UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI

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DEPARTMENT OF ARCHITECTURE

RURAL INDUSTRIAL COMPLEX

AWAHAM NKWANTA

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BY

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D E D I C A T I O N

Dedicated to the memory of my late Father, Chief Yakubu Vorgu (The Jena-Na), who had never failed to encourage and help me, contributing generously of his own resources and giving me that most precious of all gifts - A SOUND EDUCATION

AND

to the rural poor, whose unsung sweat and toil constitute the veritable motive force behind our national agricultural base.

A C K N O W L E D G E M E N T S

I am sincerely thankful to God who did not only create, but governs and sustains the Universe, and whose existence as a Supreme Power is irrefutably manifested in the existence of exquisite order and design in this great universe where all components function in perfect cohesion. That I should be preparing this DESIGN THESIS REPORT now in relative GOOD health, having been mesmerized by a strange sickness which defied all optimistic prognosis and diagnosis of medical brains for more than one year, convinces me of God's pre-eminance in my life.

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A B S T R A C T

Development strategies the world over have for long laid undue emphasis on the use of high level technology in industry, most often inappropriate to existing economic, social and physical situations. Diligent industrial developments often thrive in Urban areas at the expense and strangulation of rural communities, in so far as they largely incite and perpetuate a rural-urban migration of the youth who are by all means 'the blood of rural settlements'.

Urbanisation has not only led to intractable problems in banditry, vandalism and wanton unemployment, but has largely exposed men to ludicrously complicated urban and city management systems. These problems have often disposed several governments to awkward and desperate situations, and motivated them towards evolving measures to either check, or reverse wanton migration to cities from the countryside. Incontestably however, all such attempts are deemed to exquisite failure unless rural areas are given their fair share of the national cake by way of physical development in the first instance.

The Provisional National Defence Council (PNDC) government of Ghana has drawn up an Economic Recovery Programme (ERP) which emphasises the consolidation of our national agricultural base; a laudable idea which together with its policy of decentralization of the national administrative machinery promises to constitute a suitable platform for take-off to regional development.
In the very short term therefore, rural industrial concerns that will largely employ agricultural products as basic input deserve emphasis. Such rural industrial concerns may not only discourage rural-urban migration, but shall more particularly become growth

poles thereby presenting formidable joints for both backward and forward industrial linkages for the total development of Ghana.

Fortunately, a few conscientious Ghanaian Industrialists, who certainly deserve all encouragement and support from central government as well as the blessings and prayers of the rural poor, have decided to take advantage of the government rural industrialization policy.

One of such pragmatic nationalists is Mr. J.K. Kwaw of Gokab Limited, who has acquired a tract of land of about 11,34 hectares (28 acres) at Awaham Nkwanta, between Asamankese and Osenase, in the Eastern Region of Ghana for a rural industrial complex.

There are cogent signs that Ghanaians may soon be ushered into a true 'rural industrial revolution', and era that will rely on the use of appropriate technology and locally available input in rural industrial concerns.

It is one of the objectives of this thesis to create an architectural entity for the proposed Rural Industrial Complex at Awaham Nkwanta, in order to demonstrate physically the feasibility of the concept of rural industrialization.

C O N T E N T S

CHAPTER 10 - THE SCHEME

CHAPTER 1

I N T R O D U C T I O N

1.01 THE PROJECT AND ITS RELEVANCE TO GOVERNMENT POLICY ON INDUSTRIALISATION

The Investment Code, 1985, promulgated through the Provisional National Defence Council Law (P.N.D.C.L.) 116, identifies Agriculture[1] - in terms of production, protection, processing and preservation of crops and livestock, and manufacturing industries[2] that predominantly use local raw materials as priority areas of investment and consequently qualifies enterprises in these sectors for the following benefits and incentives.

1. Government guarantee of landuse for the establishment and operation of the project
2. Requisite permission for importing essential machinery and equipment required for the enterprise
3. Exemption from payment of customs import duties on plant and machinery exclusively to establish the enterprise
4. Investment allowance of between 7½% - 10%
5. Depreciation or Capital allowance of between 40% - 100% in the year of investment

The P.N.D.C. government's policy on industrialisation, as can be inferred from the Investment Code, 1985, does not only give unequivocal preference to enterprises such as integrated Agro-Industrial Complexes, but goes further to urge their utilization of Ghanaian labour in preference to imported machinery[3], and their location in zones of raw material production.[4]

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1. Investment Code, 1985 Part II, Section 12 (1)
2. Ibid
3. Investment Code, 1985, Part II, Section 13(4)
4. Investment Code, 1985, Part IV, Section 22(3)

Thus, a rural industrial complex such as the one proposed for Awaham Nkwanta, which organises the resources of the rural environment, with little capital but high labour intensity, for processing falls in line with the government's industrialisation policy.

