne, Lamassa and Mpaha areas. The soils were grouped into six land use classes according to suitability for cultivation. Class I, II and III are suitable for cultivation and irrigation or dry farming in decreasing order of suitability. Class IV has limited agricultural suitability and Class V and VI should only be used for pasture or forest. The

classes are further qualified by the letter grades S for texture or depth, W for wetness or drainage, and Cn for excess concretions (ironpan). The area in square miles of each soil class is presented in Table 1.

Table 1
Northern and Upper Regions,
Main Soil Types - Areas and Land Capability Class

Soil Description	Area, Sq.Miles	Capability Class
1. Alluvial soils, seasonally wet	7,000	IIS, W, III
2. Concretionary soils, seasonally wet, shallow	6,000	VCn, VI
3. Concretionary soils, moderate drainage	2,700	IVCn, V
4. Moderately well-drained, light textured, deep non-concretionary soils	3,500	I-II
5. Light textured soil with deep concretionary subsoil	2,000	III
6. Moderately well-drained soils, 3-5 feet deep over granites	2,000	II-III
7. Moderately well-drained, concretionary soils, 3-5 feet deep over granites	6,500	IVCn
8. Moderately well-drained stoney soils, 2-3 feet deep	3,000	IVS
9. Shallow ironpan soils	2,500	VI
10. Rocky, shallow, eroded soils	2,600	VI
Total suitable for cultivation	14,500	
Total of limited suitability	9,500	
Total unsuitable for cultivation	13,800	

The semi-detailed surveys of the five areas indicate that there is no Class I soil without problems of development due to

their position on the higher slopes. The best possibility for expansion of the existing agriculture lies in the alluvial soils because of the existing small dams and the relative ease of irrigation. Full utilization of the alluvial soils will require intensive flood control. Development of the Class II and III soils outside of the river alluvium will require an extensive canal system. The semi-detailed survey of the Bolgatanga area indicates only 1,500 acres suitable for irrigation; about half the acreage is alluvial.

Accra-Ho-Keta Plains

A line drawn from Accra to Ho and then to Keta and back to Accra forms a triangle that covers the southeast corner of Ghana and encloses the Accra and Ho-Keta plains. The topography is flat to gently undulating with a few rolling terraces and an occasional small, steep, ricky hill. The area is crossed with semi-permanent streams and overflow channels. Drainage ponds and lagoons occur near the coast and along the lower reaches of the river. Natural vegetation in the alluvial river soils consists of dense tall grasses and reeds. The natural vegetation away from the river is open, short grass savannah with few trees except along the waterways. North and east of the Volta towards Ho the vegetation is more typically brushy. Annual rainfall varies from 30 inches near the coast to 45 inches in the north in a two-peak season.

A detailed soil survey (Report on Survey of the Lower Volta River Flood Plain, Vol. II, FAO 1963) has been completed of the easily irrigable area along the Volta river. The soils have been divided into four main groups: primary soils, recent alluvial soils, old alluvial terrace soils, and claypan soils. The different soils within each group have to be classified according to their

suitability for irrigation. Class I, II and III soils have decreasing suitability for irrigation. Class IV is not suitable for irrigation except under special conditions. Class V is not suitable for irrigation at present, and Class VI is permanently unsuitable for irrigation. The classes have been further modified by the letters s, t, and w indicating soil, topographic and drainage or flooding limitations.

The primary soils are represented by the Akuse, Prampram and Kloyo series. The surface soils are black clay loams to clays that develop a coarse prismatic structure. Surface soil pH ranges from 6.5 to 7.0. The subsoil increases in clay content, is usually lighter in color (grey to olive brown), and develops a blocky structure. Subsoil pH ranges from 7.0 to 8.0. The Akuse series is more than 30 inches deep, the Prampram series is 12 to 30 inches deep, and the Kloyo series is less than 12 inches deep. The internal drainage is poor. Some of these soils should be suitable for the production of rice and to a lesser extent sugar cane. The deeper, better drained soils of this group are Class IIs, IIw, and IIIw. The shallow, rocky soils are Class IVs.

The recent alluvial soils are represented by the Chichiwere, Hake, Amo, Lupu and one unnamed series.

The Chichiwere soils are deep, well drained, light textured soils developed on the upper portion of natural levees. In some locations, Chichiwere may be too sandy for farming, but in the Volta flood plain it is Class I soil. Soil reaction ranges between pH 5.0 and 6.0. Many food crops are grown on this soil.

The Hake series is a heavier textured, less well drained version of the Chichiwere series. Occasional flooding slightly restricts the value of the soil. It is classed as IIw.

The Amo soils are deep, poorly drained, acid clay soils that are frequently flooded. Amo soils are Class IIIw or Class Vw depending upon the frequency of flooding.

The Lupu soils are extremely heavy, poorly drained soils forming on colluvial material from the Tropical Black Clays. The surface soil is neutral to slightly acid and the subsoil is alkaline. Depending on the frequency of flooding, these soils are Class IIIw or Vw.

The unnamed series is a dark, grey brown, neutral, clay loam that is reasonably well drained. The surface soil is neutral to slightly alkaline. The subsoil has more clay and is usually calcareous. These limited soils are Class I.

The old terrace soils are represented by the Aveime and Zipa series. The Aveime soils are deep well drained sandy loams. Clay content increases with depth to a clay loam. The subsoil has a characteristic strong red color. The soil reaction varies from place to place, but the surface is usually neutral and the subsoil usually strongly acid (pH 5.0). Aveime soils are Class I.

The Zipa soils are similar to the Aveime soils but are more clayey and less well drained. The soil reaction is variable, but generally is slightly acid in the surface and strongly acid in the subsoil. Depending on drainage, these soils are classed IIs, IIw, or IIIw.

The claypan soils are represented by the Agawtaw series. This series has a dark grey brown, light textured surface soil over a limey dense claypan subsoil at six to twelve inches. There are often saline conditions in the deeper layers. This soil is Class IVs.

The Class I soils are extremely limited, but there is wide expanse of Class II and III soils. The acreage breakdown for the first survey and the additional land covered by the second survey is shown in Table 2.

Table 2
Acreage of Each Soil Class, Phase I & Phase II Surveys

First Survey			Second Survey		
Class	Acres	Percent	Class	Acres	Percent
I	2,960	4.4%	I-IIw	3,514	8.4%
IIs	17,170	25.6	IIs	46	.1
IIw	5,580	8.3	IIs-IIw	5,036	12.1
IIst	6,090	9.1	IIw-IIIw	1,744	4.2
IIsw	4,710	7.0	IIIw	4,108	9.9
IIIw	8,010	12.0	IIIw-Vw	5,622	13.5
IVs	4,320	6.5	IIw-IVs	600	1.4
Vw	14,300	21.3	IVs	6,168	14.8
VIs	200	.3	Vw	13,312	31.9
Unclassified	3,690	5.5	V	14	--
	67,030	100.0%	Water	1,544	3.7
				41,708	100.0%

II. CLIMATE

The chief characteristics of the climate of Ghana are: 1) the relatively high temperatures occurring in all places throughout the year, 2) the great variation in the amount, duration, and seasonal distribution of rainfall from south to north, and 3) the tendency of two dry seasons to grow longer and more intense with distance from the ocean. Also of importance to agriculture is the day length which varies only slightly from twelve hours throughout the year and the annual sunlight-obscuring, dust laden, harmattan winds from the Sahara.

