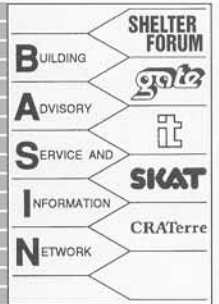




Wall Building Case Study



Small and medium scale brick and tile production in Ghana – 1 An overview

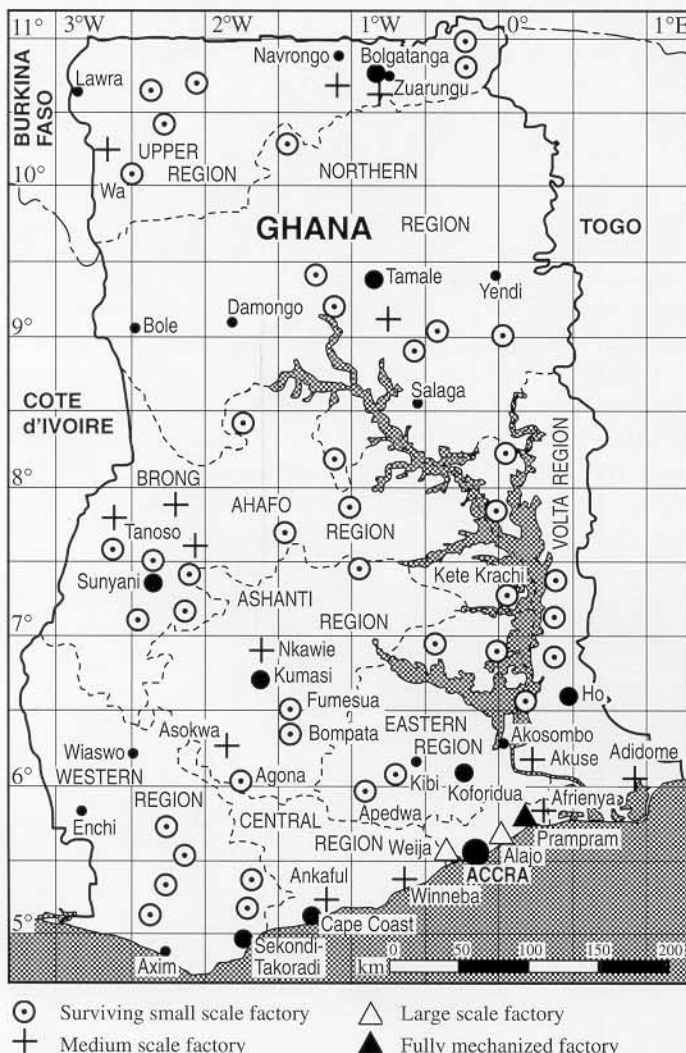
Introduction

The manufacture and use of burnt clay bricks for housing started many decades ago in Ghana, as can be observed from the existence of some old brick buildings in Accra, Kumasi, Cape Coast and Takoradi. The practice died down until after the Second World War. Before and during the war, however, the missionaries, notably the Basel and Scottish missionaries in Ghana, continued to produce bricks and tiles on a small scale and taught the skills at all their teacher training colleges and schools.

In 1954, the Ghana Industrial Holding Corporation (GIHOC) set up a brick and tile factory in Accra. The products were very popular and the demand for them was so great that orders could not be supplied for months, if not for years. So by the late 1960s, this resulted in the establishment of new factories in Ghana. Through a mass importation of Brazilian brickmaking machines, more factories were established in the late 1970s and early 1980s. But their products exerted little impact on the building construction industry and many large scale factories have had to close down.

Research was therefore initiated to support the industry. Initially, the research work concentrated on clay evaluation and kiln design, but later the research focus was shifted to identifying the causes for the poor performance of the brick and tile industry, to find means of overcoming the problems.