1.02 PURPOSE OF PROJECT

The main objective of this project is to design an industrial facility for the production of gari and starch, and the manufacture of brushes, as well as make room for the engagement in other auxilliary enterprises to support the operations of the factories or else make use of the factories by-products.

The intention is that by bringing industrial development to Awaham Nkwanta, the village does not only become a growth pole, but more importantly the socio-economic standard of the people in that geographical area (Awaham Nkwanta and environs) is enhanced. In pursuance of the prime objective of the project as already stated, the following factors are achieved:

1. The provision of ready market for agricultural products in and around Awaham Nkwanta in the West Akyem District of the Eastern Region. This injects enthusiasm in the farmer
2. The promotion of efficient utilization of agricultural input and other local materials in the proposed processing and manufacturing industries.
3. The creation of employment opportunities for the rural communities thereby reducing rural-urban migration.
4. The motivation of a country-wide distribution of viable enterprises through rural industrialisation in preference to the hitherto strait jarkect industrialisation of the

urban areas.

1.03 METHODOLOGY

The methods and strategies employed in the preparation of this thesis were

(i) to ensure that the project tied in with the government's policy on industrialisation as contained in the Investment Code, 1985.

(ii) to identify a client who has sufficient experience and resources to undertake the project

(iii) literature review and compilation of bibliography

(iv) feasibility studies and survey data collection

(v) documentation of the data collected

(vi) analysis and synthesis of documented data

(vii) special and technical studies with respect to the project planning and design.

(viii) sketch design and presentation of drawings

(ix) 3-dimensional presentations

(x) Report.

CHAPTER 2

CLIENT'S DEVELOPMENT INTENSIONS

2.01 THE CLIENT AND HIS CONCEPTION OF THE PROJECT

It is true that one of the problems the author had to grapple with was to identify a client who did not only possess the capital, but had the nerves to venture into the area of rural industrialisation, an area which has been largely neglected over the years.

The client's intension was to attach equal emphasis to the following enterprises, each of which was to be tackled at a high enough commercial scale - a dangerous concept in view of spatial, capital and management limitations.

(i) Gari and starch production factory, with a production target of 10 - 20 bags daily.

(ii) Brushes manufacturing factory, with a production target of 80 - 200 brushes/day/worker depending on the types of brushes being manufactured.

(iii) Crop production: the commercial cultivation of cassava, maize, oil palm and vegetables under 5, 6 hectares

(iv) Fish farming

(v) Commercial palm oil and palm kernnel oil production

(vi) Soap production

(vii) Livestock rearing: Poultry (1000 - 10,000 birds)
Pigs (200 - 500)
Sheep and Goats (1000 - 3000)

Being architecturally uninformed and with the realisation that the project location was in the rural area, the client wanted to go into several enterprises on the same premises, with the scale and variety of investments not only capable of posing serious management and spatial problems, and by that leave the viability of the project in a doubtful state, but also that it was going to become increasingly difficult, nearing impossibility, for this thesis to handle specific problems in the area of architectural design and construction to a reasonable standard within the time constraints that confront the author.

2.02 THE TARGET AREA

2.02.1 CHOICE OF AREA

The proposed location of the rural industrial complex is Awaham Nkwanta, a rural settlement not far from Asamankese, Osenase, Oda, Akwatia, Nsaba, etc. all of which settlements come under the West Akyem District which constitutes the projects target area.

The West Akyem District has been identified as an area with very high potentials for viable agricultural and agro-industrial ventures,, a fact which has prompted the West Akyem District Committee for the Defence of the Revolution (CDR) to launch a two-year action programme[5] aimed at mobilizing all available human and material resources for the effective development of agricultural enterprises at Osenase ($9\frac{1}{2}$ miles from Asamankese); the projects to be undertaken during the period being estimated to cost about ¢76 million. An electrification project to cover the district has already started from Boadua and Asamankese in great earnest.

The following factors also prompted the choice of the West Akyem District as the project's target area:

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5. Peoples Daily Graphic, Monday, February 3, 1986 edition, No. 10953, Page 1.

(i) The West Akyem District is predominantly an agricultural area with cassava and oil-palm cropping as the major areas of concern. The proposed gari and brushes factories will therefore enjoy an inexhaustible supply of raw materials imput.

(ii) The availability of ready market for gari and brushes, produced in the rural industrial complex, within the target area. The sources of market will be detailed out in the next section of this chapter under feasibility studies.

2.02.2 GEOGRAPHICAL CHARACTERISTICS OF AREA[6]

(i) Location:

The target area is bounded by latitudes 0° 30' W and 1° 00' W, and longitudes 5° 30' N and 6° 10' N.

(ii) Relief:

The target area is moderately hilly, and rises averagely from about 300 - 700 ft. above sea level.

