OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

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

0.8626

RESTRICTED

(R) TERMINAL REPORT 14 JAN 1979

ON

THE PROJECT FINDINGS FOR THE DEVELOPMENT OF SALT INDUSTRY IN PAPUA NEUGUINEA.

PREPARED FOR

THE GOVERNMENT OF PAPUA NEW GUINEA

BY

MR.C.L.MALHOTRA

EXPERT OF THE UNITED NATIONS' INDUSTRIAL DEVELOPMENT ORGANISATION

VIENNA

ACTING AS EXECUTING AGENCY

FOR

THE UNITED NATIONS DEVELOPMENT PROGRAMME

Note: This report has not been cleared by the United Nations Industrial Development Organisation, Vienna, which, therefore does not necessarily share the views expressed therein.

CONTENTS

ANNEXURES.

INTRODUCTION.

This is the report of the exper's findings on his return miesion to Papua New Guinea, in pursuance of the action taken by the Government on the recommendations made by him in the terminal report submitted by him in July 1977.

During discussions held with the concerned officials of the Government, the scope of work required to be performed by the expert was defined as under:

(i) to evaluate the technical data as collected by the Government.

(ii) to carry out an appraisal of the financial study of the project as perpared by the Government for the establishment of a 100 acre solar salt plant in Lea Lea, Papua New Guinea.

(iii) to prepare specifications for project engineering of the proposed plant, to achieve the following targets of production.

(a) cattle licks - 1000 tons per annum.
(b) Cooking salt - 1500 tons per annum (iodised)
(c) Table salt - 500 tons.

(iv) to contact engineering firms in India to locate suitable equipment for the manufacture of salt cattle licks (1000 tons per annum), after completing his studies in Papua New Guinea.

The present mission was originally for a duration of one month, including travel, debriefing and report-writing.

In view of the paucity of time, the duration was extended by two weeks, on the request of the Government supported by Resident Representative, UNDP, Port Moresby.

p.t.o.

Accordingly the expert commenced his mission on 2nd December 1978. He arrived in the field on 8th December, 1978. He completed his studies and observations on 22nd December and left for Vienna for debriefing on 28 and 29 December, 1978. Thereafter he returned to India and visited Bombay and Madras and contacted a number of industrial engineering firms to collect information regarding availability, prices and delivery schedules of the machines required, viz. Crusher, Mixer and Hydraulic Press etc. of suitable size and specifications for the manufacture of Salt Cattle licks.

During his two weeks' stay in Port Moresby, the expert carried out an in-depth study of all the records made available to him and held discussions with the officials of the various Government departments and agencies. He also made two visits to the site to inspect the site and weather recording instruments and station.

The findings of the expert in the light of the information as available with suitable conclusions and recommendations have been recorded in the following pages of this report.

The expert places on record his sincere thanks for the co-operation and help he received from all the agencies during his stay.

SUMMARY

DATA COLLECTION:

(1) The weather station established at Lea Lea (Project area) and the automatic weather recorder installed at the Project Site (area B of the tidal flat) were found to be NOT functioning properly and therefore the data furnished and collected from these sources is not considered reliable. Proper arrangements for their installation and measurements are required to be made.

(2) The investigations regarding soil, water etc. are detailed and comprehensive and the data received confirms that the local soils are suitable-impermeable and strong enough to undertake manual harvesting operations and for light machines to ply. The beds of the crystallisers would however require to be compacted.

(3) The available data regarding salinity of the creek water is very scanty. The measurements of salinity and analysis of the water of the Mokeke creek the water of which will be utilised for salt manufacture, have not been taken regularly. The work should be taken up in hand in the coming dry season.

(4) The contour map of the area is complete. The map, however, requires to be upto dated by including a small strip of land upto and forming the Mokeke creek.

(5) The tidal waters do not spread over the flat during the dry season and therefore pumping of creek brine from the Mokeke creek will be necessary.

(6) The results of three drill holes made in the area have not established the presence of any substantial saline aquefer and therefore, the possibility of tapping sub-soil brine of high density is ruled out.

p.t.o.

TECHNICAL FEASIBILITY

(7) As the data for the project site is still incomplete, a correct estimate of the productivity of land in area B of the Tidal Flat proposed for construction of the Plant (in terms of tons per acre) cannot be formed at this stage. An approximate estimate (on the assumption that the climatic factors of Port Moresby may be applicable to the project area and the salinity of the Mokeke creek is 2° Be which was measured four times during the expert's visits to the site and after taking other limiting factors into consideration) would be that 2000 tons to 2500 tons per annum could be harvested from the proposed 100 acre plant annually.

ECONOMIC VIABILITY:

(8) The estimates of capital outlay as prepared by the Government for construction of a salt plant over an area of 100 acres (estimated production 2000/2500 tons per annum) are considered very high.

(9) These estimates do not include the full requirement of plant and machinery and buildings (to produce purified salt, iodised salt and cattle licks) and therefore there is likely to be further increase in the capital outlay to the tune of 30% (K 860,000 - U.S. $ 115,0000.00-as against K.690,800 - U.S. $ 920,000)

(10) The cost of production of salt ex.factory is likely to be kina 95 per ton (1 kina ≠ US $ 1.33 app.) There will be a small I.R.R. of 5.9% , if the selling price of salt is fixed at K 150 (U.S. $ 205.00)/ ton which is the CIF price of the imported salt at the [illegible] in Papua New Guinea p.t.o.

(11) If, however, the capacity of the plant is doubled (area 200 acres and estimated production 4000 tons per annum), the capital outlay will increase further by 30% (K.1155,500 - U.S. $ 1540,500.00). The cost of production will come down to K 68 - 70 / ton (U.S. $ 91.00) and the internal rate of return (I.R.R.) will be 11.75% if the selling price of salt is fixed at K 110 / ton. (U.S. $ 150.00), as against K.150 (U.S. $ 205.00) of imported salt.

