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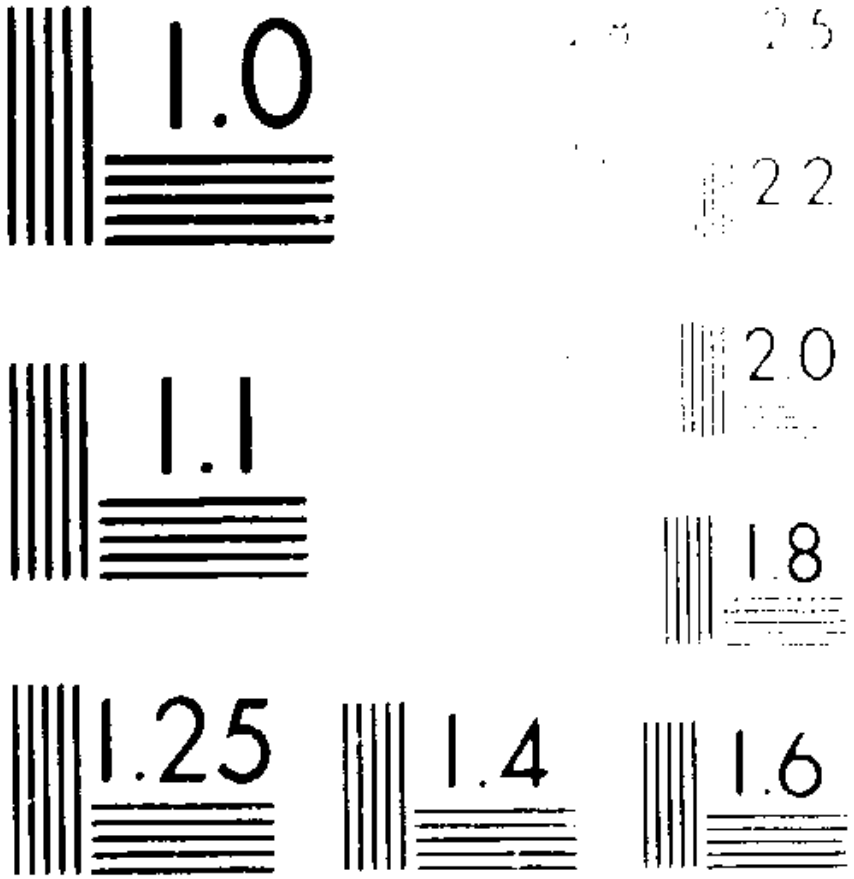
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FINAL REPORT

OF THE

FEASIBILITY STUDY ON THE ESTABLISHMENT OF A SMALL-SCALE BRICK MAKING PLANT

(PHASE I)

IN THE GAMBIA

UNDER THE AID OF THE UNIDO

PREPARED BY

THE FEASIBILITY STUDY TEAM OF
A BRICK MAKING PLANT
CHINA NATIONAL COMPLETE PLANT
EXPORT CORPORATION

JANUARY 1980
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INTRODUCTION

In accordance with the Contract (UNIDO Contract No.79/82) between THE UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION (the UNIDO) and THE CHINA NATIONAL COMPLETE PLANT EXPORT CORPORATION (the CNCPEC) for the provision of services relating to Conducting a Feasibility Study on the Establishment of a Small-scale Brick Making Plant (Phase I) in The Gambia, signed on July 19, 1979 in Vienna, Austria, the CNCPEC Clay Brick Making Feasibility Study Team made their on-the-spot investigations successfully in The Gambia on 19 clay deposits distributed in 15 localities from July 26 to December 1, 1979 during which representative clay samples were collected with special attention and their physical properties were tested by simple means. After a careful comparison, the BUSUMBAL clay deposit was eventually selected for detailed prospecting while primary prospecting was carried out only on the MANDINARY clay deposit. Representative clay samples were taken from both deposits for burnability test that was conducted with hand moulding green bricks made of each one of the single, as well as mixed clays of the two.

Apart from the above-mentioned activities, necessity of and conditions for establishing such a brick making plant, such as water, power and fuel supply, communication and transpor-

tation, marketing and economic effects etc. were investigated and studied. What is more, the Team also paid a visit to each one of the three existing manual brick making units.

The Chinese Team owes hearty thanks to the UNDP Resident Representative Office in the Gambia, Ministry of Economic Planning and Industrial Development of the Gambian Government, The Gambian State Lands Office and its laboratory and many other departments involved in this project for their great assistance to and unique cooperation with the Team throughout the feasibility study.