(iii) Vegetation:

The target area is within the forest zone of Ghana.

(iv) Great Soil Group:

Soils found in the target area fall largely under the Forest Ochrosols.

(v) Average Annual Rainfall:

The rainfall is quite heavy and evenly spread with roughly two peak times in a year. The average annual intensity is about 1270mm - 1778mm.

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6. All facts and figures under this section are presented as published by the Survey of Ghana, 1969.

2.03 FEASIBILITY

It is important to undertake a feasibility study of the client's development intentions, so as to be able to establish the viability or otherwise of the proposed rural industrial complex. The following areas shall be investigated under this study:

(i) EXPERIENCE

The client - GOKAB LIMITED - has considerable experience in the production of gari as well as the manufacturing of various types of cleaning and scrubbing brushes. He has a gari production factory at Osenase which has a production capacity of 9-10 bags of gari daily. His brushes workshop, even though not properly organised in terms of the spatial adequacy and disposition for the various production processes, is housed in a small premises at Asylum Down in Accra.

By virtue of his experience, the client is capable of avoiding earlier mistakes in the previous enterprises and managing the rural industrial complex into a very viable undertaking.

(ii) Capital and Finance:

Most of the money spent in the establishment of factories infact about 75% of it, goes into the purchasing of the machinery that are necessary for handling the various stages of production processes. The client possesses all the needed machinery for gari and brushes factories, some of which have been installed in his gari factory at Osenase. Apart from a diesel operated motor which runs the mill and cassava graters, all other machinery are locally manufactured by establishments like the Osudoku Metal Works and the Forneku Engineering Works.

Probably the only machine that the client lacks, for the purposes of the rural industrial complex, are a Band saw

and a Lathe turning machine, which are very important equipment for the carpentry section of the brushes factory. These two machines will not cost more than $5000 (¢450,000.00) to import - cost price, freight, insurance and handling charges inclusive.

Fortunately the client has the finance, and also enjoys the support of financial institutions like the Agricultural Development Bank, Social Security Bank and the National Investment Bank, all of which have expressed their interest in the proposed rural industrial complex and willingness to finance the infrastructural works essential for the construction and smooth operation of the proposed factories, like the construction of the factory buildings, access and circulation roads, power lines and stations, storage areas and silos etc.

(iii) Raw Materials Imput

Apart from the client's auxiliary activities in the production of cassava and piassava, (made from palm fronds and used in the production of brushes), which are the major inputs needed in the gari and brushes factories, the entire West Akyem District constitutes a catchment area for an inexhaustible supply of the said agricultural imputs.

Currently, the clients gari factory at Osenase proceesses 100 maxi bags of cassava into gari every day, all year round. However, several thousand tonnes of cassava still remain locked up in the West Akyem District due to an excess of supply over demand.

(iv) Economic feasibility

- Cost of Production

The cost of production of gari and brushes is low enough to allow

the client a reasonable profit margin at the end of the production process. This is so because of the following reasons:

(a) the cost of transporting raw materials from areas of agricultural production to the factories is quite low because of the strategic location of Awaham Nkwanta within the catchment area. The client also possesses a farm vehicle which is used in carting raw materials from the catchment area, thereby introducing further relief from transportation costs which are quite prohibitive now-a-days.

(b) The factories are run with the use of minimal power (electricity and diesel). Factory operations are labour intensive as they are mostly accomplished mannually. The relatively low cost of labour therefore, helps in keeping the cost of production of gari and brushes low.

- <u>Marketing of produce</u>

The client will enjoy both local and foreign market for the gari and brushes to be produced in his factories. Contacts have already been established with the following institutions and organisations for the supply of gari and brushes by the client - Gokab Limited:

(a) the following educational institutions all of which are within the West Akyem District: Asamankese Secondary, Nsaba Secondary and St. Roses College in Akwatia.

(b) the Kingsway, GNTC and UTC Departmental stores in Accra

(c) the Paso-Taa departmental shop which has 70 outlets in Bourkina Faso has expressed its intention to import gari from Golab limited, starting March, 1987.

(d) the client has also made sufficient contacts for the exportation of gari to England and the Gambia; starting January, 1988.

The low cost of production and the bright marketing prospects that confront the client convinces the author of the economic feasibility of the rural industrial complex at Awaham Nkwanta.

CHAPTER 3

TECHNICAL STUDIES

3.01 PRODUCTION PROCESS FOR GARI AND STARCH

The basic input for the production of gari and starch is cassava, a crop which is produced in great abundance in the West Akyem District.

The cassava is normally brought in large consignments, enough to sustain the production of gari for one week. It is established from practice that every 10 bags of cassava yield 1 bag of gari when prodessed. Once the production target is established, it can therefore be determined what quantity of cassava is needed for a week's production of gari, hence the right size of storage facility is provided for.