(12) The foreign exchange component of the cost of the project is estimated at 25% including the cost of project engineering. The remaining expenditure will be required in national currency (Kina)

(13) The wide gap or high cost of imported salt (CIF K 150 upward/per ton) and the opportunity for employment for about 30 workers in the manufacturing season and about 10 - 15 workers all the year round are the plus points of the project. On the other hand, the high capital outlay and lack of suitable skilled labour and supervisory staff in Papua New Guinea are the adverse aspects of the Project.

(14) The Government is therefore requested to re-examine the technical and financial aspects of the project as discussed in this terminal report and arrive at a suitable decision. In case they decide to go ahead with the project, then steps may be initiated for (a) collecting the remaining data as discussed in the report and (b) requesting UNIDO/UNDP for carrying out complete engineering and economic feasibility of the project for an estimated production of 4000 tons per annum for which the market in Papua New Guinea exists as seen from the figures of import of salt (3773 tons in 1975-'76).

R E C O M M E N D A T I O N S

FOR ATTENTION OF THE GOVERNMENT

DATA COLLECTION:

1. The work regarding collection of meteorological data from the station at Lea/Lae and from the automatic recorder as installed should be properly organised and supervised so as to ensure availability of reliable data. Assistance of the National Weather Service, PNG, should be taken.

2. The measurement of salinity of water of the Mokeke creek at least once weekly and analysing the samples of creek water should be regularly performed during the entire duration of the dry season (April thro' December, 1979).

3. The contour map of the area should be uptodated by including additional area.

4. The Bureau of Water Resources should be addressed to undertake the work of measurement of flow in the Mokeke and Knuka creeks during the wet season commencing January 1979.

PROJECT ENGINEERING:

5. As soon as after studying the financial implications of the project as revised, the Government arrives at a decision to go ahead with the project, UNDP/UNIDO may be requested to assist the Government in carrying out complete engineering and economic feasibility of a viable salt plant for Papua New Guinea.

FOR ATTENTION OF UNDP/UNIDO

6. Upon receipt of a request from theGovernment, necessary assistance and support may be extended to (i) carry out project engineering (ii) to construct the plant (iii) provide supervisory staff to ensure effective control over manufacturing and processing operations for about 3 years and (iv) to train PNG nationals as supervisors and skilled workmen.

CHAPTER I.

EVALUATION OF TECHNICAL DATA

1.1 The Government established a small observation station at Lea Lea for recording measurements of the following instruments by the village pastor:

(i) Rain gauge
(ii) Evaporeter
(iii) Maximum and minimum thermometer.
(iv) Dry and wet bulb thermometer
(v) Water maximum and minimum thermometer.

1.2 The data recorded for the period April to November 1978 and as compiled has been carefully examined but several obvious errors were noticed therein. Besides, during an inspection of the observation station, it was noticed that the measurement and recordings are not being done properly and regularly.

1.3 Also, it was noticed that the instruments have not been located in an open place. On the other hand, their location behind the village pastor's house being too close to the house and the surrounding trees, tended to obstruct the movement of air. These factors would invariably affect the rate of evaporation, temperature, humidity etc.

1.4 In addition to the above facility, an automatic weather recorder has been installed at the project site (area B) (Refer to Locality Plan vide Annexure 1 of Experts' Terminal Report of July 1977), since September, 1978 to record (i) evaporation, (ii) wind speed and (iii) rainfall. On inspection of this equipment, it was noticed that the evaporeter tube was leaking at one of the joints. Thus recording of evaporation by this equipment would not show

p.t.o.

correct rate of evaporation.

1.5 In view of the above, the data supplied by the village pastor for the Len Len weather station and the recordings of the automatic instrument cannot be relied upon nor applied for calculating salt productivity of the lands. In the circumstances, it would be safe and advisable to adopt the metereological data of the Jackson Air Port, Port Moresby, the detailed records of which are available for the past 30 to 40 years, for carrying out detailed engineering of the Project.

1.6 The officials of the National Weather Service with whom this matter was discussed agreed with the above evaluation.

1.7 The following follow up action is therefore recommended:-

(i) The instruments at Len Len should be installed at an open place and a place is available barely 10 meters away from the present location.

(ii) The automatic weather recorder should be inspected regularly and as soon as some mechanical fault is noticed, the same should be attended to.

1.8 The officials of the National Weather Service who accompanied the expert to the site have agreed to assist the Business Development Department in (i) and (ii) above.

1.9 Soil Data:- The Departments of Minerals, Energy, Geological Survey (Mines Division) and Works and Supply have carried out detailed investigations on the local soils etc. and the following points have been confirmed by them.

p.t.o.

(i) The soil is impermeable.

(ii) The bearing strength of the soil is adequate for manual harvesting and hoisting practices and also for light machines to work.

(iii) The crystallising area will, however, require compaction.

(iv) The leakage from the ponds, if any, will be within reasonable limit.

(v) There is no likelihood of dilution of brine with underground water.

(vi) The occurrence of sub-soil brine in copious supplies is not confirmed by the results of 3 drill holes drilled in the investigated areas.

(vii) The local clay is suitable for making stop banks, and for earth-fill.

1.10 In brief, the site is considered suitable for the construction of the plant. The results of various sites may be seen in the following reports received in the Business Development Office, Ministry of Commerce, Papua, New Guinea.

(i) Letter No.E 4836 dated 1-9-78 from the Geological Survey, Department of Minerals & Energy, Papua, New Guinea.

(ii) Letter No.PR 03 dated the 18th August '78, Department of Works and Supply, Government of Papua, New Guinea.

(iii) Letter No.E.3036 dated 21-9-78 from the Geological Survey, Department of Natural Resources, Ministry of Minerals & Energy, Papua New Guinea.

(iv) Letter No. dated February 1978 from Geological Survey.

p.t.o.