This case study, based on the above mentioned research work and on investigations undertaken at the end of 1996, gives an overview of the brick and tile industry in Ghana, analysing the major causes of its



Name and location of factory	Type of factory	Status of factory
Prampram Brick and Tile Company, Prampram, Greater Accra Region	Fully mechanized, automated using tunnel kiln	Sold
GIHOC Brick and Tile Company, Weija, Greater Accra Region	Fully mechanized, loading and unloading kiln manual	Divestiture
Clay Products Ltd, Alajo, Greater Accra Region	Fully mechanized, loading and unloading kiln manual	Operating
Agitree Brick Company, Afrienyaa, Greater Accra Region	Semi-mechanized,	Will be on sale
Ashanti Brick and Tile Company, Nkawie, Ashanti Region	Semi-mechanized,	Operating
Asokwa Brick and Tile Co., Asokwa (near Obuasi), Ashanti Region	Fully mechanized, loading and unloading kiln manual	Will be on sale
Gomoa Brick and Tile Co., Mpramen, Central Region	Semi-mechanized,	Sold
Ankaful Brick and Tile Co., Ankaful, Cape Coast, Central Region	Semi-mechanized,	Sold
Adidome Brick and Tile Co., Adidome, Volta Region	Semi-mechanized,	Operating
About 10 small scale factories were visited, including BRR1 R&D factory, Kumasi; Kukran Brick and Tile Co., Apedwa; and VicAlex Enterprises Ltd, Mfensi, covering 4 regions	Small scale and cottage enterprises	Most of the factories thriving. Major problem: financial working capital locked up in unsold products

Figure 1: Location of some brick and tile factories in Ghana

Table 1: Brick and tile factories visited for the study

low productivity and the collapse of some large scale, fully mechanized factories (such as the Prampram factory), and discussing the potentials of the surviving factories, which are predominantly small scale (labour-intensive) and a few thriving medium scale (semi-mechanized) ones.

Production inputs

Raw materials

The raw materials for brick production are clay, water and fuel, and in some cases, also sand. Deposits of both residual and transported lateritic brown and black clays suitable for brick production are distributed over Ghana, whereby the Western Region is favoured with the most clay deposits as against the Volta Region with the least deposits. The quality of the clay deposits at Kukran Brick Company at Apedwa, for example, are superior to those of the Prampram Brick and Tile Company and of Agritree at Afrienyia. The total volume of known clay deposits in Ghana is estimated to be 500 - 600 million cubic metres.

There is no difference in the quality required of the clay and water for a large scale fully mechanized brick factory from that of a small scale manually operated process. The only significant advantage the large or medium scale factory has over the small scale one is in the processing of the clay prior to moulding, as bigger volumes of materials can be processed.

Energy

Energy is one of the most important inputs in the manufacture of bricks. There are three main sources of energy: petroleum fuels, gas, and wood and agricultural wastes. In terms of production scale, there are differences in the quality of fuel used: whereas a large or medium scale factory may be restricted to the use of diesel or residual oil or gas, the small scale one is versatile and may use firewood, agricultural wastes, as well as petroleum products for firing. The small scale brick industry is not directly affected by the shortage of petroleum products on the market. However, their activities have direct effect on the environment through cutting of trees for firewood. Difficulty to get firewood adversely affects the small scale industries in Northern Ghana and coastal areas. Therefore, brick factories have been encouraged to grow their own wood lots. A small scale enterprise using wood will need about one tonne of firewood to fire 1000 bricks.

Labour

The small scale brick factories are labour intensive and rely mainly on semi-skilled and unskilled labour, which is always available at the labour market. Medium and large scale factories, on the other hand, require skilled personnel and managers of different operations, namely a production manager, sale/marketing manager, accountant, cashier and accounts clerk as well as technicians and skilled operators, and usually need time to train them before they are used. The training that is sometimes required for the small scale brick factories is not as intensive and expensive as that for the medium or large scale factory, but a major disadvantage of unskilled workers is that they tend to be casual and impermanent. Hence there is always the need to train a new batch of labour.

In the large and medium scale brick factories, some amount of labour is imported during the installation of the plant and for periodic maintenance of the factories.

Machinery and equipment

There are basically five processes in brick production. These are clay winning, raw material preparation, moulding, drying, and then setting and firing of the green bricks. Manual, semi-mechanized and fully mechanized methods can be employed for any of these processes.