(i) Weighing and Storage

The weekly consignment of cassava that is brought in is weighed, to ascertain its true quantity, and dumped in a store.

(ii) Peeling

The quantity of cassava needed for the day's production is fetched from the store and its weight recorded, and sent to the peeling section.

The cassava is peeled mannually, and the peels are heaped in a waste pit, to be evacuated for livestock feeding.

(iii) Washing:

The peeled cassava is now washed thoroughly to rid it of any sand particles and dirt.

(iv) Grating

The peeled cassava is grated to the required texture, either smooth or very smooth. The graters which are motor run can normally work about ½ a bag of cassava at a go.

(v) Fermentation or Straining for starch

In the next stage the grated cassava is fermented over a period of about 12 hours for purposes of gari production. Alternatively, water is added to the grated cassava, and stirred into a slightly firm consistency and strained. The liquid collected is allowed to settle, and is decaned to leave a layer of starch in the receptacle.

(vi) Pressing/Squeezing

The fermented pulp is put in bags and squeezed by mannually operated geared pressing machines.

(vii) Breaking and Seiving

The compacted pulp that results as a result of the squeezing is broken or loosened by the breaking machine before seiving. The seiving is accomplished by use of a sieving machine.

(viii) Roasting

The loosened pulp is now roasted on wood-fired kilns until a light cream colour is obtained. The kilns are provided with chimneys that are natural-draught operated.

(ix) Seiving (Quality Control)

The roasted pulp, which at this stage is gari, is seived for a second time to eliminate twigs and other fiberous matter, thereby ensuring good quality gari. The rejects can

either be milled and added to lower gari, or else used as a constituent in livestock feed.

(x) The gari is bagged either in jute bags or polythene bags, weighed to the accepted weight and sealed.

(xi) The packaged gari, now ready for marketing, is sent to the output store from where depatch is effected.

3.02 MACHINES FOR GARI PRODUCTION

(i) GRATER

This is normally connected to a motor by means of a belt. Cassava is fed into the top of the grater whereas the pulp is collected into a receptacle at the bottom.

Machine Size: Length (1,8m), Width (0.9m), Height (1.3m).

Labour Requirements: Two people are needed to operate the grater.

Special Requirements:

(a) Because it is motor run, the grater vibrates a dot during operation. It is therefore necessary to mount it rigidly to a concreted base.

(b) The working area around the grater should be well drained to prevent the stagnation of waste liquid that is squeezed out as the cassava is grated into pulp.

Working area and Maintenance

A floor area of 3.8m x 2.9m is adequate to take the grater and provide for adequate working space.

Maintenance is done once every six months and often involved the replacement of grinding or grating plates.

(ii) PRESSER

This is operated mannually by means of levers and gears.

Porous sacks laden with fermented pulp are pressed to squeeze out a milky liquid from the latter.

Machine Size

length (1,2m, width (0,8m), height (1.6m)

Labour Requirements

Two people are needed to operate the presser.

Power Requirement

Manual

Special Requirements

The working area around the presser should be well drained.

This is the process that produces the greatest quantity of waste liquid, which if not taken care of, will produce very objectionable working conditions.

Working area and Maintenance

A floor area of 3,2m x 2,8m is adequate to take the presser and provide for reasonable working space.

The machine is quite robust and can work for more than 1 year without remedial maintenance. Routine maintenance involving greasing of gears and lever is done once every 6 months.

(iii) BREAKER/MILL

This machine is motor run and is used for loosening the compacted pulp from the presser. The breaker may also be used in milling grain and refected bibrous matter from gari.

Machine Size:

Length (1,0m), Width (1,0m), Height (1,5m).

Labour Requirements

Two attendants are required for a breaker.

Special Requirements

Since the breaker vibrates a lot during operation, it is necessary to bolt it rigidly to a well compacted concrete base in the floor.

Working Area and Maintenance

A floor area of 3,0m x 3,0m is adequate to take the breaker and provide for reasonable working space. Maintenance is done once every six months and often involves the replacement of grinding plates.

(iv) SEIVING MACHINE:

This machine is normally operated mannually and serves to control the quality of gari by seiving out cassava twigs and other fibrous matter.

Machine Size

Length (2,0m), Width (1,0m), Height (1,3m).

Labour Requirements

Two attendants are required for the operation of a seiver.

Special Requirements

The machine does not need any special mode of fixing.

Working Area and Maintenance

A floor area of 4,0m x 3,0m is adequate to take the seiving machine and provide for reasonable working space.

The machine is very robust and can operate for more than 1 year without any major or remedial maintenance.

3.03 PRODUCTION PROCESS FOR BRUSHES

The inputs for the manufacture of various types of brushes include sisal fibre, piassava fibre, waste nylon fibre, timber and steel wire.

(i) Weighing and Storage:

The inputs, especially the fibres, are normally weighed before storage.