The temperature and rainfall statistics for each of the more important agricultural areas follow:

Pwalagu Cannery and Vicinity

This area has a five month dry season extending from November through March. It also has the warmest temperatures and the heaviest dust storms. As it is the farthest north, it has the greatest day length fluctuation with the longest days approximately 12-3/4 hours in June. The statistics from Navrongo and Tamale, shown in Table 3, best typify the Northern and Upper Regions.

Table 3
Average Monthly Maximum and Minimum Temperatures and Average Monthly Rainfall, Navrongo and Tamale

	Navrongo		Tamale		Rainfall, Inches	
	Ave.Max	Ave.Min.	Ave.Max.	Ave.Min.	Navrongo	Tamale
Jan.	96°F.	67°F.	96°F.	63°F.	0.0"	0.1"
Feb.	99	72	99	66	0.1	0.1
March	102	76	99	70	1.3	2.1
April	101	78	97	70	1.5	2.7
May	97	77	92	69	4.1	4.1
June	91	74	88	68	5.2	5.6
July	87	72	85	68	8.6	5.3
Aug.	85	72	84	68	9.9	7.7
Sept.	87	71	86	68	9.7	8.9
Oct.	92	71	90	68	2.3	3.9
Nov.	97	68	94	66	0.3	0.4
Dec.	95	65	95	62	0.1	0.2
					43.0	41.0

Wenchi Cannery and Vicinity

Wenchi is on the edge of the equatorial zone with two rainfall peaks. The main dry season occurs from mid-November to late March, but there is a wide variation from year to year. Wenchi temperature and rainfall data are presented in Table 4.

Table 4
Average Monthly Maximum and Minimum Temperatures and Average Monthly Rainfall, Wenchi

	Ave. Max.	Ave. Min.	Average Rainfall Inches
January	91°F.	68°F.	0.27"
February	91	70	1.77
March	90	71	3.40
April	89	71	5.71
May	88	70	6.97
June	83	70	8.29
July	81	69	3.72
August	81	68	2.61
September	83	69	7.90
October	85	69	8.96
November	87	69	3.21
December	87	68	0.67
			53.48

Nsawam Cannery and Cape Coast

The Nsawam area has a two-peak rainy season totaling 35-40 inches annually. There can be a fluctuation in rainfall from 25 to 50 inches per year. The December through February dry season is clearly marked. No temperature records from Nsawam were available, but the climatic data from Accra is representative. Nsawam temperatures and rainfall are slightly higher than those of Accra. Climatic data from Takoradi is similar to that of the Cape Coast pineapple area. These data are shown in Table 5.

Table 5

Average Monthly Maximum and Minimum Temperatures and Average Monthly Rainfall, Accra and Takoradi

	Accra		Takoradi		Ave. Rainfall, Inches	
	Ave.Max.	Ave.Min.	Ave.Max.	Ave.Min.	Accra	Takoradi
Jan.	87°F.	73°F.	87°F.	71°F.	0.6"	1.3"
Feb.	88	75	88	73	1.3	1.0
March	88	76	89	74	2.2	3.1
April	88	76	88	74	3.2	4.3
May	87	75	86	74	5.6	10.9
June	84	74	83	73	7.0	9.8
July	81	73	81	71	1.8	3.3
Aug.	80	71	80	70	0.6	1.6
Sept.	81	73	81	71	1.4	1.9
Oct.	85	74	84	72	2.5	5.0
Nov.	87	75	86	72	1.4	2.5
Dec.	88	75	87	72	0.9	1.8
					28.5	46.5

Accra Plains

This area has a two-peak rainy season ranging from 33 inches per year in the southeast to 45 inches per year in the northwest. High temperatures and high humidity are a consistent feature of the climate throughout the year. Day length changes over the year only from 11-3/4 hours to 12-1/2 hours. The climate of the area is

illustrated by the temperature and rainfall data from Akuse and rainfall data from Ada presented in Table 6.

Table 6
Average Monthly Maximum and Minimum Temperatures and Average Monthly Rainfall, Akuse and Ada (Rainfall Only)

	Akuse		Average Rainfall Inches	
	Ave.Max.	Ave.Min.	Akuse	Ada
January	93°F.	70°F.	0.9"	0.2"
February	95	73	1.9	0.7
March	94	74	4.1	2.7
April	94	74	4.9	3.5
May	92	73	6.2	6.8
June	88	72	7.0	7.8
July	86	71	2.6	2.2
August	86	70	1.5	0.5
September	89	71	3.8	2.5
October	90	71	5.3	3.7
November	91	71	4.0	1.9
December	92	70	1.6	0.6
			43.8	33.1

All aspects of climate affect plant growth. Rainfall can supply the necessary irrigations, but it can also impede harvesting and cause disease. Day length can induce flowering or prevent it. The short days of the tropics offer less sunlight energy for photosynthesis than do the long summer days of the temperate latitudes. Temperature can affect fruit set and alter fruit quality. The uniformly warm temperature of the tropics does not provide an ideal environment for all crops. Tomatoes and pineapple, although tolerant of a wide range of climates, do best under specific conditions.

Tomatoes set fruit best when the temperature is between 59°F. and 72°F. The pigment responsible for the red color of tomatoes, lycopene, develops best at temperatures between 50°F. and 86°F. With the average monthly minimum temperature near the maximum

for fruit set each month, and the average monthly maximum often exceeding 86°F., fruit production and color development can be restricted. In addition, the warm, humid climate is conducive to numerous diseases of tomato. Supplemental irrigation will be necessary for maximum tomato production.

Pineapple is better adapted to the climate of Ghana, but there are some limitations. In uniformly warm climates the fruit is likely to be low in acid. This low acid fruit is a good fresh market fruit, but it does not make a first quality canned product. Warmer climates that produce low acid fruit are areas where Marbled Fruit and Pink diseases of pineapple are most prevalent. These diseases are only of major concern in processed fruit. Supplemental irrigation is recommended when monthly rainfall is less than two inches. Such conditions do occur in the pineapple growing area of Ghana.

Mango is well adapted to the climate of Ghana. It has a wide range of tolerance to both rainfall and temperature. Optimum growing temperatures are between 75°F. and 80°F. Although Mango grows under a wide range of rainfall conditions, it is important that rainfall be low during the bloom period (December-March in Ghana). These conditions are satisfied in the Wenchi area.

Citrus does best in a warm frost free climate, but different citrus varieties develop better quality at different temperatures within that frost free range. Lemons thrive in the cooler frost free coastal areas of California for example, but Navels do not produce well and Valencias produce low flavor fruit. In the hot dry interior valley of California, both Navels and Valencias produce very well. Certain grapefruit varieties grow very well in even

hotter desert regions. Limes also require a warm climate. In uniform, warm, tropical climates the sugar to acid ratio of most citrus is less suitable than in fluctuating temperatures. Limes and, to a slight extent, grapefruit are better adapted to the Ghanaian climate than other citrus.

III. DISEASES AND PESTS

A discussion of diseases and pests of Ghana must include those afflicting humans as well as plants and animals. Human diseases are said to restrict agriculture in certain areas. Irrigation dams and canal systems would alter the prevalence of certain diseases. Malaria, a major disease in Ghana, might be increased by extending water availability into the dry season through irrigation. Schistosomiasis (Bilharzia) is caused by a parasitic flatworm whose intermediate host is several species of fresh water snail. This disease is prevalent throughout Africa. The extension of a canal system could well extend this disease. Onchocerceasis (river blindness) restricts population and farming in many areas of northwest Ghana. It is transmitted by the bite of a common black gnat of Africa (Simulium damnosum Theob.). This insect must breed in swiftly flowing water; thus dams that cover river rapids with impounded water will reduce the incidence of this disease. Also of some importance are the diseases of Sleeping Sickness, spread by the tsetse fly, and Filariasis (Elephantiasis), caused by a nematode usually ingested in unfiltered drinking water.