1.11 Tidal information.

Inspections were made during the period June to November, 1978 by the officers of the Business Development Office, to observe the spread and extent of high tides in the tidal flat B. They have reported that tidal waters do not reach the flat during the dry season, especially July to December.

1.12 From these observations, it is inferred that (i) sea water supplies for the proposed plant will have to be met by pumping, and (ii) that there is likely to be little danger of flooding of the proposed plant site by tidal waves etc.

1.13 CREEK WATER DENSITY AND ITS CHEMICAL COMPOSITION

This data has not been collected in spite of clear guidelines given last time, apparently because the Mokeke creek, the water of which is proposed to be harnessed, is very difficult of access from the project site. There is a thick growth of Mangrove, the ground is slushy and the Mangrove belt before the creek is infested with swarms of mosquitoes. Information on this point is available only from two readings and therefore during visits to the site on 13th and 14th December '78, samples were drawn and have been given for analysis in the University of Papua New Guinea. Further instructions have been given to collect this data regularly during the next dry season by making a small clearing through the Mangrove. For the purpose of the present study, the salinity has been assumed to be 2^{0} Be as measured on 14th and 20th December '78.

p.t.o.

1.14 Topographic map.- A detailed contour map of the area B (Project site) on a large scale 1.1000 has been prepared. From this map, it is seen that the lands are flat with a very gentle slope towards the creek.

1.15 The area of the flat B is 109 hectares, out of which only 40 hectare is proposed to be utilised at present for a production of 2000 - 2500 tons per annum. Thus, there is ample scope for expansion of the plant so that as and when it becomes necessary to increase production, the same could be possible easily.

1.16 The contour map as prepared, however, does not show the position of the Mokeka and Knuka creeks and the area covered by Mangrove growth between the Creeks and the Flat B. Since sea water supply would be derived from the Mokeka Creek, it is suggested that this Creek and the area between this Creek and the Flat B occupied by the Mangrove belt may also be included in this map.

1.17 Other data.

The flow of water in Mokeke Creek during the wet season is also required to be measured with a view to examine the hazard of inundation of the plant site by excess flood waters of the Creek during heavy and intensive rains especially during the high tide hours. The officers of the Water Resources Bureau, Government of Papua, New Guinea, were accordingly contacted to supply this information. They informed that they have not carried out this study. They have agreed to do so, during this very wet season (January 1979 onwards), upon receipt of a formal request from the

p.t.o.

Business Development Department. It is suggested that suitable action may be taken in this regard.

1.18 Unit rates. The rates of various kinds of operations of civil construction works and the cost of materials and wages of skilled and unskilled and supervisory work persons should be collected from the National Works Authority, so that this information may be handy and available to the contractor who will carry out our Project Engineering and work out detailed cost estimates of different operations.

CHAPTER II

PRODUCTIVITY, REQUIREMENT OF LAND AND LAYOUT.

2.1 In the first terminal report of the expert, it was estimated that (i) the net productivity of land in area B of the Lea Lea Tidal Flat would be 27/30 tons of salt per acre (para 4.4) and (ii) 100 acres of land would be required for the construction of the pilot plant to obtain a production of 2500 - 3000 tons of salt per annum. These conclusions were arrived at on the following main assumptions:-

(i) The tidal waters of the Kauka Creek measuring 2.25° Be average salinity would be available for feeding the plant.

(ii) The ~~xxx~~ gross fresh water evaporation at Lea Lea Plant site would be at least 49.35" for the dry season, May - November, if not more, which is the evaporation for Port Moresby (figure adopted from the report of M/s.Dominion Salt Co.)

(Inches)

	May	June	July	Aug.	Sept.	Oct.	Nov.	Total.
F.W.Evaporation.	6.71	5.79	6.71	7.08	8.15	7.69	7.20	49.33
Rainfall	2.24	1.57	0.83	1.22	1.57	1.54	2.64	11.61

2.2 Subsequent observations made during the dry season 1978 (May - November) at the Lea Lea station do not support this assumption as the gross fresh water evaporation as reported is only 44.86 inches.:

p.t.o.

(Inches)

	May	June	July	Au.	Sept	Oct.	Nov.	Total
F.W.evaporation for Len Len	5.52	5.64	4.80	5.68	7.46	8.80	6.96	44.86
Rainfall.	1.62	0.48	2.79	0.73	0.32	0.23	2.0	8.16

Further, the density of Mokeke Creek water as measured on 14th and 20th December was only 2^0 Be and therefore this salinity is less than that measured during June-July, 1977 for the Kaukaa Creek (2.25^0 Be average.)

2.3 Therefore, as a result of these variations, the productivity of the land after taking into consideration the effects of set back rains etc. is estimated at 20 tons of salt per acre onlyas under:-

Revised Calcutation.

F.W. Evaporation.	44.86"
Evaporation in closed and saline	44.86 x 0.60 = 26.9"
Less Rainfall.	8.16"
Net evaporation.	18.74"

Salt content of Creek water 2^0 Be = 1.75 tons/acre water evaporation.

Therefore for a net evaporation of 18.74" = 32.80 tons.

2:3:1 Allowing 40% for percolation and handling losses, the net productivity will be 20 tons/acre.

2.4 However, as stated in para 1.5 that the data collected at 8 Len Len Station is not reliable and therefore adopting the evaporation and rainfall datnof Port Moresby and assuming salinity of Mokaka Creek as 2^0 Be, the anticipated production from a 100 acre salt plant would work out as under:-

p.t.o.

F.W. evaporation	49.35 inches.
Rainfall	11.61 "
F.W.net evaporation.	37.74 "

Evaporation in closed surface and saline solutions 37.74 x 0.60 = 22.64

Salt content of 2° Be.Sea-Water. 1.75 tons per acre inch

Therefore, for a net evaporation of 22.64 inches, the production will be 1.75 x 22.64 tons/acre

= 39.62 tons/acre.

