Salt Extraction by Solar Energy

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INTRODUCTION

When IICA/Jamaica prepared its "Country level action plan" (PANP) it recognized that the two first government priorities were:

(1) Food production; and

(2) Employment

The first mini project to be tested by the"Rural Women Programme" of IICA follows the first two priorities recognized above and set the stage for progmatic, objective and economically feasible projects which if successful can be duplicated for the benefit of the national economy and the income and employment of rural women.

We are proud to present this paper the first of a series of mini projects of this programme.

Dr. Percy Aitken
DIRECTOR IICA/Jamaica

SALT EXTRACTION

BY

SOLAR ENERGY

-

A MINI PROJECT

-

RURAL WOMEN PROGRAMME

IICA/JAMAICA

-

OCTOBER 1980

NORMA MUNGUIA
PERCY AITKEN
ABDUL WAHAB
IRVING JOHNSON

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1. SUMMARY

(a) Name of Project: Salt Extraction by Solary Energy

(b) Location: Bracco Beach, Parish of Trelawny, Jamaica

(c) Participants: 6 women from the Schawfield Home Economics group, who will work on a rotation basis every forthnight

(d) Colaborating Institutions: Ministry of Agriculture - Home Economics, Women Bureau, Ministry of Commerce, IICA-Rural Women's Programme

(e) Total amount of money requested: J$4,450 at exchange rate of J$1.78 per one US$ equal US$2,500

(f) Input:

(1) Capital cost

Building materials	J$2,629.30
Mason's contract	576.00
	J$3,205.30

(2) Operating cost

Labour	-
Packaging materials	J$ 600.00

(3) Miscellaneous and unforeseen costs

Miscellaneous	J$ 644.70
	J$4,450.00 = (US$2,500)

The extraction of salt requires three basic inputs sea water, solar heat and labour. The first two are obtained free of cost. The labour will be provided by the group of women participating in this activity who will receive an income from the sale of the salt.
The packaging of the salt will require plastic bags (1 or 2 lb size). In a months time, 500 to 700 (2 lb) bags will be required.

(g) Output

If the rate of evaporating of water inside the salt pond is ½" a day approximately 194 kilo of salt would be extracted every 12 days. (583 kilos every 36 days).
Not taking into account the initial investment costs, the cost of production would be mainly labour which will be provided by the group, the economic output is estimated at $97.00 every 12 days. (194 kilos at the price of $0.50 per kilo).

(h) Marketing

As evidenced by the present shortages the supply of salt in the market does not cover the demand of the consumers, the salt can be sold at the local level by peddling initially, and through higglers and stores later on as production increases.

2. BACKGROUND

As far as it is known, there has been little or no experience of salt extraction in Jamaica. Historically Jamaica has always imported salt to satisfy the needs of industrial,

animal and human consumption. Originally the salt was imported from Turks and Caicos and in recent years the Dutch Island of Bonair has been the sole provider of salt to Jamaica.

According to information obtained from the Ministry of Industry and Commerce, Jamaica is currently importing between 24,000 to 30,000 tons of salt per year.

At a CIF cost of US$35/tons, Jamaica spends between US$840,000 to US$1,050,000 on salt imports. The salt imported is 99.8% pure and undergoes purification and refining processes to be sold at the following prices:

(1) US$50/short ton of industrial salt
(2) US$86.50/short ton of brine crystal and
(3) US$87.39/short ton of bakers salt

The individual consumer in retail market pays between J$0.55 to $0.65/kilo of salt. (US$0.308 to $0.365).

Price fluctuations can be due to the scarcity of salt during given periods of time. These shortages seem to be more pronounced in the rural areas and in the small towns rather than in the metropolitan and tourist areas.

3. JUSTIFICATION FOR THE INTRODUCTION OF PEASANT TECHNOLOGY FOR EXTRACTION OF SALT

The factors that justify a trial mini-project for the extraction of salt under peasant technology are the following:

(1) Jamaica being an island has the ocean and the sunlight as unlimited resources for salt extraction

(2) There is a high unemployment level in the country. This situation is worse among rural women. The opportunity cost of labour for women with large young families in the rural households is nearly zero.

(3) The extraction of salt by solar energy is a simple and inexpensive method of salt extraction.

(4) The salt obtained from these units can help to satisfy the demand for salt at the village level reducing the pressure for its importation at the national level with the consequent saving of US currency.

(5) Salt extraction under a peasant technology is a suitable income generating activity for rural women with family responsibilities.

4. SALT PRODUCTION BY SOLAR ENERGY AND PEASANT TECHNOLOGY

The extraction of salt by using solar energy can be a rather simple process such as the one to be described here which consists basically of collecting sea water and letting it evaporate until only the salts remain.