The more prosaic diseases and pests of plants are of more immediate importance to an agricultural and cannery venture in Ghana. They are discussed below by crop.

Pineapple

The insects and diseases of pineapple in Ghana have not been thoroughly studied. Only Black Rot of fruit and roots (Ceratostomella paradoxa) and Leaf Blight (Sporidesmium bakeri Syd.)

are listed as diseases found on pineapple. No insect pests are listed. Potential diseases of pineapple in Ghana are Mealybug wilt, Yellow Spot (virus), Heart Rot, and Root Rot from Phytophthora cinnamoni, and Pythium rots. Fruit diseases could include Acetic spoilage, Glassy spoilage, Yeasty fermentation, Fruitlet-core rot, Marbled fruit, Thielaviopsis soft rot, Pink disease, and Cork spot. There are also numerous physiological disorders. The possible insect pests include fruit and stem borers, nematodes, mealy bugs, termites, scale and mites. Also, rats and other rodents could be a problem.

Tomato

Tomatoes are subject to a wide range of bacterial and fungal diseases. One of the more important is Bacterial Wilt (Pseudomonas solanacearum), but fruit rots, Early blight (Alternaria solani), and Fusarium and possibly Verticillium wilts are of concern. Also present are Cladosporium leaf mold, Septoria leaf spot, and a mosaic and curly leaf virus. Insect pests include a cutworm like white grub, numerous caterpillars, aphids, nematodes, and a group of large fruit sucking moths.

Mango

Numerous fungal and bacterial diseases of mango are recorded. Anthracnose is the most common fungal disease of mango. Also of concern in Ghana is Black-spot, Soft rot, Powdery mildew, and Sooty Blotch. There are no known virus diseases of mango. Mango insects include scale, fruit sucking moths, Red-banded thrips, termites, mites, and numerous caterpillars.

Citrus

Citrus diseases include Tresteza virus, gummosis, root rots, and citrus scab. Purple scale, shoot borer, and black citrus aphid are the major insect pests. Also present are the swallow tail caterpillar and the fruit sucking moths.

IV. ECONOMIC FACTORS

The economic factors involved in an agricultural venture determine the profitability and feasibility of the undertaking. Many of these factors can be accurately stated--freight rates, fertilizer costs, land rent, and insecticide costs. Other factors are less precise--labor rate, farm equipment costs, and interest rate. Still others can be determined with any accuracy only after long years of experience. In this latter group fall labor efficiency, land productive capacity, and disease or insect problems. Such uncertainty is inherent in any agricultural venture. The uncertainty is magnified when new lands and new crops are considered.

For comparative purposes, some known cost factors are listed and briefly compared to U. S. costs. Monetary calculations have been based upon an exchange rate of one new Cedi equal to $1.00 (since July 8, 1967).

Land tenure in Ghana is complex. The land is said to belong to numerous persons long dead, a few presently living, and untold thousands yet to come. At present, through arrangements with the tribal chiefs, land can be rented for $2 to $3 per acre per year. This tribal procedure grants only the ownership of the crop and not the land. The idea of a long term lease, and the cultivation of land for commercial agricultural production, based on annual rental payments, is an uncommon practice. In at least two recent instances, such long term arrangements have been broken after the first year of farming. A solution to this problem must be reached before private modern agricultural development can take

place. The Ghanaian government has appointed a six-man committee to study the land tenure problem.

Tractor costs were obtained from Ghana Plant Hire Ltd., a government company established to lease tractors, heavy equipment, and drivers. The charges include the operator, lubricants, grease, but not the diesel fuel. A complete list is presented in the exhibits, but a few basic items are presented here. A D4 bulldozer rents for $9.10 per hour, a D6 dozer and ripper rents for $14.95 per hour. Using an MF65 or Zeter 55 (Massey Ferguson 65 or Russian Zeter 55) tractor on heavy black clays, the following costs have been established: disc plowing $2/acre, deep plowing 10-12 inches $4/acre, harrowing $1/acre, and ridging and furrowing $3/hour. These latter rates are similar to those charged in the U. S., although they do not include fuel. The heavier equipment leasing is slightly more costly than U. S. leasing would be, and especially so when fuel cost is included.

The cost of fertilizer is subsidized by the government. The government price for 112 pounds of 15-15-15 at Bolgatanga is $3.00 in large lots, $4.00 in small lots. The price quoted by Shell Chemical Company in Accra is $6.97/112 pound bag of 15-15-15. The freight rate for fertilizer is $9 to $10/ton to Kumasi, $10 to $12/ton from Kumasi to Tamale, and $8 to $10/ton from Tamale to Bolgatanga. Although little fertilizer is presently used, a large scale commercial venture would require considerable quantities and it is doubtful that the government could continue to subsidize all fertilizer. The commercial cost of ammonium sulfate is about $95.00 per ton in Accra and $105.00 per ton in Kumasi. The commercial cost of single super phosphate (18 percent) is about $72.00

per ton in Accra and $82.00 in Kumasi. These prices are about twice those of the U. S. Additional fertilizer costs are presented in the exhibits.

Insecticides and weedkillers are available in Ghana from Shell Chemicals, Kingsway Chemists, Imperial Chemical Industries, Union Trading Company and Pestagbelor Ghana, Ltd. The relative cost of insecticides and weedkillers in Ghana, compared to U. S., California costs, varies considerably from item to item. Aldrin costs about the same as it does in California, Dieldrin costs less, DDT is slightly more expensive, and DD in considerably more expensive. Only Gamalin (gamma isomer of BHC) is subsidized by the government. Gamalin is used for the control of the Cocoa Capsid. By and large, insecticide costs will not differ materially from those in California. California costs are slightly higher than most other U. S. locations.

Ghanaian government freight rates are presented in the cannery phase of this report.

Labor costs in Ghana are relatively low. Cultivating and weeding, usually done by women and children, costs about $19.00 per month. The common labor rate is 75 to 80 cents per eight-hour day. There is usually a 48-hour work week. Semi-skilled labor (a crew boss on the farm) is paid about $30.00 per month. An area supervisor is paid approximately $40.00 per month. Those with special training such as an agricultural extension specialist, would be paid $100 to $160 per month.

V. AGRICULTURAL POTENTIAL

The complex equation of climatic and soil suitability, productive capacity, cost of production and market possibilities equals the agricultural potential. The interaction of these factors is discussed by crop below.

Tomatoes

At the present time tomato yields are estimated at 2-1/2 to 5 tons per acre respectively for the canneries at Wenchi and Pwalagu. The government has had to set the price at $60 per ton. (The initial cannery economic study was based on a price of $28 per ton.) At this raw product price and the addition of freight charges, it will be impossible to sell the canned product in other than a protected local market.

There are various considerations in respect to yield improvement. Some of the soil, though infertile, has good physical qualities. Only the better soil should be farmed. Fertilizers, insecticides, and fungicides should be used with discretion. Where necessary, nematodes should be controlled or those areas avoided, if possible. Irrigation techniques might be improved to provide deeper water penetration without over-irrigation. Better suited existing varieties might be determined and a long term breeding project could be initiated.

Despite the improvements suggested above, it is highly unlikely that Ghana will be able to compete on the world tomato product market.