I. GENERAL INFORMATION

The Republic of The Gambia is situated in the western part of Africa and is bordered on the Atlantic to its west. It has an area of 10,000 km^2 out of which 3,000 km2 is covered with woods. The 480 km long River Gambia flows right through the plain-natured country from east to west. The climate of the country is tropical with a distinct dry season from November to May, and a rainy season from June to October. The Gambia has a population of 500,000 and the port capital BANJUL has a population of 50,000.

No coal is produced in the country at the moment and fuel

oil depends on import. The Gambia's national economy is based on agriculture with groundnuts as the primary cash crop and main export item.

The urban construction nowadays is mostly of R.C. beams and columns with hollow cement-sand blocks as walling and G.I. sheets or asbestos-cement sheets as roofing whereas the overwhelming majority of houses in the vast rural area are built out of sun-dried clay block walls and thatch roofs.

At present, The Gambia's building material industry is still at an early stage of developing and can hardly stand on its foot. Therefore, most of the essential building materials are relied on import at a considerable sum of foreign exchanges. Consequently, the construction of the country is affected to a certain extent. Under the supervision of British experts, a small brick making unit has been established in BRIKAMA, KERENWAN and MANSA KONKO respectively. Samples of products thereof have been tested by the laboratory of the IBSTOCK OVERSEAS LTD. of England and the results of compressive strength turn out to be 7 - 10 kg/cm^2 (105-151 psi) which cannot serve as load bearing building units for civil engineering purpose.

II. NECESSITY OF THE ESTABLISHMENT OF A SMALL-SCALE BRICK MAKING PLANT ON THE KOMBO PENINSULA

The population of the KOMBO PENINSULA (BANJUL is inclusive) is accounted to 110,000 which occupies one fifth of that of the entire country. The housing deficit in the urban area menifests itself in overcrowding whilst in the rural area, houses are simple and crude. The people, both urban and rural, are longing for an urgent improvement. Due to the absence of brick and other building materials production, house construction is handicapped considerably. Along with the development of industry, agriculture, culture and education, the improvement of housing conditions has become a crying need.

The Gambian Government has kept on trying hard for years to find a way out in developing building material industries with the strategy of making full use of the local resources and bringing down expenditures of foreign exchanges to achieve the goal of raising the people's living standards. To this end, expert of the UK, Czechoslovakia and India have been invited to the country to carry out feasibility study. And so has been the Chinese Feasibility Study Team of a Clay Brick Making Plant. After their visits to many parts of the country and studies, the Team holds that it

would be advisable to build a small-scale brick making plant on the KOMBO PENINSULA first, as this area is densely populated, raw materials, fuel, water and power supply, communication and transportation etc. are all within easy reach. Such a plant will play an important role in promoting development of the area, improving housing conditions, and providing more job opportunities. In the meantime, it may accumulate experience for and give demonstration to establishing and developing building material industries of the country. Hence, to have a small-scale brick making plant put up here would be a necessity.

III. FEASIBILITY OF ESTABLISHMENT OF A SMALL-SCALE BRICK MAKING PLANT ON THE KOMBO PENINSULA

1. Raw Materials

Upon arrival to The Gambia, the Team began their activities with field work of clay resources investigation. Inspecting and primary prospecting were conducted on all the 19 clay deposits distributed in 15 localities as recommended by the Gambian Government. Clay samples were collected with special attention and their physical properites were analysed by simple means. Based on the comparison of the test results, BUSUMBALA clay deposit appeared to be the top choice for detailed prospecting, so it was done. As for the MANDINARY

clay deposit which was a water holding swamp then it made the detailed prospecting impossible, for this reason, only primary prospecting was undertaken. Then, semi-industrial experiment was conducted with representative clay samples taken from both of the deposits, green bricks were hand moulded with either single clay as well as mixed clays. Results from three firings approved that bricks made of mixed clays produced obviously better appearance, ring and strength than that made of either single clay. The minimum compressive strength was 69.6 kg/cm^2, the maximum reached 84.7 kg/cm^2. and the average was 75.8 kg/cm^2. These tests promised that load bearing clay bricks for engineering purpose could be turned out with mixed clays of a proportion of about 65% of BUSUMBALAclay and 35% of MANDINARY clay.

The surveyed area of the BUSUMBALA clay deposit was some 34,000 m^2 and the clay layer varies between 0.30 - 2.00 m with the average thickness of 0.84 m, thus the reserve was estimated at 28,000 m^3. This would be sufficient for 20 years' consumption of a plant with an annual capacity of 500,000 bricks. An overburden of 0.2-0.4 m has to be stripped off during mining.

The MANDINARY clay deposit is about 20,000 m^2 with an average

thickness of 0.70 m clay layer. The reserve was estimated at 14,000 m^3.