The salt extraction unit to be described here is a simple and unsophisticated aritifical salt pond which is fed sea water directly from the sea, provided that the unit is located at a rocky beach or where the water is clear and not muddy. If, however, this unit were to be located near a muddy beach, filtering the water before it goes into the pond might be necessary. This of course, would increase the cost of production.

5. DESCRIPTION OF THE UNIT

The salt pond consists basically of a concrete pool which is 28 feet long, 14 feet wide and 6 inches deep. This is equal to 196 cu. ft. of water which would be collected and then evaporated. (See Figs. I & 2). The salt pond is enclosed by a salt resistant aluminum roof and sides which would assist in increasing the solar heat and avoid dirt and rain mixing in with the sea water and would accelerate the evaporation of the water by the higher than ambient temperatures resulting from the enclosure. The roof would be painted opaque black which will absorb a higher amount of heat. The corrugated roof would allow the ventilation to accelerate the evaporation of the water.

According to the literature and to trial experiments the content of salts in sea water is approximately 3.5%. This means that the sea water collected in the salt pond (5552 liters approximately), contains 194 kilos of salt.

The time taken for all the water to evaporate will depend on the temperature inside of the salt unit, number of sunshine hours, etc. Assuming that the rate of evaporation is approximately one half of an inch, per 24 hours, 194 kilos of salt will be obtained every 12 days. This rate of production will have to be verified by tests, once the unit is built.

6. TECHNICIAL BACKGROUND

The production of salt by solar evaporation of sea water has been used for thousands of years and it is still being used in the lowest cost industrial salt production plants in many parts of the world, such as in the United States and Europe.

The salt works in the United States and Europe by solar evaporation, are open air evaporators which are located in desertic low rainfall areas.

In Jamaica, due to the heavy rainfall experienced during some months of the year and to the unpredictability of rains, it is preferable to have the salt unit roofed. This also avoids larceny of the produced salt.

7. INVESTMENT AND LABOUR DEMANDS

In accordance with the attached list of materials, costed in the marked on June 15, 1980, the investment cost would be J$3,205.30 out of which J$2,629.30 covers the cost of the materials and J$576.00 the mason's contract to build the unit.

The operating cost would be limiting to the packaging materials used since the labour will be proved by the entrepreneurial group.

8. PARTICIPANTS AND LOCATION

The first group which would set up a salt producing unit would be a pre-cooperative group formed by six (6) women of the Schawfield Home Economics group, located in Bracco, parish of Trelawny.

The group will work under the direction of the Parish Home Economics Co-ordinator for the Western Region of the Ministry of Agriculture.

9. OUTPUT

As indicated at 4 above the salt unit will receive 196 cubic feet of water. Each cubic foot is equal to 7.489 gallons of water, equivalent to 28.327 liters of water. The salt content in sea water is of the order of 35 gr. per thousand. 196 cubic feet of water is equal to 552 liters of water equivalent to 194.25 kilos of salt.

The rate of evaporation is not confirmed at present and will vary between six to twelve days. If we assume twelve days, we can safely calculate that the potential production will be approximately 971.20 kilos every sixty days (two months).

The market value of the output sold at J$0.50 is J$485.60 every sixty days.

10. COST BENEFIT RATIO

The unit is estimated to last five years without any additional costs. The benefit/cost ratio for five years is equal to 3.3 in direct benefit due to the project. The secondary or social benefits are far greater than the direct benefits and would have to be estimated.

11. POTENTIAL EXPANSION & EMPLOYMENT

Given the demand for salt in the Island this same model could be duplicated in different locations producing employment and income for rural women whose employment opportunity are low due to family obligations (large young families) and isolated locations, but who could spare a couple of days to bring their produce to the market. The women could be assisted by their children, making the salt unit a "household" operation.

The additional income generated by the project would have an immediate effect on the family welfare, and standard of living.