Other more productive, lower cost, countries have the competitive advantage in the world tomato market. The better soil areas of the Accra plain appear to be the best locations for fresh market tomatoes, although cheap transport developed on the Volta lake may provide a wider range of productive areas.

Pineapple

The pineapple situation is similar in many respects to the tomato situation. Transport is a problem, and the raw product yield per acre is low, manifesting itself in the cost of the raw product. At the present time varieties grown are Sugar Loaf and Smooth Cayenne. An attempt is being made to convert more of the acreage to Smooth Cayenne by means of the macro section technique. Even this approach will not solve the problem of canned quality because the climate of Ghana is not conducive to the production of the best quality pineapple for canning.

If the climate is responsible for poorer canned quality, it, together with the Sugar Loaf variety, is responsible for excellent fresh market quality. The high sugar content is accentuated by the uniform warm climate. Pineapple investigations could well be directed toward further fresh market development.

Many suggestions can be proposed for improved pineapple production, but all must balance the cost against the gain. Among the procedures that should be investigated are preplant soil fumigation, trash mulching for weed control and moisture conservation, paper or plastic mulches for vigorous young plantings, and fertilization. Supplemental irrigation for the dry periods should also be considered.

Mango

The world market for even top quality canned mango is limited. The few varieties capable of producing a high quality canned product are grown in Ghana only in variety collections. Variety propagation would require eight years from planting to time of bearing. The mango generally available for processing is fibrous and small. It is the intention of the government to process only mango paste at the Wenchi cannery. It is not likely that this product could be widely sold outside of Ghana.

Citrus

Citrus can be grown in Ghana with relative ease. This is true of the entire Mediterranean area and many other parts of the world. Consequently, quality processed citrus is very competitive in the world market.

Other Crops

Ghana has shown an ability to increase the production of traditional agronomic crops. In the spring of 1966 when maize was in very short supply, the government requested farmers to plant twice as much corn as they planted in 1965. Within one year Ghana reportedly overcame the deficiency. Maize production could be further improved with the gradual adoption of more advanced agronomic techniques and machinery. Improved storage facilities are of immediate importance to prevent losses.

With the ability to become self-sufficient in maize production, the same is reported possible for rice. The clayey alluvial soils are better adapted to rice than to any other crop. Few crops can be farmed on large acreages with mechanization, or

intensively by hand labor on small plots as successfully as rice. With the recently developed new varieties and modest fertilization, rice yields might be substantially improved. Development of the best rice soils will require flood control and water storage dams and a water distribution system. The irrigation development of the Accra plains would lend itself to rice production expansion. Terracing of the soils on the edge of the Volta lake may also offer a possibility.

Sugar cane is already under investigation in respect to potential expansion in the Accra plains.

GHANA

AGRICULTURE AS RELATED TO INVESTMENT OPPORTUNITIES IN FOOD CANNING INDUSTRIES

A PRELIMINARY SURVEY

SUMMARY AND CONCLUSIONS

SUMMARY

Tomatoes are grown in Ghana under marginal conditions with respect to soil fertility, climate, disease control, insect control, and agricultural technology. Ghana, to compete on the world canned tomato market, would have to compete with countries such as Spain and Portugal where the raw product price is presently $20/ton for good quality fruit as compared to $60/ton in Ghana for the quality of raw product now experienced.

The pineapple situation is similar to that of tomatoes. It is further complicated by the fact that low acid fruit is produced under the climatic conditions prevailing in Ghana. Also, the dominant variety (Sugar Loaf) is a high sugar, low acid variety. The major volume of world trade in pineapple is built upon a quality of pineapple for which climate and growing conditions in Ghana are not suitable.

Mango is well adapted to Ghana. Most of the varieties grown are suitable only for the production of mango paste. This product will have an exceedingly limited market outside of Ghana. Better quality varieties, which could be grown with equal ease, are available. A variety change will be expensive and time consuming due to the length of time required for mango to come into bearing.

Citrus can be grown with relative ease, but the sugar-acid ratio is not favorable under Ghanaian climatic conditions. Again, the world market picture for quality citrus is extremely competitive. Limes are better adapted to the climate, but this industry is well established in Ghana.

Production of corn, rice, and other basic food crops can be most easily increased through mechanization, new varieties, and other relatively minor improvements. Improvements along these lines are underway.

CONCLUSIONS

1. Ghana is at a disadvantage for canned tomato, pineapple, mango or citrus products if world market competition is contemplated.

2. Tomato, pineapple and citrus investigations for increased fresh market sales indicate a probable potential.

3. Tomato production near the major markets would minimize transport problems.

4. Mango is well adapted to Ghana, but the contemplated product, mango paste, will have a limited market. Consideration should be given to the market potential of canned mango slices.

5. The agricultural effort might best be utilized by concentrating on making the country self-sufficient in corn, rice, sugar and other agronomic crops rather than competing with poorly adapted horticultural crops.

6. With regard to number five above, improvements in storage facilities for grain and other foodstuffs are required.

EXHIBIT I

PESTICIDE AND FERTILIZER COSTS

Pesticides

Product	Pack	Retail Price
Aldrex 40 (Aldrin EC)	5 IG Drum	$9.55 per IG
Aldrin 40% W.P.	110 lb. Drum	$1.06 per lb.
Aldrin 2-1/2% Dust	55 lb. Bag	$0.16 per lb.
Dieldrin 20% EC	5 IG Drum	$9.04 per IG
Dieldrin 50% W.P.	81.6 lb. Drum	$1.39 per lb.
Dieldrin 2% Dust	55 lb. Drum	$0.20 per lb.
Arkotine D-25 (DDT E.C.)	55 AG Drun	$2.14 per AG
Arkotine D-25 (DDT E.C.)	5 AG Drum	$2.26 per AG
DDT 5% Dust	50 lb. Bag	$0.12 per lb.
Malariol (Oil)	44 IG Drum	$0.52 per IG

Weed Killers

Shell D-50	5 IG Drum	$7.44 per IG
Shell T-50 (2,4,5-T)	12 x 32 oz. Tin	$3.23 per tin
Stam F-34 (Propanil)	5 AG Drum	$17.77 per AG
Gramevin (Dalapon)	2 x 5 lb.	$1.14 per lb.

Fungicides

Copper Fungicide	110 lb. Bag	$0.50 per lb.
Dithane M-45	50 lb. Drum	$1.04 per lb.

Fumigants

Shell DD	5 IG Drum	$2.81 per IG
Shell DD	46 IG Drum	$2.75 per IG
Nemagon Granules	110 lb. Bag	$0.45 per lb.
Nemagon 75% E.C.	5 IG Drum	$17.44 per IG
Ethylene Dibromide	50 x 5 ml	$0.09 per capsule

Seed Treatment

Aldrex T	7 lb. Bag	$1.85 per lb.
Dieldrex 'A'	24 x 1 lb.	$1.60 per lb.
Dieldrex 'A'	56 lb.	$1.14 per lb.
Dieldrex 'B'	48 x 1/2 lb.	$1.82 per tin

PESTICIDE AND FERTILIZER COSTS (cont'd.)