Results of Physical and Chemical Analysis are shown as follows:

PHYSICAL PROPERTIES

Clay Sample	Plasticity %			Particle Analysis %			Factor of Drying Sensitivity	Linear Shrinkage of Drying %
	Liquid Limit	Plastic Limit	Plasticity Index	> 0.02 mm	0.02-0.002 mm	< 0.002 mm		
BUSUMBALA	30	17	17	76	6	18	0.78	4.62
MANDINARY	53	31	22	43	15	42	-	-

CHEMICAL ANALYSIS %

Clay Sample	L.o.i.	SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	SO_3	K_2O	Na_2O
BUSUMBALA	5.15	80.40	1.21	9.90	0.40	0.16	0.43	0.12	2.16
MANDINARY	8.11	57.93	10.52	16.20	0.68	0.96	1.41	0.88	2.82

Having had inspection survey over ten other clay deposits in the KOMBO area, a general impression obtained is that the plain clay is rather too sandy and less plastic thus causes it difficult in vitrification. On the contrary, clay of swamp along the River Gambia is slipery, belongs to a category of high plastic pelinite. Neither is suitable for brick making independently. However, qualified load bearing bricks can be produced when the two kinds of clays are mixed together in a reasonable proportion.

2. Fuel

There is no coal produced in the country, fuel oil depends on import and the limited forest resources is under strict protection by the Government policy. Fortunately, The Gambia produces a large quantity of groundnuts. Whilst a part of the groundnut shells are being used for energy generating, the rest are simply burnt as waste that can serve as good fuel, free of charge, for clay brick firing as it has been well approved by the successful experiment by the Chinese Team. Of course, the plant has to bear the freight.

3. Labourer

There is a number of urban people remaining jobless and in the rural area, a well half of the year is off season of agricultural activities. The proposed brick making plant can adopt

a seasonal production system by employing seasonal labourers. In the rainy season, the workers are laid off from the plant to work in their fields and production resumes in the dry season. Therefore, abundent labourer resources are available.

With the above evidence in mind, it is feasible to establish a small-scale brick making plant on the KOMBO PENINSULA.

IV. RECOMMENDATIONS OF ESTABLISHMENT OF SAMLL-SCALE BRICK MAKING PLANT ON THE KOMBO PENINSULA AND ITS ECONOMIC ANALYSIS

1. Proposed Plant Site

To select an ideal plant site, the Team conducted on-the-spot inspections to KANIFING where was recommended by the Gambian Government. Taking the future physical planning of the government and comprehensive factors into consideration, to locate the plant behind the Police Barracks, just opposit the HPS plant is more advantageous.

i). KANIFING is a growing industrial estate which is 10 km away from BANJUL, 3-5 km from SURREKUNDA and BAKAU. In recent memory, the pace of urban development has been speeded up. So KANIFING will be a main brick consuming market.

ii). Both water and power are supplied to the estate and it is connected with the principal towns hereabouts by city

roads that make it easy for raw material, fuel and products transportation.

iii). KANIFING is 14 km apart from either BUSUMBALA or MANDINARY clay deposit and is near to the groundnut shells supplying localities, about 300 m from the HPS Plant and 5 km from DANTON BRIDGE.

2. Working Days, Output and Varieties of Products of the Plant

Considering the local climate, seasonal production system (close down in rainy season) is recommended. Excavation and transportation of clay, moulding and drying shall be one shift per day and 170 working days per annum while firing shall be three shifts per day and 210 working days per annum. The annual output of common solid clay bricks (240 x 115 x 53 mm) will be 500,000.

3. Personnel Organization

Seasonal workers (by contract)	approximate	22
Permanent worker	"	1
Administrative and technical supervisor	"	2
	Total	25