Storage facilities for both timber and fibres should be provided and architecturally treated to keep off vermin like mice and rats, who would other wise constitute a serious nuisance.

(ii) Carpentry

The first process in the production of brushes is carpentry, the shaping wood into the forms to be used as handles for the various types of brushes. A number of holes are normally drilled on the underside of the handles for the purposes of fixing the required fibre. Wooden pins, needed in the fixing of fibre to handles are also made.

The wooden handles can be ordered on specification from carpentry shops in Asamankese.

(iii) Fibre treatment

Here the required fibre - sisal, nylon or piassava - is cut into the required lengths and combed out.

(iv) Assembling

The fibre is folded into U-shapes and fixed into the holes on the underside of the handle by means of wooden pins, to produce the required type of brush. This process is typical for the bass broom, and scrubing, banister and sweeping brushes.

(v) Bottle cleaning brush

The production process for this type of brush varies from those outlined already. Here a mannually operated twisting machine is used. A steel wire is fixed, in U-shape, on the twisting machine with pre-cut nylon arranged along one half of its length. The wire is then twisted to form the brush.

3.04 MACHINES FOR BRUSHES MAKING AND THEIR FUNCTIONS

(i) Band saw and lathe turning machines:

These are electricity driven and are used in the carpentry section of the rural industrial complex for cutting and shaping of wood.

(ii) Wire twisting machine

This is used for the twisting of steel in the making of bottle cleaning brushes. It is mannually operated by means of a handle which is rotated to achieve the twisting effect.

3.05 GENERAL REQUIREMENTS OF INDUSTRIAL FACILITY

(a) LOCATIONAL REQUIREMENTS

(i) Planning Controls

It is important to make sure that the site chosen for the industrial facility is without litigation. Planning regulations and zoning principles should allow the use of the site as such.

(ii) Accessibility

The site should be readily accessible to vehicular traffic from the main trunk road that runs from Asamankese, through Awaham Nkwanta, to Osenase and other areas beyond, as well as from Awaham and other

areas in the hinterland from where raw materials can be purchased.

The site should also be within manageable walking distance from the settlement (Awaham Nkwanta) from where the factory will tap its earliest labour requirements.

(iii) Infrastructural Services

The site should be located in an area that will allow smooth access to electricity and water supply.

Work has already started on a programme to extend hydro-electricity to Asamankese from Boadua through Awaham Nkwanta.

There is also a proposal to supply pipe borne water to Awaham, where large gold deposits have been found, from Asamankese through Awaham Nkwanta.

(iv) Land-use compartibility

The use of the site for industrial activity should be compartible with the existing land-usage of the area. For instance, a site may not be very good for industrial activity if it is located in the heart of a residential area.

(b) FUNCTIONAL REQUIREMENTS

(i) Future Expansion

The site should be of a size big enough to allow for future expansion.

(ii) The site should also be located in an area which is not remote from both raw material sources and market.

(c) STRUCTURAL REQUIREMENTS

The Structural systems employed in the industrial facility, especially the production halls, should be such as will allow large uninterrupted interiors for the smooth flow of various production processes. Thus, as few columns as possible should be employed unless they fall along the external walls of production halls.

CHAPTER 4

CASE STUDIES

4.01 GOKAB GARI FACTORY - OSENASE

(i) Introduction:

The Gokab Gari Factory at Osenase employs 18 people who work on only one shift, from 8.00 a.m. - 5.00 p.m. every day of the week. Weekends are used for servicing the production equipment.

The production capacity of the factory is 10 bags of gari/day at lowest and 15 bags of gari/day at maximum capacity.

(ii) Welfare:

No provision has been made for changing facilities, neither is there any office for the storage of a first aid kit.

There is also no resting place nor dining area.

(iii) Services:

There is no pipe-borne water supply to the premises.

Water is brought in buckets from a well situated about 100m from the factory and stored in a tank. There is no electricity connection on the factory, and so production ends strictly at 5.00 p.m.

There is no storage space for cassava on the premises, neither is there one for the finished product - gari.

Cassava and gari are stored in two separate stores situated about 50m from the factory.

(iv) Circulation:

The disposition of the production equipment within the enclosed bay allows for easy circulation and a smooth line of production.

The only short coming in the planning of the production flow is the absence of an area for peeling and washing of cassava. This is normally done anywhere in the factory with the later conveyance of peeled cassava to the graters making circulation rather awkward.

(v) Environmental Impact:

The location of therfactory in the heart of a residential area and the absence of proper waste liquid management within the factory has an objectionable impact on the environment. Coupled with the fact that the factory is largely open with no provisions for insect proofing, a lot of flies are attracted during the production process.

(vi) Conclusion:

The factory was not well designed, in terms of its suitability to the production process of gari.