Fertilizers

Product	Pack	Accra Retail Prices
Ammonium Sulphate 21% N.	over 10 tons	$95.00 per ton
Calcium Ammonium Nitrate 23% N. Nitra Shell	1-10 tons	$96.00 per ton
Single Superphosphate 18% P_2O_5	over 10 tons	$72.00 per ton
Compound Fertilizer 15:15:15	over 10 tons	$122.00 per ton

EXHIBIT II

GHANA PLANT HIRE LIMITED

HIRE RATES EFFECTIVE 9/8/67

Machine	Rate Per Hour
Cat. D8 Power Shift Bulldozer	$23.15 per hour
Cat. D7 Bulldozer	13.00 per hour
Cat. D7 with winch	14.00 per hour
Cat. D7E Bulldozer	15.82 per hour
D4 Bulldozer	9.10 per hour
955 Traxcavator	13.65 per hour
D6 Dozer and Ripper	14.95 per hour

SUGAR CANE STUDY, BLACK CLAYS

Machinery Work - First Ploughing (Shallow)	Cost per Acre
MF.65 or Zeter 55 - 3 disc plough	$ 2.00
Second ploughing (10"-12" deep) MF.65 or Zeter 55 3 Disc plough	4.00
Harrowing by using disc harrow behind MF.65 or Zeter 55	1.00
Ridging and furrowing MF.65 or Zeter 55 and disc ridger behind	3.00
1st Earthing up (after development of secondary sheets) MF.65 or Zeter 55 and disc ridger behind	3.00
2nd Earthing up (Final construction of ridgers)	3.00
	$16.00

Hand Work	
Cutting down scattered tress by cutlasses or axes and removing of stumps 4 labor days per acre	2.60
Cutting canes for seedlings loading, trashing, selecting and cutting into seed pieces 12 labor days	7.80

SUGAR CANE STUDY, BLACK CLAYS (cont'd.)

Hand Work (cont'd.)	Cost per Acre
Planting canes with fertilizer application (1 bag of sulphate of ammonia) 18 labor days	$11.70
Correction of carting up and weeding in rows (twice) 16 labor days	10.40
	$32.50

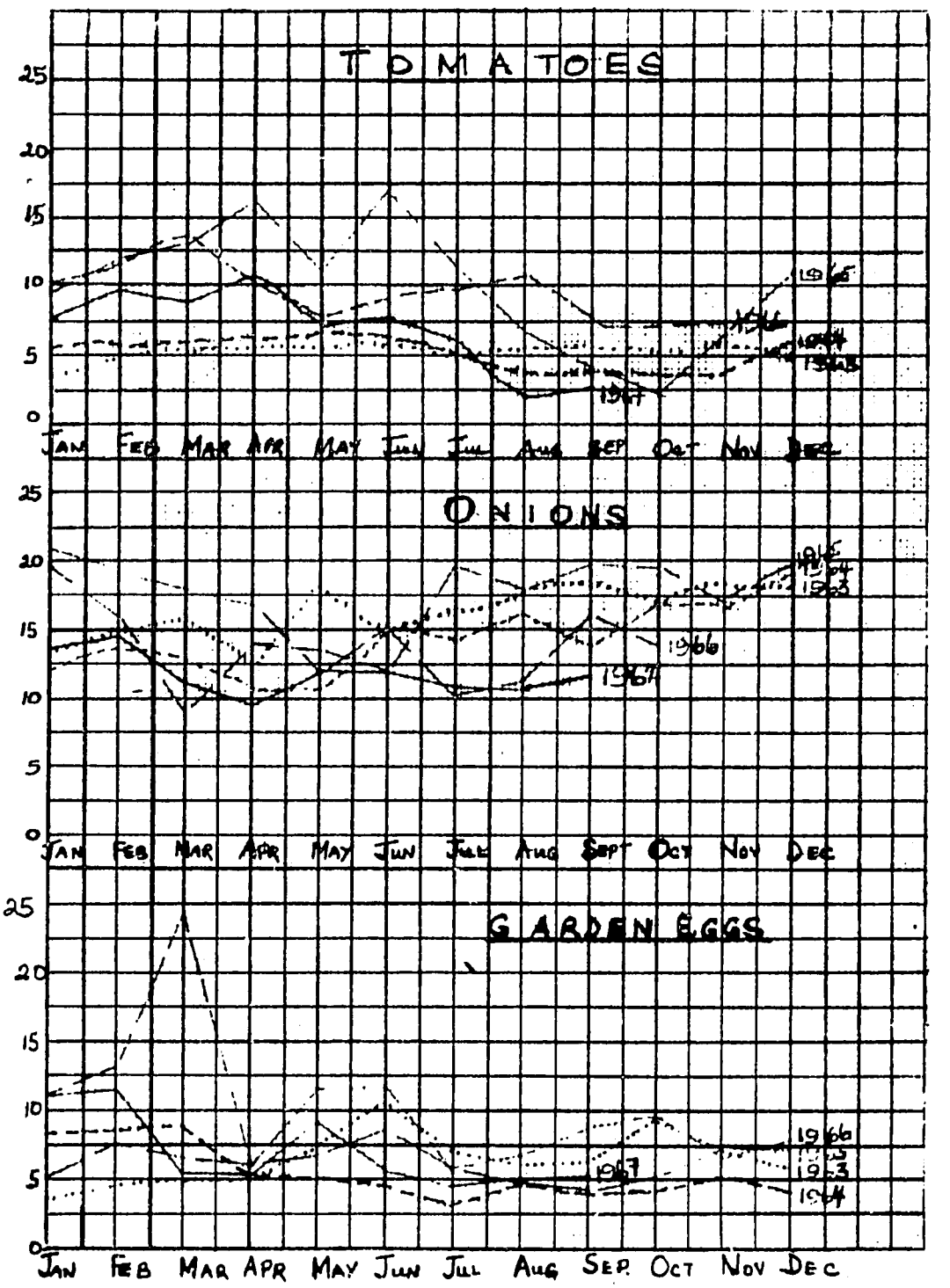
Harvesting of Sugar Cane	
Cutting, topping, trashing and loading	1.20 per ton
Additional expenditures like food supply and transport of laborers	.30
	$1.50