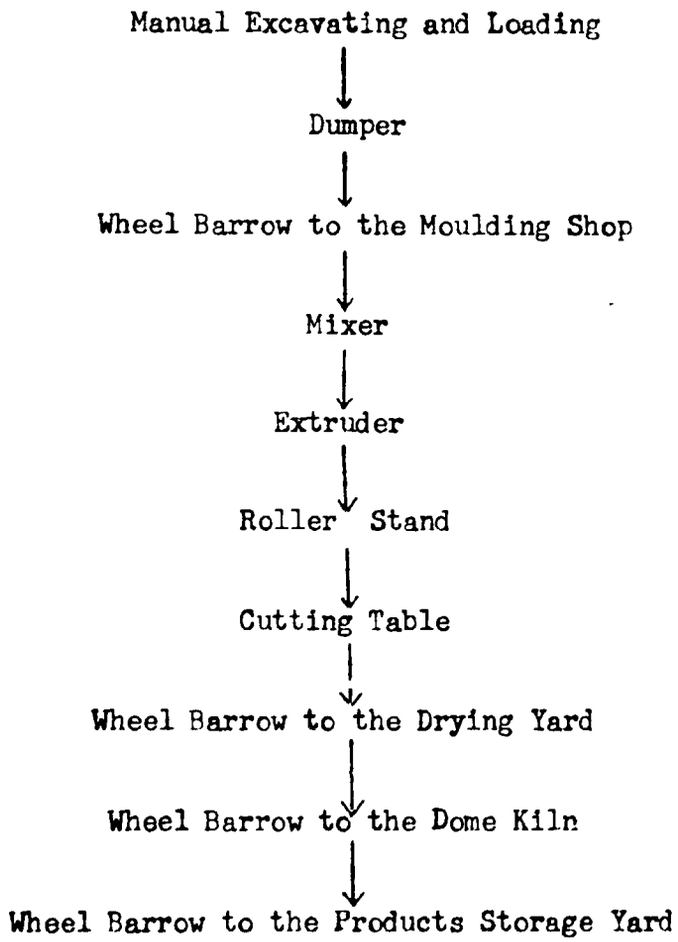
4. Composition and Area of the Plant

The envisaged brick making plant will consist of a moulding workshop, an air drying yard, a green brick storage, an office, a storehouse and a gate house.

The plant will occupy an area of about 6,000 m^2 and the floor area will be about 200 m^2.

5. Production Technology

Bearing in mind the local conditions and properties of the clays, extruding moulding process is recommended as follows:



6, Quantity of Main Equipment and Materials Provided by China

Mixer	1	set
Extruder	1	"
Roller Stand	1	"
Cutting Table	1	"
Wheel Barrow	30	pcs
Pallet	100	"
Iron element for the Kiln	500	kg
P.V.C. Water Hose	100	m
Tools and Apparatus	10	set
Wooden Platform	2	pcs

7. Annual Consumption of Materials by the Plant

Clay	approximate	1.100	m^3
Fuel (groundnut shells)	"	300	T
Water	"	500	T
Electricity	"	18,800	kwh
Petrol	"	7	T

8. Estimation of Total Investment of the Plant

i). The UNIDO inputs:

Equipment and materials supplied from China	approx.	RMB100,000
Expert expenses	"	RMB205,000
		US$39,000

(5 experts, 6 months service each, monthly salary at RMB6,000 plus round about air tickets RMB5,000 and daily allowance of US$44)

ii). The Government inputs (Dalasis):

Ground levelling, boundary walls and roads approx.		D7,500
Civil construction	"	D40,000
Water	"	D3,500
Electricity	"	D6,000
Kiln construction	"	D25,000
Machine installation	"	D3,000
Tools and apparatus and furniture	"	D5,000
One dumper truck	"	D30,000
Total	"	D120,000
Plus working capital for 6 months		D20,000

9. Total Production Cost (Dalasis)

i). Salary and wages	D21,000
ii). Groundnut shells	D5,000
iii). Petrol (about 7 tons)	D5,950
iv). Water	D300
v). Electricity	D6,000
vi). Maintenance and management	D2,500
vii). Depreciation of fixed assets at 5%	D12,500

(including the UNIDO inputs D125,000 and the Government

inputs D120,000. Total D245,000).

viii). Insurance of fixed assets at 1% D2,450

Total D55,980

Total production cost of 500,000 bricks per annum will be estimated at D55,980, therefore, production cost per brick will be at D0.112. Assuming the sale price per brick to be fixed at D0.13, then the total income of sales will be D65,000, the annual profits will thus be (D65,000-D55,980) D9,020.

10. Price Comparison between Clay Bricks and Cement-sand Blocks

Sale price of a double core cement-sand block produced locally is D1.25. One such block equivalent to 7.6 bricks in volume, convert this amount into brick price, i.e. per piece will be at D1.25÷7.6=D0.164. So it is more expensive than that of the actual clay brick.

V. PROPOSAL ON WORK DIVISION IN EXECUTION OF THE PROJECT

The UNIDO shall be responsible for:

1. providing technological equipment and materials (the dumper is exclusive).

2. dispatching experts to render technical supervision in construction of the plant, on-the-spot firing of bricks

for the kiln construction, machine installation, commisioning and technical training to the workers.

The Government shall be responsible for:

1. providing a dumper truck for raw materials transportation.
2. providing the lands for the plant area and raw material mining.
3. construction of the plant, roads of both inside and outside of the plant, materials for water and power supply and their execution.
4. clearing and deliverying the goods from the port to the plant site and storing them properly.
5. providing the experts with necessary offical transportation, suitable office, essential furniture and office equipment.