Production from 100 acre plant = 39.62 x 100 = 3962 tons.

Allowing 40 - 45% for handling losses and percolation etc. the net production is anticipated at $\frac{3962 \times 60}{100}$ = 2300 tons.

Production range: 2000 to 2500 tons per annum.

2.5 Lay-out of the Plant.

The ratio of evaporating ponds to the crystallising ponds, in view of the revised data may be 16 : 1 (as per Annexure 1), so that the break up of areas of Reservoir, Condensers and Crystallisers should be :

Reservoir	- 30 acres.
Condenser Stage I	- 32 acres.
Condenser Stage II	- 16 acres.
Condenser Stage III	- 16 acres.
Pre-crystallisers	- 1 acre.
Crystallisers.	- 5 acres.
Total.	100 acres.

CHAPTER III

PLANT CONSTRUCTION AND INSTALLATIONS

3.1 The constructional details of the plant comprise mainly of three parts:-

(1) Construction of earth works as per lay out plan.
(2) Installation of required machinery.
(3) Construction of required buildings.

3.1.1 Construction of earth works.

This is the major item of construction and investment. The Government has got preliminary estimates of this work framed by a Civil Engineering Consultant firm - M/s.Willing & Partners. According to their design, the estimated cost works out to K 540,000 (U.S. $ 756,000). The design and estimates were discussed with this firm with a view to reduce the estimates. Not much success could be achieved except that they agreed to reduce the size of the platform and specifications of the partition bunds. On the other hand, it is felt that the estimate is capable of further reduction by reducing the sections of (i) peripheral bunds (ii) the access road and the crystallisers' embankments. This is suggested on practical considerations and that M/s.Dominion Salt Co who estimated a work of this nature in 1975-76 for a bigger size plant, at this very site, assumed smaller sections. However, without entering into any controversy in this matter, it is suggested that the firm which will carry out the detailed project engineering will take note of the above observations.

p.t.o.

3.1.2: Installation of Plant and Machinery:

The Government intends to utilise the production from this plant for manufacture of cattlelicks and for making iodised and cooking salt. Therefore, the following machinery will be required:-

(1) Pumps

(2) Simple maintenance equipment like Tractor, trailor, dump truck etc.

(3) Transport like Car, Van, Motor cycle.

(4) Cattle Lick making plant - Hopper, Mixer Hydraulic press - Capacity 1000 ton/annum.

(5) Purification plant - hopper, conveyor, classifier, centrifuge etc. Capacity 10 tons per day.

(6) Iodisation Plant - hopper conveyor, Ribbon Mixer etc. Capacity - 7 tons per day.

(7) Weighing scale, bag -Stitching machine,etc.

(8) Water supply.

The estimated cost of the required equipment would be K 150,000.00 (U.S. $ 210,000) as against K 78,600.00 provided in the financial study prepared by the Government. Details may be seen in the Annexure 2.

3.1.3 Construction of buildings.

Buildings of suitable size and specifications will be required for:-

(a) Office, store, Metereological Station, Laboratory.
(b) Garages.
(c) Labour Shed.
(d) Shed for Cattlelick plant.
(e) Shed for purification plant.
(f) Shed for iodisation plant.
(g) Ware House for cattlelicks and iodised salt.
(h) Guard room.
(i) Urinals and Lavatory.
(j) Water Storage tanks and solution tanks etc.

The cost of buildings is estimated at K 130,000 (U.S. $ 182,000)

3.2 According to production schedules only 30% production will take place in the first year, 60% in the 2nd year and 100% in the 3rd year after completion of construction work. The plant and machinery and the buildings will accordingly be required mostly in the 2nd or 3rd year of workingof the plant.

3.3 The crude salt as produced from the ponds will be heaped, drained and sun-dried and stored on the platforms in the crystallising area from where it will be removed periodically as per requirement of the processing plant. The heaps of salt made into proper shape and size may be covered with polythene sheet lining against rain wash.

CHAPTER IV

ECONOMIC VIABILITY OF THE PROJECT.

4.1 The construction of the 100 acre solar salt plant recommended after the first mission of the expert was suggested in the nature of an experimental plant mainly to establish the possibility of manufacturing salt in Papua New Guinea with a view to gain experience in the techniques and practices of solar salt manufacture. (Paras 5 and 6 of the report of July 1977 under 'Summary' refer).

4.2 The intention as such was to include minimum of operations at this stage and reach a stage of ability to produce crude salt on the ground and thus arrive at a convincing proof of the possibilities of developing the salt industry on scientific and economic lines.

4.3 From the economic study prepared by the Department of Business Development for submission, it appears that Government now contemplate the construction of the proposed plant as a profit - earning concern of commercial nature. The study as carried out has revealed an attractive internal Rate of Return on the investments totalling nearly K 750,000.00 (about 1 Million U.S. dollars.) According to the study, the processing of about 2500 tons of salt to produce cattlelicks, refined salt, iodised salt etc. is envisaged. The details of the financial study have been scrutinised in the light of specifications of the finished product as requested by the Government and it has been found that provision for more equipment and buildings will be required to be included in the estimate. The estimtes of investments

p.t.o.

were accordingly reviewed and the financial picture of the project has emerged as under:-

As per NPCP Submission.

Capital Investment over 3 years.

Earth works	K 540,000	
Buildings.	K 18,000	
Plant & Machinery	K 78,800	
Project engineering	K 54,000	K 690,800
Working expenditure	K 60,000	
Total.	K 750,800	(U.S.$ 105,0000)

for an ~~maximum~~ estimated production of 2500 tons of salt in the 3rd year.

4.3.1 The production of 750 tons in the first year and 1500 tons in the 2nd is proposed to be sold as crude salt @ K 68/- per ton and in the third year 2000 tons will be processed and valued at K 75/- per ton and 500 tons will be crude salt. The project will ensure a positive cash flow in the seventh year and the internal rate of return will be 10.5%. The Annexure 3 may be seen for details. The Government appear to be interested in this project.