Consideration was not given to the handling of waste liquid from the pressers and graters, nor cassava peels.

These defects leave the floor of the factory in a mess anytime during production.

4.02 GOKAB BRUSHES: WORKSHOP - ASYLUM DOWN, ACCRA

(i) Introduction:

The Gokab Brushes Factory at Asylum Down in Accra employs 5 people who work on only one shift, one of them permanently assigned to the production of bottle cleaning brushes.

(ii) Welfare:

No provision has been made for changing rooms, rest room and first aid space.

(iii) Services:

There is both pipe-borne water supply and electricity connections to the factory. Input such as sisal fibre piassava fibre, nylon waste cotton fibre are stored in the general store on arrival.

There is no carpentry section. The wooden handles for the brushes are moulded in a carpentry shop, about 50m from the factory, from where they are purchased.

(iv) Circulation:

Circulation is rather tight and haphazard in the Assembly room. There are not any sufficient furniture like benches and other work tops in the Assembly room.

(v) Conclusion:

Working conditions in the factory are not the best. Ventilation is very poor, so is lighting; so there is the continuous use of artificial lighting during working hours. The storage areas have not been artificially treated to prevent the encroachment of vermin like rats and mice.

CHAPTER 5

B R I E F

5.01 PROBLEMS AND LIMITATIONS

The major problem confronting the author is the number of enterprises the client wants to engage in; and the scale of investment in each enterprise too. The client's conception of the project as presented in section 2,01 of Chapter 2 is so extensive and multi-faceted, that if the greatest care and effort is not taken to evolve a well defined scope, the purpose of the project as detailed out in chapter 1, section 1,02 becomes inaccessible.

5.02 SCOPE

The scope of the project had to be tailored down, so that not only was the efficient socio-economic development of Awaham Nkwanta and its environs going to be ensured, but that specific problems in the area of architectural design and construction were adequately handled within the constraints of time and space. The scope defines the major areas of investment, with specific production targets. A number of auxiliary ventures are also undertaken on the same premises, the operation of which will either benefit from the by-products of the major (industrial) enterprises, or else supplement the raw material needs of the latter. The scope of the rural industrial complex at Awaham Nkwanta is defined as follows:

(i) INDUSTRIAL ENTERPRISES:

(a) Production Halls to accommodate the manufacture of Gari.

The production capacity of the factory shall be 10-15 maxi bags (equivalent to 800 -1200 kg. weight) of gari/ day.

(b) Starch

(c) Brushes

Various types including lime, sweeping, banister and bottle cleaning brushes will be produced.

From experience drawn from the Gokab brushes workshop at Asylum Down, Accra, each worker is capable of assembling 60 - 80 brushes of a given variety a day. With the bottle cleaning brushes production capacity rises to 150 - 180 brushes per worker per day.

(ii) ANCILLIARY FACILITIES

(a) Administrative block

(b) Welfare block

This will accommodate changing facilities, first aid rooms, kitchen and dining rooms.

(c) Maintenance workshop

To take care of the maintenance of production machinery

(d) Automobile Workshop

To service tractors and trucks belonging to the rural industrial complex.

(e) Staff Housing:

A number of self-contained apartments to accommodate 15 staffers.

(f) Community Centre

(g) Farm Service Block:

To accommodate storage areas for both farm input and produce.

(iii) SUBSIDIARY VENTURES

(a) Crop production

The client will cultivate cassava, maize, oil palm, and vegetables like tomatoes and garden eggs on a small enough scale as will be required to ensure concentration of effort on the industrial enterprises. This will be done under 3,6 hectares.

(b) Fish Culture

Any portion of the site which is prone to muddiness can be harnessed for small scale fish farming. Part of the fish so produced will be used in the preparation of feed for livestock.

(c) Small Scale livestock rearing

A maximum of 50 pigs and 400 domestic fowls will be kept. The poultry will be kept under the intensive management system, with day-old chicks being procured from bigger commercial farms and reared for the purposes of egg and table meat production.

CHAPTER 6

PROJECT PLANNING STUDIES

6.01 SELECTION OF PLANT LOCATION

In considering where to locate the factory within the target area, the following towns were considered, via Asamankese, Osenase and Awaham Nkwanta.

It was realised that whereas Asamankese and Osenase enjoyed the existence of a number of processing industries, like the Fountain Soap and Wappahs Gari factories in Asamankese, the same could not be said of Awaham Nkwanta. The result of such imbalanced industrial development is that Awaham Nkwanta is gradually becoming a dead village, with majority of the young men migrating to Asamankese, Akwatia and other bigger towns for jobs.

The Chief Executive of Gokab limited, who are the client, Mr..J.K. Kwaw chose Awaham Nkwanta for the location of the proposed Rural Industrial Complex for the following reasons:

(i) Awaham Nkwanta is the adopted village of Mr. J.K. Kwaw. He is therefore desirous of contributing to the development of Awaham Nkwanta by implementing the proposed rural industrial complex, a project which will avail youngmen in the village with job opportunities.