VI. ANALYSIS OF ECONOMIC EFFECTS

The Gambian economy is mainly based on agriculture which is basically individual farming of manual operation while mechanized cultivation and field management is seldom seen. Though there are such industries around BANJUL area as soft drinks and groundnut processing etc., they after all belong to a category of single product economy of agriculture.

At present, the principal building materials and industrial commodities depnd on import. Due to the limitation of financial resources, various developments of the country are restricted to some extent. As how to improve the existing state of The Gambia's economy, the Team holds, based on its findings, that those medium and small sized industries applicable to the situation should be established and developed. This shall be a significant measure to flourishing The Gambia's national economy. When industry is developed, developments of agriculture, culture and education, commerce and import and export etc., are bound to be promoted and consequently leading the country to prosperity step by step.

One of the first considerations of development of industries is the building materials industry as it is a basic one which will push forward the development of other industries as a general rule. Even though the envisaged small-scale brick making plant will only play a minor role in the development of the national economy for its offering only 500,000 bricks a year that is just sufficient to build 1250 m^2 houses in floor space at an estimated consumption of 400 bricks/m^2. Assuming that a minimum area of 8 m^2 per capita and the mean household size taken as 6-7 people, that quantity of bricks can only house 156 people of 25 households. This estimation show how little the plant can do,

but, however small the plant is, its significance in essence lies in that The Gambia begins to establish building materials industry by completely utilizing the local natural resources and manpower of her own. This is also another fruit of cooperation between The Gambia and the UNIDO.

In the initial period soon after the plant established, most probably the people are not used to clay bricks since very little being used in the country. It may take some time for the people to understand the superiority of the products. Once people are convinced, and both of the Government and people are benefited from using it, a plant capable of producing two million bricks per year including hollow bricks and lattice bricks may be brought under consideration so as to satisfy the broadened market and to accumulate capital for the country. This plan will suit the densely populated urban areas but not the rural areas.

Concerning the development of building materials industries in the rural areas, various forms applicable to the countryside different with those of urban areas should be employed according to the local characteristics and specific conditions. The normal size of a Gambian village has a population of 300-500, some are bigger while others are smaller. The

farmers are free during the dry season that lasts 5-6 months. This would be the right time for clay brick manufacture. The Community Development Department may organize a few families with about 10 labourers, where conditions are favourable, into a labour intensive production unit on the cooperative basis for experiment. Adopt the process of manual digging, moulding and firing bricks with agricultural disposal in a dome kiln. The capacity can be set at 100,000 bricks per annum. To make such production unit go at the beginning, a sum of 5,000-10,000 Dalasis financial assistance by the Government would be necessary to purchase some essential facilities. When the experiment turns out to be successful, let it be popularized in the countryside throughout the country. In this way, quick results can be easily achieved with less investment. Such production unit will give direct impacts to improving the housing conditions in the rural areas, raising the living standards of the farmers, developing and enlivening the rural economy. The implementation of this plan requires the necessary UNIDO expert services.

Assuming the above-mentioned plan materialized, it will not only play an important role in improving people's housing conditions, but also in the development of The Gambia's culture, education, commerce, tourism and urban

and rural economy etc..

Apart from the clay brick industry, other aspects of building materials also shall be worth exploring. Such as:

1. Lime. Lime is a widely used cementing material in building industry, particularly in plastering in place of cement which completely depends on import. There is abundent deposit of oyster shells out of which lime can be produced in The Gambia as various studies show.

2. Ceramsite: Pebbles or rubbles are not available in The Gambia and the locally sonsumed aggregates for concrete works have to be imported from abroad at the rate of over 100 Dalasis/m^3 (over US$60). Nowadays, many countries that are short of aggregates have begun to manufacture ceramsite out of clay which serves as aggregates in substitution of pebbles or crushed stones. China has also built a number of such ceramsite plants supplying with good quality of aggregates.

Should the above said products be developed, they would be very significant to the Gambian economy. Therefore, the Team should like to recommend that the two items be given a place in the development plan of the national economy. At the first stage, invite the UNIDO to provide expert services to commence

the feasibility study of the establishment of the lime and ceramsite plants.

VII. POSTSCRIPT

As the clay brick industry develops, the problem of brick laying technique in civil engineering projects will crop up therefrom. In order to popularize the proper usage of clay bricks in the country, brick laying technique training for the Gambian people seems to be quite necessary. Therefore, a reasonable number of UNIDO financed experts of this kind are recommended to offer technical training in this field after the plant is formally put into operation.

* The End *