EXHIBIT III

FIVE YEAR COMPARISON OF WHOLESALE PRICES PER POUND

(EQUIVALENT TO U. S. CENTS) OF FRESH VEGETABLES

1963 - 1967



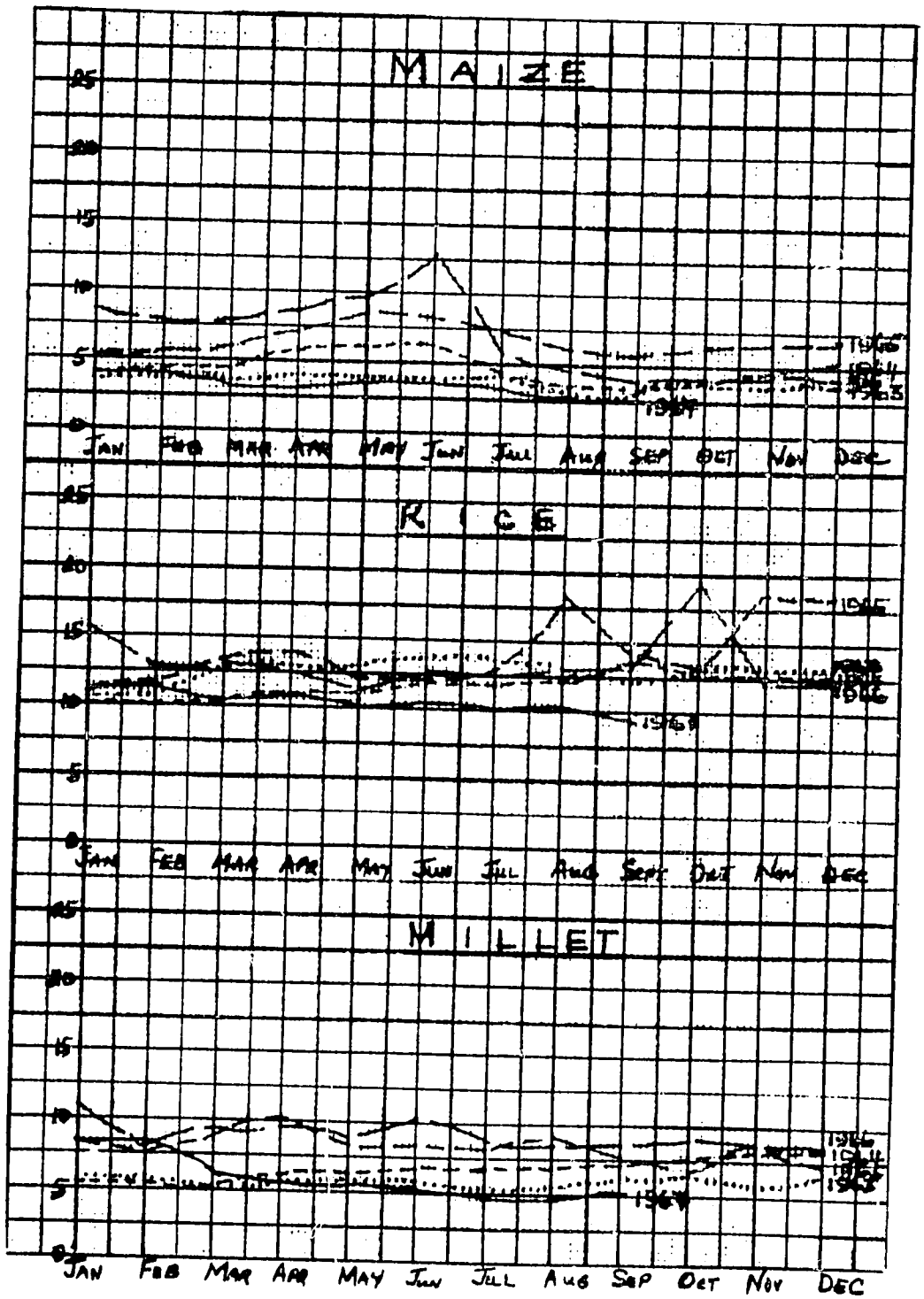
Source: Dr. E. Reusse

EXHIBIT IV

FIVE YEAR COMPARISON OF WHOLESALE PRICES PER POUND

(EQUIVALENT TO U. S. CENTS) OF STAPLE FOODS

1963 - 1967



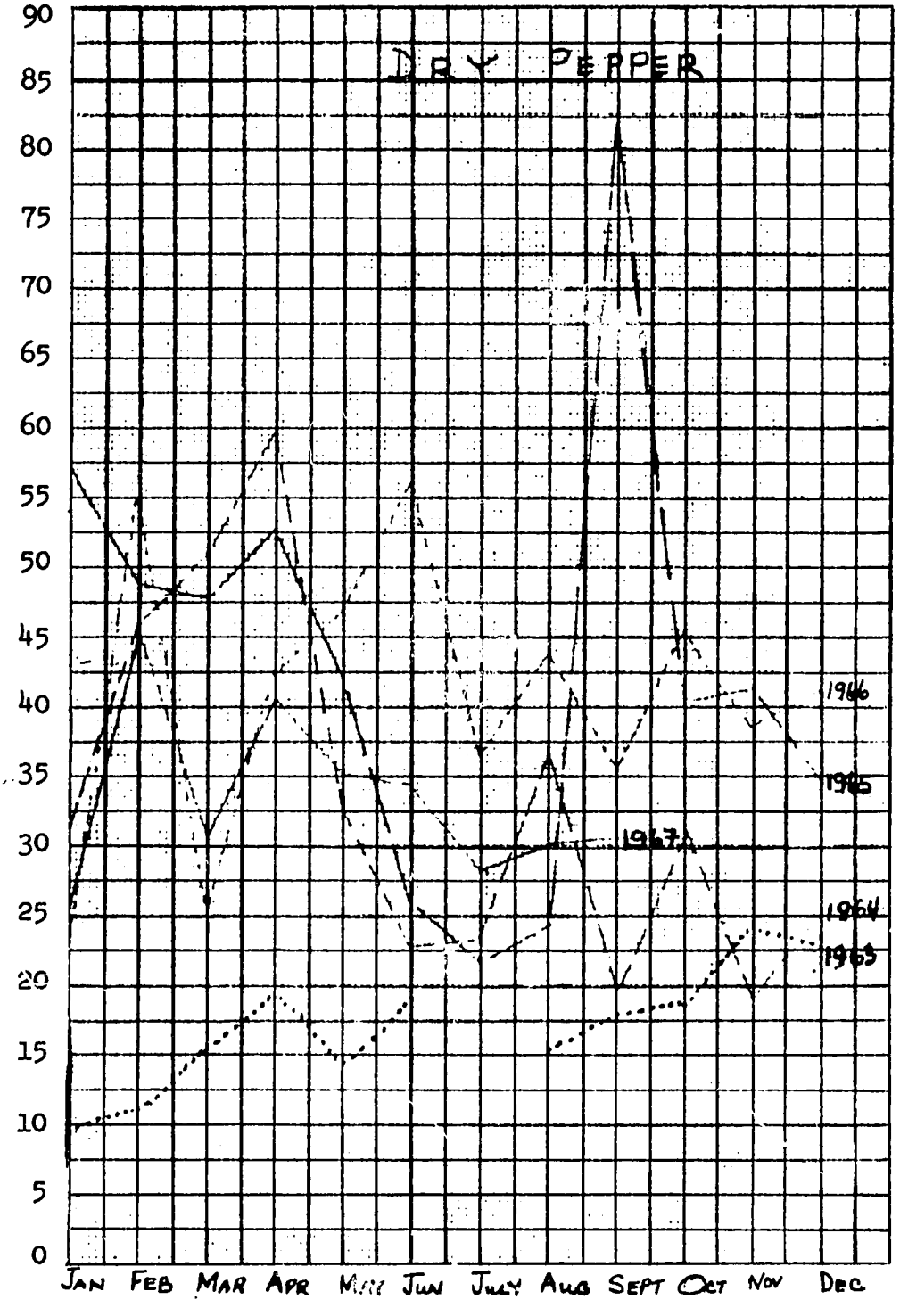
Source: Dr. E. Reusse

EXHIBIT V

FIVE YEAR COMPARISON OF WHOLESALE PRICES PER POUND

(EQUIVALENT TO U. S. CENTS) OF DRIED PEPPERS

1963 - 1967



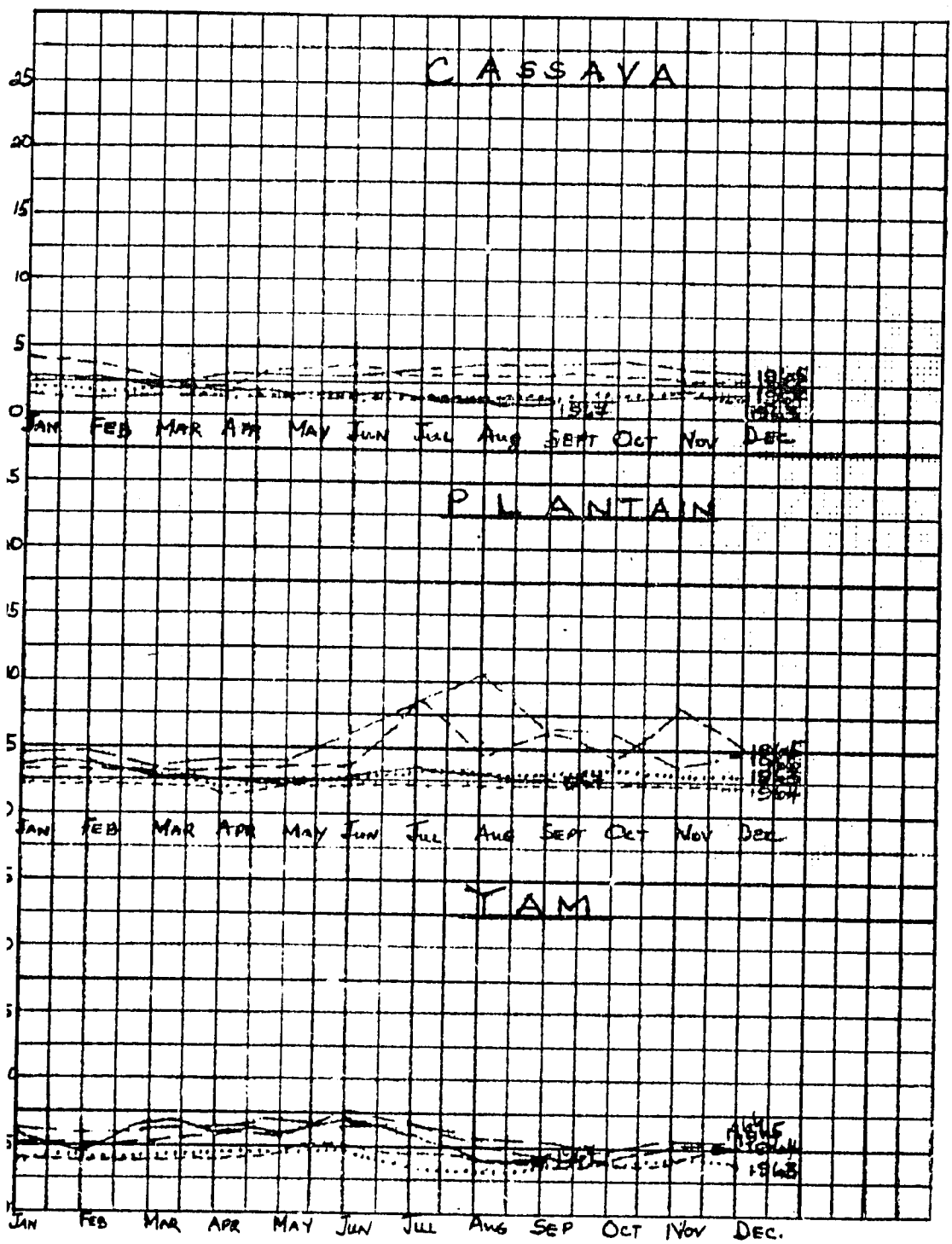
Source: Dr. E. Reusse

EXHIBIT VI

FIVE YEAR COMPARISON OF WHOLESALE PRICES PER POUND

(EQUIVALENT TO U. S. CENTS) OF STAPLE FOODS

1963 - 1967



Source: Dr. E. Reusse

References and Reviews

Vegetable and Fruit Canning, Foods and Nutrition and Markets

1/ Pineapple Processing and Canning Factory at Nsawam - Republic of Ghana - Economic Survey - Zagreb - Yugoslavia - 1962 - Reproduced by National Investment Bank - Accra, Ghana

2/ Tomato Tinning Factory in Pwalagu - Republic of Ghana - Economic Survey - Zagreb - Yugoslavia - 1962 - Reproduced by National Investment Bank - Accra, Ghana

3/ Tomato and Mango Canning Factory in Wenchi, Ghana - Economic Survey - Zagreb - Yugoslavia - 1963 - Reproduced by National Investment Bank - Accra, Ghana

4/ Preliminary Analysis of the Agricultural and Economic Viability of the State Canneries, Ghana - July 1967 - U.S. AID, FAO, Crops Research Institute and Food Research Institute

5/ Descriptive Summary of Available Information for Evaluation of State Canneries - A Report by Development Service Institute of National Investment Bank - Accra, Ghana - November 1967

6/ Processing of Fruits and Vegetables - Dr. E. Reusse - 1967 - FAO Food Research and Development Unit - Accra, Ghana

7/ The Market for Processed Fruit and Vegetables in Ghana - R. Schurman - 1967 - FAO, Rome

8/ Ingra Food Industry - Equipment Publication - Zagreb - Yugoslavia - 1964

9/ Ghana's Food Industries - Private Communication - Dr. Eberhard Reusse - FAO/UN Food Marketing Economist

10/ Benefits and Limitations of Food Industries in Africa - Paul Erner Andersen - Nutrition Division, FAO, Rome - 1966