(ii) The client has a good offer of landscape, about 11,34 hectares at Awaham Nkwanta for the development of the project.

(iii) That Awaham Nkwanta offered sites that satisfied the general requirements of industrial facility as spelt out in chapter 3, section 3.05.

6.02 PROJECT DEVELOPMENT STRATEGIES - PHASING

PHASE 1: Years 1 and 2

(i) Cultivation of maize, cassava, oil palm vegetables under 3.6 hectares.

(ii) The construction of management and staff housing (first part)

(iii) The construction of production halls for gari, starch and brushes.

PHASE 2: Years 3 and 4

(i) The construction of the Administration Block

(ii) The construction of the Welfare block

(iii) The construction of the Maintenance Block.

PHASE 3: Years 5 and 6

(i) Construction of the Automobile workshop

(ii) Construction of a carpentry workshop to supply the brushes factory with wooden handles.

(iii) Construction of the remaining units of management and staff housing.

PHASE 4: Year 7

(i) The construction of the community centre

(ii) The construction of the fish pond

(iii) The construction of livestock units for the rearing of pigs and poultry.

CHAPTER 7

DEVELOPMENT IMPLICATIONS

Awaham Nkwanta is a small village settlement, of 14 houses with a population of about 210 people. The population structure exhibits a dominance of older folk, the younger persons having migrated to other areas with better employment opportunities. The only way to curb the continuous migration of the yough from Awaham Nkwanta and possibly to entice those already self-exiled, will probably lie in the setting up of viable concerns in industry and commerce, like the proposed rural industrial complex, which would offer some employment opportunities.

The development of the rural industrial complex at Awaham Nkwanta, brings in its wake a number of implications for the village settlement itself, the populace as well as any surrounding settlements.

7.10 PHYSICAL DEVELOPMENT IMPLICATIONS

For the rural industrial complex, apart from the buildings that will be put up on site to house the various production processes and ancillary functions, access roads, power lines, water supply systems and of course drainage systems will have to be take care of.

Excavation, construction and in some cases filling might be necessary on site, and these should be done in a manner that will synthetise the physical fabric of the proposed complex with the existing architecture of the settlement.

Appropriate methods, in the use of materials and construction e.g. the use of Tek block, will be used in the construction of the complex, the success of which could raise the consciousness of the rural folk in the application of 'appropriate technology' in the construction of their houses.

The vertical spans to be attained in the rural industrial complex should fit into the existing massing profile of the settlement to give a sense of homogenuity in the conceptual development of the physical environment.

7.02 SOCIO-POLITICAL IMPLICATION

The project will need the goodwill of all natives or residents of Awaham Nkwanta, for that matter it is essential that the site for the proposed complex be devoid of litigation.

The acquisition of the site should be in line with the normally accepted practice of the people of Awaham Nkwanta, and any compensation, if need be, be paid to the custodians of the land.

7.03 SOCIO-ECONOMIC IMPLICATIONS

The proposed rural industrial complex should not have been needed at any greater urgency anytime other than now, to forestall the depletion of Awaham Nkwanta of her youth.

Thus, the project will introduce some job opportunities for the inhabitants of the village. It will also give greater stimulus to farmers within the target area to increase production to take advantage of the project-brought increased demand for farm produce.

The project will therefore ehance the socio-economic situation of the people of Awaham Nkwanta.

7.04 ENVIRONMENTAL IMPLICATIONS

Suppose the rural industrial complex made provision for only gari production and brushes making - the two major enterprises - the disposal of by-products and rejects, like cassava peels and rejected twigs and fibrous matter from gari at the final quality control stage, would have constituted an environmental issue over several years of production.

Fortunately, the complex is an integrated venture with a number of subsidiary ventures either supporting the major enterprises or benefiting from their by-products and rejects. The operations of the rural industrial complex do not pose any undesirable environmental impacts.

7.03 PSYCHOLOGICAL IMPLICATIONS

When the proposed rural industrial complex zooms into reality, the inhabitants of Awaham Nkwanta who have been without such a facility before, will autbmatically get psychological tuned up to it. This will establish a sense of concern in the local people towards the project.

The end result is that any people employed to work in the complex shall put in their very best to ensure optimum productivity.

CHAPTER 8

SITE STUDIES

8.01 POSSIBLE SITES

Two sites were considered for the siting of the Gokab Rural Industrial Complex at Awaham Nkwanta. These are Site 'A' and Site 'B', both of which have already been earmarked by the village planning committee for Industrial activity.

'SITE 'A' - Located on the trunk road that runs from Asamankese to Osenase through Awaham Nkwanta. It is about 340m away at the South-Western end of the rural settlement (Awaham Nkwanta).