4.3.2 However, as stated under paras 3.1.2 and 3.1.3, the requirements of Plant and Machinery and buildings ~~have~~ have not been properly estimated. The revised figures have been estimated as under:

p.t.o.

Capital Investment

Earth Works		540,000.00
Buildings		130,000.00
Plant & Machinery		130,000.00
Project engineering and investment expenditure.		60,000.00
Total.	K.	860,000.00
Annual working expenses.		60,000.00
	K.	920,000.00 (U.S. $ 125,0000.00)

4.3.3 The estimated production from this plant may be 2000 tons and even if the selling price of salt is fixed at the CIF price (K 150.00/Ton), the internal rate of return is estimated at 5.933% only which is not attractive. The project as such is not economically viable. The high initial investment is mainly attributed to high cost of earth works - which accounts for about 68% of the total cost, the balance on buildings 16% and plant and machinery 16%.

4.4 There are as such two alternatives:

(i) to bring down the initial cost of construction and

(ii) to plan a bigger size plant.

4.4.1 Therefore, the financial implications of a plant of 4000 tons capacity of salt was examined and the following picture has emerged.

Capital Outlay over three years.

(1) Earth Works	K	745,500.00
(2) Buildings	K	150,000.00
(3) Plant & Machinery	K	200,000.00
	K	1095,500.00
(4) Project Engineering	K	60,000.00
	K	1155,500.00
(5) Working expenses.	K	160,000.00
	K	1255,500.00
	(U.S. $	1,70,0000.00 approximately)

p.t.o.

4.4.2 The estimated production of 1300 tons in the first year, 2600 tons in the second year and full production of 4000 tons from the 3rd year onwards has been assumed.

4.4.3 The study shows that if the finished product is sold at K 110.00 per ton (as against the import price of K 150 per ton), then the project will show cash flow with an internal rate of return of 11.7523.% (Annexure 4 may be seen.) The study further shows that by 33% increase in the initial capital outlay better financial results will accrue.

4.5. Cost of production.

Assuming the entire amount to be raised as loan bearing a rate of 9% per annum as interest, and depreciation at 3% on mud works, 5% on buildings and 15% on Plant and Machinery, the cost of production ex. factory for the two alternatives discussed above works out as under:-

(1) 100 acre plant. (Production 2000* tons) K. 95.50 per ton (U.S.$ 130.00)

(2) 200 acre plant (production estimated * 4000 tons per annum) K. 68 .00 per ton (U.S.$ 91.00)

(* When the plant goes into full production.)

(Annexures 5 and 6 may be seen for details)

p.t.o.

4.6 Prices of imported salt:

Coarse Salt in 50 Kg.bags	K	68.00/ton FOB (Australian Port).
Cooking salt in 50 Kg.bags	K	75.00/ton "
Freight charges Ex.Port Australia to Lae Lae(Papua New Guinea)	K	90.00/ton

CIF Price

Coarse Salt Ex.Lae Lae 68 + 90 = K 158 / ton.

Cooking salt " 75 + 90 = K 165 / ton.

(Source: File No.54-11-13 PTII page 166 of Business Development, Ministry of Commerce, Papua New Guinea.)

These prices are substantially higher than the estimated Ex.Factory cost of production (para 4.5)

4.7 As for market for the increased production, it is felt that in view of the increasing trends in imports (as stated in para 7.3 of the first terminal report which shows the imports of salt totalling to 3783.69 tons during 1975-76 as against only 2706.69 tons during 1970-71) the estimated production after small internal cushion stock (say 500 tons) will find easy market for internal consumption in Papua New Guinea.

4.7.1 It is further stated that the foreign exchange component of the Project is likely to be of the order of 20 - 25% only.

4.8 In view of the above, the following course is suggested:-

To prepare complete engineering of the Project by a firm which possesses experience of Project Engineering of Solar Salt plants. From such a study, the possibilities of reducing cost of initial investments and cost of production will be clearly brought out vis-a-vis the size andcapacity of an economically viable plant.

p.t.o.

4.9 Since the Government proposes to undertake this project as a Commercial Enterprise with emphasis on attractive returns on investment, the picture as emerging from the foregoing paragraphs may be summarised as under:-

(1) The initial capital outlay of the Project for establishment of a 100 acre (2000 - 2500 ton production) will increase by about 30% over the estimated amount of K.690,000.

(2) The estimated cost of production of salt is likely to be K 95 per ton ex.factory and therefore the proposed selling prices assumed in the Cash Flow Sheet (K68 and 75) would result in loss.

(3) The Internal rate of return is not likely to exceed 6%, if the selling price of salt is fixed at K.150.00 per ton which is the CIF price of imported salt.

(4) If the capacity of the plant is doubled (200 acre production 4000 tons) the capital outlay will increase by 30% of the estimated Capital outlay of 100 acre plant.(i.e. from K.860,000 to K 1155,800). The Project will yield an internal rate of return of 11.75% by fixing the selling price of salt at K 110.00 per ton as against K.150 per ton of imported salt (CIF).

4.10 In view of the above, the Governmentis requested to take a careful look at the economics of the project and weigh the same with the comparative advantages viz. (i) the selling price of indigenous salt will be less than the imported price and (ii) employment for some nationals of Papua New Guinea will be available.

p.t.o.

4.11 In case the Government decide to pursue the project, it is suggested that steps for undertaking complete and detailed engineering and economic feasibility of such a study should be taken in hand.

4.12 The Government desired that the expert should prepare the specifications of the finished products - crude salt, cattle licks, cooking salt and kitchen salt - proposed to be manufactured so that the same may be supplied as an annexure to the Notice Inviting Tenders for Project Engineering.