The VicAlex Enterprises, a small scale brick factory, uses no machinery and equipment except tools (pickaxes, mattocks, cutlasses, etc.), which are manufactured locally and are readily available. The other small scale factories use very limited number of machinery. The Building and Road Research Institute (BRRI) research and development factory at Fumesua/Kumasi is also labour-intensive. The only process mechanized is the mixing of the clay, using a locally fabricated machine, but during power cuts, the clay is mixed by treading with feet. The installation, maintenance and repair of these machinery are all undertaken by local skills. The medium scale factories use a mixture of machinery and labour. Although the Clay Products Ltd started with very limited mechanization, currently it has mechanized most of the processes, leaving a few areas to labour.

Investment in buildings and related infrastructure for the small scale factory, mainly comprising the kiln and the drying shed, is relatively low and involves no foreign exchange component. Many small scale factories (VicAlex type) can be obtained from

the total investment of a medium scale factory, like Clay Products or Agritree. These have to invest in offices, drying shed and many other facilities. The general trend with the small scale factories is that they start with sheds and wooden structures for offices. As the factories pick up, the bricks and tiles produced are used to construct the required infrastructure, such as offices. This way, the products are advertised and working capital is conserved.

Type and sources of technology

Type of technology

- Clay winning

For all scales of brick production this is a capital-intensive process, using clay digging machinery, such as tractors and grab excavators, although small scale enterprises do employ labour-intensive methods, using pickaxes and mattocks, and conveying the clay to the factory with wheelbarrows and carrying in headpans (eg Kukran and VicAlex factories). The fully mechanized and semi-mechanized factories (eg Prampram, Clay Products, GIHOC, Agritree, Ankaful and Gomoa) convey the clay by using tipper trucks and dumpers owned by the factory. Semi-mechanized factories sometimes hire additional tipper trucks for the task. The BRRI factory, employs both manual and mechanized methods for winning.

- Preparation and mixing

In the preparation and mixing of the raw materials, the degree of mechanization (using screens, crushers and disintegrators) varies considerably with each semi-mechanized factory, but even some small scale factories, eg Ankaful, partly use machines in the preparation and mixing of the raw materials. Sometimes, mixing is carried out using a pugmill (BRRI factory).

- Moulding process

Hand-moulding techniques are common in small scale factories. In medium scale factories the moulding process is generally machine-aided, but also in some small scale factories, eg Kukran, which introduced a brickmaking machine from India to facilitate moulding.

- Drying of green bricks

All the small scale factories use natural drying methods. Some medium scale factories use natural and/or artificial methods. Natural drying means air drying, with or without forced ventilation. The green bricks are placed on drying racks such that air may circulate freely around them. Natural dry-

ing takes 14 to 21 days before firing. Drying is relatively slow during the rainy season, but fast during the harmattan (dry season), resulting in many and intense shrinkage cracks. Hence the rate of drying of green bricks can affect production targets. For example, Clay Products had severe production setbacks because of inefficient drying methods. This deficiency has been overcome through enclosure of the drying sheds, which now enable the utilization of the hot air from the kiln for drying the green bricks, as is done at the Agritree factory. Only the Prampram factory used tunnel dryers, an expensive but efficient artificial drying technique.

- **Setting up and firing of green bricks**

In all the small and medium scale brick factories, the setting up of green bricks into kilns and firing are carried out manually. In fully mechanized factories the setting up and firing are linked and carried out automatically. Whatever the scale of technology applied, the firing is started at low temperature in order to get rid of moisture in the green bricks, so as to avoid explosion. The temperature is then increased when all the steam generated in the kiln has been driven off. Between the temperatures 500°C and 580°C, where quartz inversion occurs, the firing is carried out slowly to avoid thermal shock of the bricks in the kiln. After this range of temperature, the rate of firing is increased. Generally, the rate of heating in a small scale factory is relatively slow. This is safer, but faster rates of heating involve less heating time, lower heat losses and are therefore cheaper. The optimal heating rate is that which requires the shortest heating schedule, while at the same time yielding a product of satisfactory quality. Removal of burnt bricks from the kiln is carried out manually in all small and medium scaled factories.