11/ Investing in the Food Industries - E. N. Afful - National Investment Bank - Accra, Ghana - May 1967

12/ Accra's Food Retail Trade - Private Communication - Dr. Eberhard Reusse - FAO Food Research and Development Unit - Accra, Ghana

13/ Report of the First FAO Food Technology Seminar for the African Region - Accra, Ghana - December 1965 - FAO/UN, Rome

14/ Food Packaging in Ghana - Erik Wallenberg - September 1967 - FAO/UN, Rome

15/ Plan of Operation United Nations Special Fund - Ghana - Food Research and Development Unit - FAO

16/ Foods of Ghana - Pauline Whitby - Food Research and Development Unit - FAO - Accra, Ghana

17/ Human Nutrition in Tropical Africa - Michael Latham - FAO/UN, Rome - 1965

18/ Foods and Nutrition - Report to the government of Ghana - FAO/UN, Rome - 1962

Agriculture

19/ Agriculture and Land Use In Ghana - Edited by J. Brian Wills - Oxford University Press - London, Accra, New York - 1962

20/ A Geography of Ghana - E. A. Boateng - Cambridge University Press - 1966

21/ Background Notes, Ghana - Anonymous - U. S. A. Department of State Publication 8089 - Washington, D. C. - 1966

22/ Fruits and Vegetables in West Africa - H. D. Tindall - Food & Agriculture Organization of the United Nations - Rome - 1965

23/ Sand and Water Survey in the Upper and Northern Regions, Ghana - Vol. I - General Report - FAO Team - Rome, 1967

24/ Medical Entomology - William B. Herms - The Macmillan Co., New York - 1950

25/ Preliminary Report on Proposed Pineapple Area, Ashalaja - M. F. Purnell - Kumasi - 1954

26/ Report of the Detailed Soil Survey of Wenchi Agricultural Station, Wenchi - Sunyani District, Ashanti - A. R. Stobbs - Kumasi - 1959

27/ Report of the United Nations Team on Multipurpose Uses of Volta River Basin with Special References to Irrigation - J. Bennema, A. de Vajda, M. Rajendra, Kanwar Sain - Accra - 1963

28/ Report on Survey of the Lower Volta River Flood Plain - Vol. I General Report by FAO Team - FAO United Nations, Rome - 1963

29/ Report on Survey of the Lower Volta River Flood Plain - Vol. II Soil Survey and Classification - T. H. Day - FAO United Nations, Rome - 1963