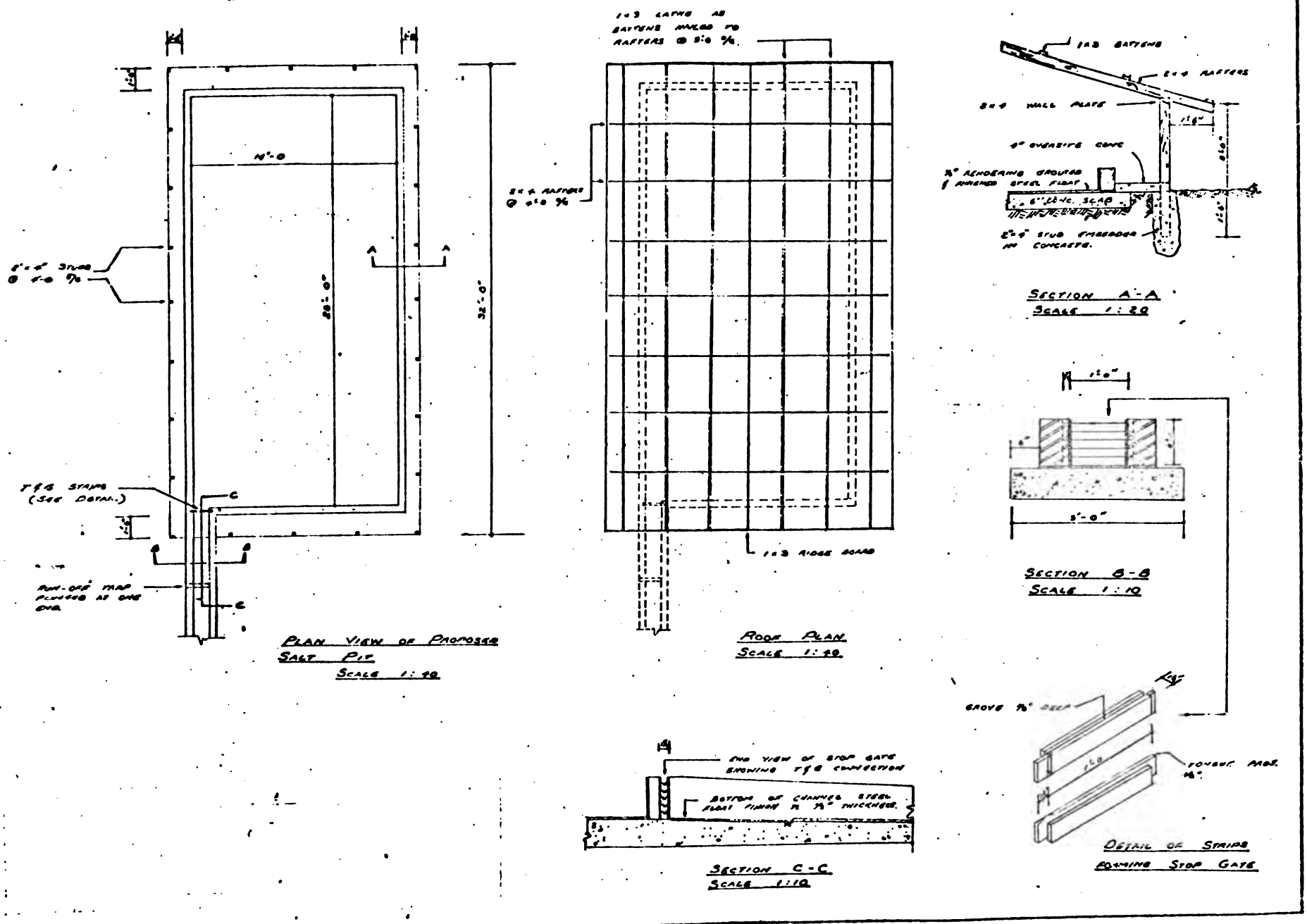
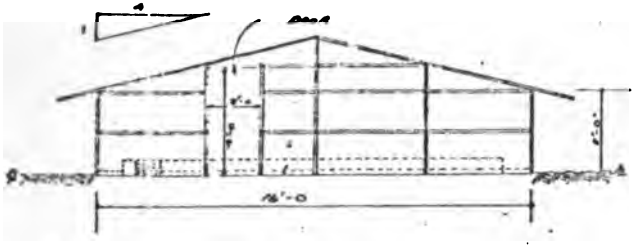
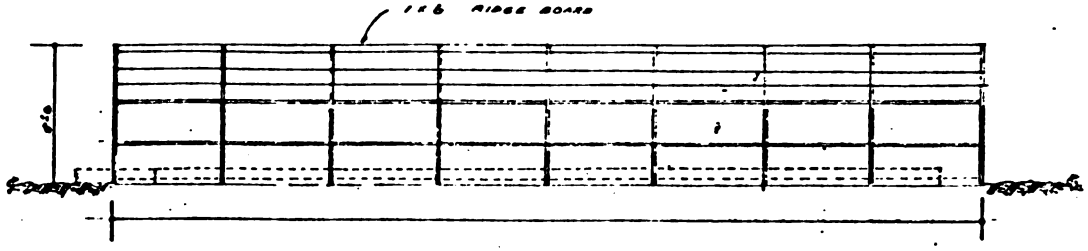