Sources of machinery

The machinery employed in brick production by the large scale and medium scale factories are all of foreign origin. Practically all the machines at the Prampram factory are Italian. The machines at Clay Products are of Belgian make. The GIHOC factory has a conglomerate of Belgian, German and French machines. The other semi-mechanized factories have Brazilian brickmaking machines. However, digging machines and trucks come mainly from Europe. The small scale factory at Kukran acquired an Indian brickmaking machine. Only the pugmill at the BRRI factory was locally fabricated. The Institute has also fabricated a mobile hand operated tile making machine.

Labour component in imported technology

During the installation and trial of plant and imported machinery, foreign labour was necessarily imported from some time. For instance, when the Indian red brick technology was introduced into the Kukran factory, an Indian expert worked there for four months. The situation was similar at Agritree, GIHOC and the others. In the case of Prampram and Clay Products, the foreign labour was kept for a long time. Recently, Clay Products has engaged a foreign expert to run the factory.

For the Brazilian technology, Ghanaian experts were sent to Brazil by the Bank for Housing and Construction to study the installation procedure of the machine and equipment. They returned to Ghana and helped install the machines in the factories. Later a few Brazilian experts came over to Ghana, acquainted themselves with the performance of the introduced technology and gave advice where appropriate. In the other small scale factories, like the VicAlex Enterprises, there was no imported foreign labour. The BRRI factory benefited from Egyptian Technical Aid, whereby an expert from Egypt came over to Kumasi to help with the construction of a kiln.

Economics of production

Production cost comparison between different levels of brick production

While the medium scale factories manufacture similar products as the large scale factories, the small scale and some medium scale factories produce only solid bricks. However, the unit production cost of standard solid bricks from the medium scale factories is nearly twice that of the small scale ones.

The transportation cost of bricks from the factories is fairly high and after a certain distance it is not economical to transport the product. Of the factories studied, only the Ankaful and Prampram factories used to have the facilities to deliver the bricks. For example, the Ankaful Company charged ₵ 2,000 per 1,000 hollow clay blocks for a radius of 13 km from the factory. For the same radius ₵ 2,000 were charged for 2,000 solid bricks. The delivery distances were limited to 80 km radius. At this radius, the charges were ₵ 8,000 per 1,000 hollow clay blocks and for the standard solid bricks it was ₵ 8,000 per 2,000 bricks. Generally, delivery charges for standard solid bricks within Accra was ₵ 3 to ₵ 5 per brick. All of these factories have ceased functioning,

except the Clay Products Ltd. Currently, they charge a lump sum for the distance and not for the number of bricks purchased. For example, if delivery is made within a radius of 2 miles (3.3 km) they charge ₵ 115,000 (≈ US\$ 65); within 15 miles (25 km) they charge ₵ 150,000 (≈ US\$ 85) and if the distance is within the radius of 25 miles (40 km) they charge ₵ 180,000 (≈ US\$ 100).

Differences between the clients or users

The small scale factories mainly produce standard solid bricks and tiles for housing, while the medium scale factories manufacture a variety of products for many constructional purposes. It may, therefore, seem that high-income earners only patronize medium scale factories, but in reality this is not true, and the products of all production scales are used for the same functions and by the same class of clients. The Kukran factory, a small scale enterprise, for instance, used to supply the Public Works Department at Koforidua with bricks for its construction work.

Product quality

Products from medium scale factories are uniform with little variation, whereas the hand moulded products of the small scale factories usually have wide differences in dimensions, strength and water absorption. Although their strength is adequate, the variability within a batch of these products are of concern to buyers. On the other hand, many architects prefer the rustic texture of the hand-moulded bricks.

None of the products of the small scale factories showed efflorescence, which is mainly due to the chemical properties of the clay. However, the products of two medium scale factories showed efflorescence, and the product of one other factory showed very serious "lime popping".