30/ Report on Survey of the Lower Volta River Flood Plain - Vol. III Agronomic Considerations - S. L. F. Rudolphi - FAO United Nations, Rome - 1963

31/ Report on Survey of the Lower Volta River Flood Plain - Vol. V Economic Appraisals - W. G. Eichberger - FAO United Nations, Rome - 1963

.2/ Tables of Temperature, Relative Humidity and Precipitation for the World-Part IV - Meteorological Office - London, Her Majesty's Stationery Office

33/ The Mango (World Crops Series) - L. B. Singh - London, Leonard Hill Books, Ltd. - 1960

34/ The Pineapple (World Crops Series) - J. L. Collins - London, Leonard Hill Books, Ltd. - 1960

35/ The Suitability of the Soils of Mangoase Cooperative Farm for Large Scale Cultivation of Avacado Pears - H. B. Obeng and J. T. Ama - Tech. Report No. 53 - Kumasi - 1963

36/ The Suitability of Soils of Nyiensiso Cooperative Farm for Large Scale Culture of Citrus - H. B. Obeng and J. T. Ama - Kumasi - 1963

Fisheries

Ghana Department of Fisheries - J. N. N. Adjetey, Chief:

37/ Notes on Ghana's Fishing Industry, January 1968

38/ Fisheries Regulations, 1964

Capital Investments Board of Ghana:

39/ Capital Investments Act, 1963

40/ Investors Manual

Food and Agriculture Organization:

41/ Intentions and Results of an Important Venture in the Field of Fish Distribution - E. Reusse - July 26, 1966

42/ Marketing Operations of the Ghana State Fishing Corporation - E. Reusse - January 1966

43/ Biological Investigations of Fisheries Resources, Ghana - Dr. Miroslav Zei - 1965

44/ Fish Marketing in Ghana - John L. Dibbs - 1961 - Reports #1300 and #1446

45/ Review of the Principal Results of the Guinean Trawling Survey - F. Williams - 1966

U. S. Department of the Interior, Bureau of Commercial Fisheries:

46/ Fisheries Survey of Ghana - March 1963

National Investment Bank - Ghana:

47/ Ghana's Fishing Resources and Activities - (From a study prepared by I.B.R.D.) - March 14, 1966

Individual Contacts

Washington, D. C.

Messrs. Roy M. Melbourne - A.I.D. Ghana Desk Officer, Washington, D. C.

David B. Dorsey - Private Enterprise Officer, Bureau for Africa, A.I.D., Washington, D. C.

James P. Emerson - Agriculturist, Bureau for Africa, A.I.D., Washington, D. C.

Howard Smith - A.I.D. Ghana Desk, Washington, D. C.

M. R. McRoberts - FAO North American Regional Office, Washington, D. C.

FAO Headquarters, Rome

Messrs. H. C. Felix - FAO/Industry

A. G. Friedrich - FAO/Industry

W. W. Simons - FAO/Industry

G. d'Avout - Food Technoligist, Food Industries Development Section, Food Science and Technology Branch, Nutrition Division

P. H. Davey - Chief, Food Policy and Planning Section

F. P. Pansiot - Chief, Fruit and Vegetable Crops Branch, Plant Production and Protection Division

E. Quartey-Papfio - Agricultural Officer (Industrial Crops), Industrial Crops Branch, Plant Production and Protection Division

H. J. Mittendorf - Chief, Marketing Branch, Economic Analysis Division

R. Schurman - Associate Expert, Economic Analysis Division

A. de Vajda - Deputy Director (Special Fund Operations), Land and Water Development Division

F. W. Hauck - Soil Fertility and Management, Soil Survey and Fertility Branch, Land and Water Development Division

R. W. Harrison - Director, Fishery Economics and Products Division

R. Kreuzer - Chief, Fishery Products and Marketing Branch, Fishery Economics and Products Division

D. W. Sahrhage - Chief, Marine Biology Section, Marine Biology and Environment Branch, Fishery Resources and Exploitation Division

FAO Headquarters, Rome (cont'd.)

Messrs. A. Collart - Fishery Economist, Fishery Economics and Products Division

A. Meschkat - Fishery Resources and Exploitation Division

M. J. Creek - Animal Production Officer (IWP), Animal Production and Health Division

A. D. Faunce - Chief, Agricultural Engineering Branch, Land and Water Development Division

J. H. Huls - Chief, Food Science and Technology Branch

U. S. A.I.D. Mission - Ghana

Messrs. R. M. Cashin - Deputy Director, Accra

R. I. Jackson - Food and Agricultural Officer, Accra

Robert J. Dirks - Agronomist, Accra

D. E. Dibble - Industry Officer, Accra

P. C. Pierce - Aquatic Biologist, Accra

W. H. Taylor - Agricultural Extension Advisor, Tamale

J. A. Flaa - Agricultural Extension Advisor, Bolgatanga

J. F. Buffington - Agricultural Education Advisor, Kwadaso, Kumasi

L. W. Holman - Agricultural Education Advisor, Wenchi

U. S. Embassy

Mr. John Foley, Jr. - Deputy Chief of Mission

Government of Ghana

Messrs. R. S. Amagashie - Commissioner of Ministry of Industries, Accra

J. Therson-Cofie - Principal Secretary, Ministry of Industries, Accra

J. O. Torto - Commissioner of Ministry of Agriculture, Accra

F. J. Tekyi - Managing Director, State Cannery Corporation, Nsawam

Henry Obeng - Soil Research Institute, Kwadaso, Kumasi

B. S. Apte - Director, Crops Research Institute, Kwadaso, Kumasi

Government of Ghana (cont'd.)

Messrs. John Doku - Crops Research Institute, Nyankpala

E. A. Ocanssy - Assistant Commissioner of Police, Bolgatanga

A. Iddisah - Member Upper Regional Committee of Administration, Bolgatanga

J. A. Indome - Secretary/Member Committee of Administration, Upper Region

R. D. Ofosu - Resident Engineer, Pwalagu Plant

W. K. Sneman - Plant Operations, Nsawam

C. Bartells - Director of Food Research Institute, Accra

J. N. Adjetey - Chief Fisheries Officer, Ministry of Agriculture, Department of Fisheries, Accra

Bawana - Assistant to Mr. Adjetey, Accra

National Investment Bank

Messrs. E. P. L. Gyampoh - Managing Director, Accra

Badu - Capital Investment Board, Accra

G. K. A. Hammond - Accra

E. N. Afful - Agricultural Industry, Accra

Aidam - Director Investment Service Institute Analysis Section, Accra

L. C. Troescher - Economic Consultant, Accra

FAO/U. N. - Ghana

Messrs. A. E. G. Markham - FAO Country Representative, Accra

E. Reusse - Food Marketing Economist, Food Research and Development Unit, Accra

O. F. Rauha -Project Manager, Food Research and Development Unit, Accra

M. Jevremovic - Plant Production and Protection Officer, Accra

W. H. L. Allsopp - Fishery Officer, Accra

Miroslav Zei - Fishery Officer, Accra

Standard Bank of West Africa, Ltd.

Mr. Stanley L. Edis - Assistant Ghana Executive Director, Accra

Palm Line Agency, Ltd.

Mr. H. B. Julian - Tema

Mankoadze Fisheries, Ltd.

Messrs. R. K. N. Ocran - President, Tema

H. F. Eagleton

Oliver Bryant - American Consultant

Starkist International, Ltd.

Mr. John Radine - Manager, Tema

Shell Ghana, Ltd.

Mr. C. A. Christian - Accra