4.13 The specifications of finished products, viz. targets of production and quality of salt required to be achieved may be seen at Annexure 7.

CHAPTER V.

PROJECT ENGINEERING, CONSTRUCTION AND OPERATION.

5.1 The next logical step after the preliminary fesibility studies (technical and economic) is to carry out the complete engineering of the project.

5.2 Project Engineering envisages the availability of necessary basic data, meteorological, soils, sea water, geological, hydrological and a good contour map. Generally, meteorological and sea water data for 3 to 5 years is taken into consideration to arrive at a correct idea of average prevailing conditions.

5.3 In the present study, this pre-requisite is not fully met with, as in spite of the best efforts and intentions of the Government, meteorological and Creek water data as collected are not representative of average conditions for the first instance, it is for a limited period and then it has not been found to be correctly recorded.

5.4 On the other hand, the Government are anxious to see that the implementation of the Project should not be delayed. They have arranged for thelease of the lease of the lands and have allotted priority to this Project.

5.5 Therefore, if the Government feel inclined to take up the project as per revised economic fesibility (parns 4.3 to 4.7), action to carry out the detailed engineering of the Project should be taken by using the following data:-

(1) Meteorological Data: As available for Jackson Air Port, Port Moresby. (During discussions in the National Weather Service, the opinion was that as the data collected

p.t.o.

from Len Len station and automatic Weather Recorder is not reliable, it would be advisable to adopt the meteorological data for Port Moresby as climatic conditions in Len Len appear to be drier than those in the Port Moresby.)

(2) Water Density: The record being very scanty and insufficient, the salinity of Creek water should be assumed at 2° Be. the reading which was mensured on 3 different days at different times.

(3) Soil conditions.- As per conclusions of Geological Survey and Soils Research Centre, Government of Papua New Guinea.

5.6 Plant Construction and operation.

It is recommended that the work of the Project Engineering be entrusted to an experienced firm who have carried out detailed engineering of Salt Works and have constructed and successfully operated Salt Plants in respect of target of production, quality and cost of production etc. situated in areas having climatic and other conditions identical to those obtaining in Papua New Guinea. In other words, the entire project should be executed on a complete turn key job basis to an experienced firm.

5.6.1 One such experienced firm is M/s.Dominion Salt Co., Ltd., a Government of Newzealand Undertaking which is operating a Salt Plant at Lake Grassmere where climatic conditions are reported to be identical with those in Len Len area of Papua New Guinea. Therefore, after prior approval of the Government, a meeting was held with an official of the Newzealand High Commission in Port

p.t.o.

Moresby with a view to enquire whether the said Company would be interested in taking up the Project as a Turn Key Job. So far, no reply has been received. However, it would be in the interest of the Project to entrust the execution of the Project to this firm or another firm of repute and experience.

5.6.2 M/s.Imperial Chemical Industries, Australia and M/s.Technosel, Milan, Italy are two other experienced firms who may be sent a copy of the Notice Inviting Tenders.

5.7 As the activity, as envisaged in this Project would be a new adventure in Papua New Guinea where skilled labour and Supervisory staff for plant control etc. are not available, for a successful completion and achievement of targets, the continuation of Supervisory Control by the Construction Contractor for about three years after the plant goes into production should be provided in the Contract. During this period, the labourers of Papua New Guinea should be trained.

ANNEXURE 1

Gross Fresh water Evaporation.	49.35 inches.
Rainfall	11.61 inches.
Net fresh water Evaporation.	37.74 inches.
Ratio between evaporation in crystallising Ponds and evaporation in evaporating ponds.	0.7

Suppose
Volume of creek water at 2^0 Be - 1000 litres.
Then as per Standard Tables,

Volume of Creek water at 3.6^0 Be - 562 litres.

(As it enters the evaporating ponds),
Volume prior to entering crystallising ponds (at 25^0 Be) 62 Litres.

Volume of water at 30^0 Be
(when it will leave the crystallising ponds) 16 litres.

The ratio between evaporation in evaporating ponds and crystallising ponds (0.7) is therefore equal to the ratio between the reduction of volume of water in the evaporation ponds i.e. (562 - 62) = 500.

and reduction in volume in the crystallising ponds (62 - 16 = 46) or $0.7 = \frac{500}{46} = \frac{500}{512} =$ 16 : 1

ANNEXURE - 2

Details of Plant and Machinery.
(Vide para 3.1.2)

	As required.			As provided.	
1)	Tractor	1	K 10,000.00	K	10,000.00
2)	Trailors	2	K 6,000.00	K	3,000.00
3)	Dump Truck	1	K 10,000.00		--
4)	Weighing machine.	1	K 9,000.00		--
5)	Bag Stitching machine.	1			
6)	Purification Plant.	1	K 40,000.00	K	60,000.00
7)	Cattle Lick Plant.	1	K 20,000.00	K	5,000.00
8)	Iodisation Plant	1	K 20,000.00		--
9)	Pumps	2	K 20,000.00	K	16,000.00
10)	Van	1	K 7,000.00		--
11)	Car	1	K 7,000.00		--
12)	Motor Bikes	2	K 1,000.00	K	600.00
	Total.		K 150,000.00 (U.S.$ 200,000.00)	= K.94600.00	(U.S.$ 126,000.00 approx.)

Notes:- Item 9 has been included in the estimate of earth works (3.1.1)

ANNEXURE -5
(Para 4.5.1)

SOLAR SALT PROJECT
CASH FLOW SCHEDULE

		1979 LEAD YEAR	1980 YEAR	1981 YEAR	1982 YEAR	1983 YEAR	1984 YEARS	
Detailed Survey and engineering		54,000						
Construction earth works		378,000	102,000					
	house		15,000					
	shed		5,000					
	refinery				60,000			
Equipment	press		5,000					
	tractor		10,000					
	trailer		3,000					
	motor bike		600					
	office furniture		200					
TOTAL CAPITAL EXPENDITURE		432,000	190,800		60,000			690,800

P.t.o.