PLAN VIEW OF PROPOSED SALT PIT
SCALE 1:40
ROOF PLAN
SCALE 1:40
SECTION A-A
SCALE 1:20
SECTION B-B
SCALE 1:10
SECTION C-C
SCALE 1:10
DETAIL OF STRIPS FORMING STOP GATE
1x3 BATTENS
2x4 RAFTERS
2x4 WALL PLATE
4" OVERSIZE CONC
6" REINF. CONC. SLAB
2"x4" STUB EMBEDDED IN CONCRETE.
1x3 RIDGE BOARD
32'-0"
20'-0"
16'-0"
5'-0"
1'-0"

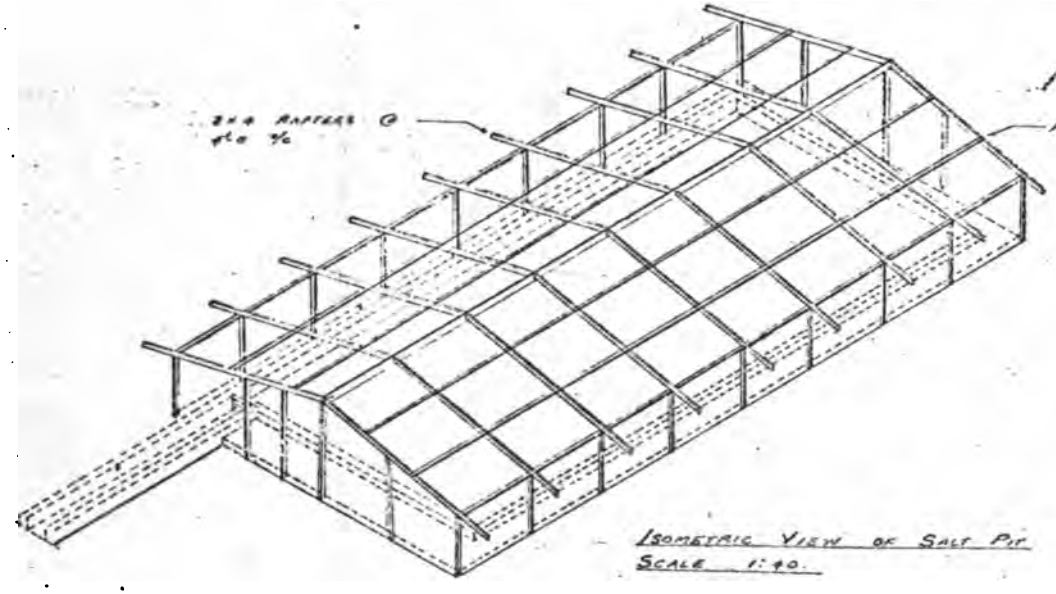
Fig. # 1



FRONT ELEVATION
SCALE 1 : 30



R.H. ELEVATION
SCALE 1 : 30



ISOMETRIC VIEW OF SALT PIT
SCALE 1:40

INTER-AMERICAN INSTITUTE OF AGRICULTURAL (IICA) GOVERNMENT OF JAMAICA (G.O.J.) EXPERIMENTAL PROJECT FOR SALT PRODUCTION		
DRAWN BY: FRANK BOYD DATE: 28TH JULY 1980	SHEET # 2	

CAPITAL COSTS

Mason's Contracts

Strip site of 6" of veg. soil and level surface to receive cc	20.00
Dig holes 12" deep for post	25.00
Cast 1:2:4 ½" agg. concrete and render with 1:3 cement and sand steel float finish	176.00
Set and bed 6" cc blocks in 1:3 cement and sand to form perimitten wall on cc slab render as above described	75.00
Set and erect stud post in 1:3:6 ½" agg. concrete. Complete with plate as wall and roof support	30.00
Make and erect rafters spacing as per plan	45.00
Lathe with 1"x3" battens and set zinc sheet to act as roof	96.00
Lathe with 1x3 battens and set zinc sheet to act as wall	40.00
Erect door on Leward side of building	20.00
Finish all extension surfaces with two (2) coats of flat black paint	40.00
Total	$576.00

MATERIALS

48 cement	480.00
Sand 5 cubic yds	120.00
Gravel 7½ cubic yds	120.00
6" cc. blocks wood	80.00
24 studs 2"x4"x4" seasoned lumber	95.00
18 rafters 2"x4"x10"	207.40
Plate 2"x4"x9"	107.10
Battens 1"x3"x108"	183.60
Misc. (nails angles etc)	60.00
2½ gal. paint	57.00
32 zinc sheets (10ft.)	416.00
Make and supply one ledge and brace pine door complete with lock and chain	120.00
Supply and erect one land water pump with 12ft. head along with soft 1" rubber tubing	240.00
	$2,629.30

Operation costs

Packaging materials	600.00	
Miscellaneous	644.70	
Total	$4,450.00	= (US$2,500)