Constraints in production

Production capacity

Most of the surviving brick and tile factories do not achieve 75 % production of the installed capacity. The lowest production capacity of 26.7 % was registered by the Prampram Company before it collapsed. The production capacities of the medium scale factories range from 45 to 55 %. An exception is that of the Clay Products Ltd, with a production capacity of 70%. Most of the small scale factories have capacities ranging from 67.7 to 75 %. The reasons for

the under-utilized production capacities lie mainly in financial constraints and the non-availability of spare parts.

Financial constraints

The financial situation for all factories is very weak. Paying back the bank loans has been difficult, because of the high interest rates and an ever increasing and unstable exchange rate of the US dollar and other foreign currencies vis-à-vis the cedi. The current interest rate of the commercial banks ranges from 40 to 45 % for industrial loans. So it is very difficult to go in for loans without passing on the high interest rate to the consumer.

Another important factor is the crippling effect of inflation and the general weakness of the economy. The overall effect is that the product is very expensive and therefore cannot compete with sandcrete blocks. Because there are not enough sales, working capitals are easily exhausted and take a long time to be replenished to enable necessary inputs like firewood to be procured for work to continue. As a result, instead of firing four times a week the factory may fire just once a week. This accounts for under-utilization of production capacity.

Non-availability of spare parts

This problem applies to the fully mechanized factories and to a lesser extent to the medium scale factories. Small scale factories do not have such problems. The Prampram factory, for instance, was greatly affected by this problem, as a large amount of equipment and machines had to be repaired or replaced. Very often the spare parts were not available, and when they were available they were very expensive. Another constraint peculiar to fully mechanized factories is lack of skilled personnel to attend to repairs and maintenance. In the case of the GIHOC factory, most of the equipment and machinery are more than thirty-five years old. So they break down practically everyday and make it difficult to achieve even 50 % of the installed production capacity.

High energy consumption

The major part of the energy consumed in the brick and tile industry is used in firing the bricks. The large and medium scale factories use petroleum products for firing. These are presently in good supply in the country. However, should there be any shortages in the future, these factories will be seriously affected.

Electricity is used by the fully mechanized factories and to some extent by the semi-mechanized factories in running the machines and providing light. But electricity is never used in firing the green bricks.

The small scale and some medium scale factories use firewood and charcoal briquette for firing. They also use petroleum products for transportation purposes, so they will also be affected by any fuel crisis. With strict implementation of environment awareness laws these days, the small scale factories find it difficult to get firewood, especially in Northern and Southern Ghana, though less so in the forest zones, like the Ashanti and Brong Ahafo regions. The poor performance of some small scale factories is attributed to inadequate supply of firewood, and each factory is encouraged to grow its own firewood, if possible.

Some medium scale factories are trying to introduce the use of liquid petroleum gas. Presently they are at different stages of effecting the necessary installations for the storage and regular supply of the gas.

Conclusion

It is clear from the case studies that in a situation where the economic condition of a country is as unhealthy as it exists in Ghana and many other African countries, technologies adopted for brick and tile manufacture should be either small scale labour-intensive, or medium scale, semi-mechanized, in order to ensure flexibility and adaptability.

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(1997)

What is BASIN?

Building materials and construction technologies that are appropriate for developing countries, particularly in the low-income sector, are being developed, applied and documented in many parts of the world. This is an important prerequisite for providing safe, decent and affordable buildings for an ever-growing population.

But such new developments can do little to improve the building situation, as long as the information does not reach potential builders. The types and sources of information on standard and innovative building technologies are numerous and very diverse, making access to them difficult.

Thus, in order to remedy this drawback, Shelter Forum, GATE, ITDG, SKAT and CRATerre are co-operating in the Building Advisory Service and Information Network, which covers five principal subject areas and co-ordinates the documentation, evaluation and dissemination of information.

All five groups have a co-ordinated database from which information is available on Documents, Technologies, Equipment, Institutions, Consultants as well as on Projects and Programmes. In addition, printed material or individual advice on certain special subjects is provided on request. Research projects, training programmes and other field work can be implemented in co-operation with local organizations, if a distinct need can be identified and the circumstances permit.

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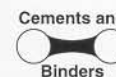
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