ANNEXURE -3 Page 2.

	1979 LEAD YEAR	1980 YEAR	1981 YEAR	1982 YEAR	1983 YEAR	1984 YEARS	
Operative Expenditure							
Salary Supervisor.		3,000	3,000	4,000	4,000	4,000	
Labour - Harvesters.		6,240	6,240	6,240	6,240	6,240	10 @ K12 per week for 4 months per year
Processing				3,120	3,120	3,120	10 @ K12 per week for 6 months per year
Maintenance			3,120	3,120	3,120	3,120	5 @ K12 per week for 12 months per year.
Travel and leave fares.			300		300	150	
Fuel		1,000	1,000	7,500	7,500	7,500	
Maintenance.			5400	5,400	6,000	6,000	1% of construction cost.
Packing Material.				19,000	19,000	19,000	1000 tonnes in 1 kg, 1000 tonnes in 50 kg.
Marketing commission.				1,500	1,500	1,500	1% sales value refined production of 2000 tonnes.
TOTAL COSTS	432,000	209,040	19,080	109,860	50,780	50,630	
Production Tonnes.		750	1,500	2,500	2,500	2,500	
crudes		51,000	102,000	34,000	34,000	34,000	Year 1 and 2 all crude year 3 on 500 tons at K68 per tonne
refined				150,000	150,000	150,000	2000 tonne/year at K 75/tonne.
TOTAL INCOME		51,000	102,000	184,000	184,000	184,000	
ANNUAL CASH FLOW	(432,000)	(158,040)	82,940	74,120	133,220	133,370	
CUMULATIVE CASH FLOW	(432,000)	(590,040)	(507,100)	(432,980)	(299,760)	(166,390)	Positive cash flow achieved in the 7th year.

ANNEXURE 4
(Para 4.5.3)

SOLAR SALT PROJECT

Life of Project 10 years.

	A 100 acres 2000 Tonnes.	A 200 acres. 4000 Tonnes.
	£	£
1. Civil Engineering (including pumps)	540,000	745,500
2. Buildings.	150,000	150,000
3. Plant and Machinery (excluding pumps)	150,000	200,000
4. Project Design and survey	60,000	60,000
Sub-Total.	900,000	1155,500
Working Capital.	60,000	60,000
Interest on investment at 9%	92,800	109,400
Depreciation 3% Engineering	16,200	22,370
5% Buildings.	6,500	7,500
10% Design & Survey.	6,000	6,000
15% Plant & Machinery	19,500	30,000
Sub-Total	191,000	235,270
Production (on) Year 1	700 Tons	1300 Tons.
" 2	1500 "	2600 "
" 3 - 10	2000 "	4000 "

ANNEXURE - 4 (Contd)

PRODUCTION 2000 tons/year (I)

Selling price. K. 150.00 / ton ex. factory.

Cash flow

	Year 1	Year 2	Years 3-10	I.R.R.
Income	105,000	195,000	300,000	5.9331%
Expenditure.	142,800	142,800	142,800	
	(62,200)	52,200	157,800	

PRODUCTION 4000 Tons per year (II)

Price ex. factory K. 100.00 / ton.

Cash flow

Income	150,000	280,000	400,000	9.3385%
Expenditure	169,400	169,400	169,400	
	(19,400)	90,600	230,600	

Price ex.factory 110.00 per ton.

Cash flow

Income	143,000	286,000	440,000	11.7525%
Expenditure.	169,400	169,400	169,400	
	(26,400)	116,600	270,600	

Price ex.factory 120.00

Cash flow

Income	156,000	312,000	480,000	14.9009%
Expenditure	169,400	169,400	169,400	
	(13,400)	142,600	310,600	

ANNEXURE - 5.

Statement of Investments and Cost of Production of Salt Plant - Production of 2000 ton/annum.(Vide para 4.5)

...

I. Capital Outlay.

1)	Civil Construction works other than pump houses.	K 540,000
2)	Buildings.	K 110,000
3)	Plant & Machinery other than pumps	K 130,000
4)	Project Engineering and survey.	K 60,000
5)	Working Capital.	K 60,000
	Total Capital outlay	K 920,000 (U.S. $. 128,0000.00)

II. Cost of production.

Interest at 9%	82,800
Depreciation.	48,200
Working Capital	60,000
Total.	191,000
Production	2,000 M.T.
Cost of production.	K. 95.5 / Ton. (U.S. $ 128.00/ton)
Cost of imported salt coarse salt from U.K.	K 95.00/ton Ex.Lae
Cost of imported salt from Australia.	K 150.00/Ton Ex.Lae (U.S.$ 205.00/ton)
Cattle Licks	K 4.5 to 5 each ex.Lae (U.S.$ 6.00 to 6.70)

...

ANNEXURE - 6

Statement of Investments and Cost of production of Salt Plant - Production of 4000 ton/annum.

(Vide para 4-5)

I. Investment

Earthworks	K	745,500
Buildings	K	150,000
Plant & Machinery	K	200,000
Project Engineering	K	60,000
Working Capital	K	100,000
Total.	K	1255,500 (U.S. $ 170,0000.00)

II. Cost of production.

Interest at 9%	K	106,445.00
Depreciation.	K	65,865.00
Working Capital.	K	100,000.00
	K	278,860.00
Cost of production	K	278,860.00 / 4,000.00
	K	68.00 / Ton (U.S. $ 91.00/ ton.)
Cost of imported coarse salt from U.K.	K	95.00/ton (U.S.$ 127.00/ton) Ex.Lne
Cost of imported salt from Australia.	K	150.00$Ton (U.S.$. 200/ton approx.) "
Cattle Licks	K	4.5 to 5 (U.S.$ 6 to 6.7) each ex.Lne

ANNEXURE -7

PROJECT ENGINEERING FOR A SOLAR SALT PLANT IN THE LEA LEA TIDAL FLATS PAPUA NEW GUINEA

(Vide para 4.13)

SPECIFICATIONS.

(as annexure to Notice Inviting Tenders)

Preparation of a complete engineering project report for the establishment of a Solar Salt Plant of the annual capacity of 3000 Metric tons of salt in Area B of the Tidal Flats at Lea Lea in Papua New Guinea, corresponding to the following specifications:

Production:

(i)	Crude salt as harvested : to be processed further and to produce:	3000 tons
(ii)	Kitchen salt (purified and iodised)	1500 tons
(iii)	Cattle licks	1000 tons (using crude salt)

Quality:

(i) Crude salt

chemical composition:

Sodium Chloride	95.0%
Soulble matter other than N_aCl	4.0%
Insolubles Less than	1.0%
Moisture content	4 to 6%

(ii) Kitchen salt (iodised)

Chemical Composition:

Sodium Chloride	97.00%
Soluble Salts ($CaSo_4$, $MgSo_4$, $MgCl_2$, $CaCl_2$ KCl etc.)	2.50%
Insoluble matter Less than	0.50%
Iodine as KIO_3	

(I part of KIO_3 in 40,000 parts of salt or as prescribed by the Health Dept.)

p.t.o.

NOTE: The salt shall not contain any substances in quantities which are harmful to the health of the consumer.

Ex pH	7.0 to 7.5
Alkalinity as Na2CO3	0.1%

Physical characteristics:

Colour	White
Shape	Crystalline, uniform, size and fine, free from grit
Packing:	50 Kg. Polythene H.D. bags.

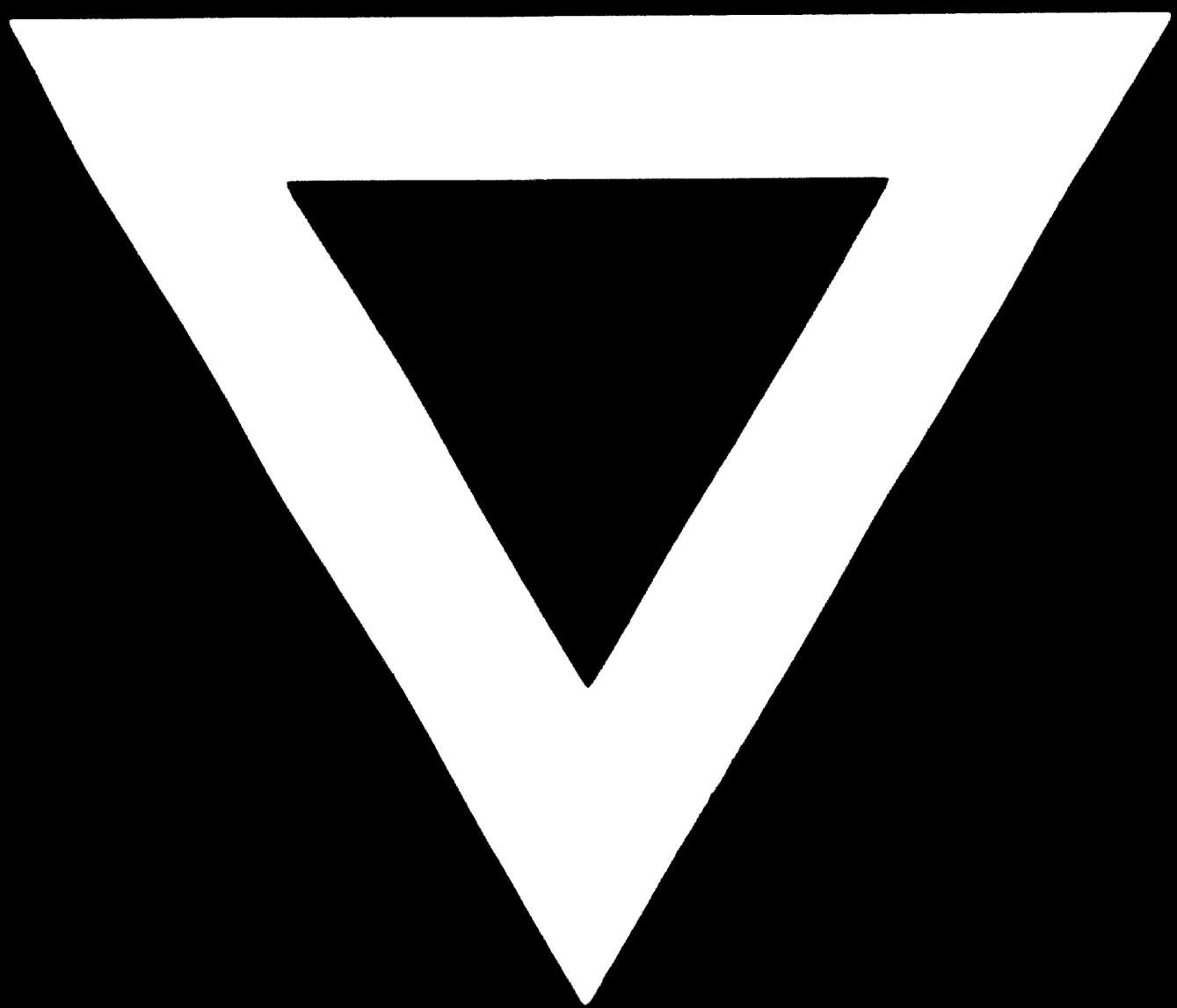
(iii) Cattle licks(plain)

Chemical composition: same as crude salt at (i) above.

Physical characteristics

Colour:	White
Shape	Rectangular or square blocks.
Weight	20 to 22 Kg. each piece.
Strength	Hard and strong so as not to crumble at pressure 150 Kg/cm^2
Packing:	Polythene or paper bags.

G-12



79.11.14