SITE 'B' - located on the South-Eastern side of Awaham Nkwanta about 430m away from the rural settlement. The site is about 200m from the Awaham Nkwanta road.

8.02 SITE SELECTION

(a) Criteria for Site Selection:

1. Planning controls
2. Accessibility to users
3. Infrastructural services
4. Land-use compatibility

(b) Suitability of Site for development:

SITE 'A' MERITS

1. The site is most accessible for the tapping of infrastructural services
2. The site is most accessible from the Asamankese-Osenase trunk road.
3. By virtue of the location of the site, it might not become 'dead' at night.

DEMERITS:

1. The site is exposed to the dangers of fast vehicular traffic.
2. The site conflicts with the residential zone in terms of land-use compatibility.
3. The penetration of the village by vehicles carrying raw materials input from Awaham and other villages due east is not desirable.

SITE 'B' MERITS:

1. The site is accessible for the extension of infrastructural services.
2. The separation of the residential and industrial zones by the green belt allows for future expansion.
3. The site is free from the inconveniences of a fast trunk road.
4. Vehicular traffic carrying raw material input from Awaham and other villages due east does not penetrate the village.

DEMERITS:

1. The site does not enjoy tight proximity to the Asamankese-Osenase trunk road.
2. By virtue of its distance from both the trunk road and rural settlement, the site may appear dead at night.

C. Conclusion:

After considering the 'criteria for site selection' and the 'suitability of site for development' with respect to both sites, Site 'B' was chosen for the project.

8.03 SITE ANALYSIS

1. Location

The site is located on the south-eastern part of Awaham Nkwanta, about 430m from the rural settlement.

2. Geology and Soil:

The soil belongs to the great forest ochrosols. The land formation is stable with neither protruding rocks or visible faults. The soil and geological conditions of the site are suitable for conventional agriculture and construction.

3. Micro Climate

Wind direction:

The prevailing wind direction is due North-east, blowing from south-west.

Rainfall:

Rainfall is evenly spread with two peaks annually.

The average annual intensity is about 1270mm - 1778mm.

4. Topography

The site slopes gently due North-west and south-west.

A valley runs along the Western portion of the site.

5. Visual Analysis:

The North-western and western ends of the site afford good views out over the village (across the valley) and the green belt respectively.

6. Water and Drainage

The site is well drained, with natural drainage due North-west and South-west into a valley.

There are two streams in the vicinity of the site. The Anyimade stream on the North-west and another one on the north-eastern portion of the site. These streams could be harnessed for the supply of water to the site in the absence of the proposed pipe borne water supply from Asamankese.

7. Plant Ecology and Site Vegetation:

The site is within the forest zone of Ghana, with rafia palm trees stretching along the Anyimade stream on the North-East. There is an existing oil palm plantation and vegetation farms on the North-eastern portion of the site.

CHAPTER 9

PLANNING AND DESIGN CONSIDERATIONS

9.01 SITE CONSIDERATIONS

The location of the site, its size and other characteristics, surrounding developments, and not in the least its development potentials need very careful consideration for an interesting and workable design and planning of the rural industrial complex.

9.02 DISPOSITION OF ACTIVITIES:

The disposition of various activities to be contained within the rural industrial complex needs careful scrutiny for the realisation of desirable working relationships and linkages in the various processes. It would be more desirable to structure the layout of the complex such that on entering the site one moves from a communal activity zone (the community centre) through the residential zone to the factories, since the latter needs very strict control.

9.03 FUNCTIONAL RELATIONSHIP:

Various units that relate functionally should be disposed closer to each other in order to ensure an efficient flow of people, goods and vehicles within the rural industrial complex.

9.04 SECURITY ARRANGEMENT:

Public and non-public areas should be unambiguously defined physically for security reasons. The factories and other areas that need strict control could better be located at areas quite remote from the main gate.

9.05 ENVIRONMENTAL CONTROL:

Natural ventilation should be employed in all the buildings - their proper orientation and the use of courtyards can enhance the realisation of this objective.

Wide overhangs should also be employed to effect some shading in an effort to keep down glare and prevent the penetration, into the production halls, of depriving ruin. The disposal of industrial wastes has an undesirable effect on the environment if not properly handled. Waste water and liquid which results in the production of gari and starch is varried by covered drains into a sump and soakaway, whereas cassava peels are stock-piled and later transferred and fed to pigs at the livestock section.

9.06 PHYSICAL STRUCTURE:

(i) Massing:

The massing of the building fabric of the rural industrial complex should be homogeneous with what obtains in the rural settlement. The proper integration of forms enables the gradual assimilation of the massing into the surrounding country.

(ii) Views:

The beautiful views what obtain on the western side of the site should be enjoyed by the workers' housing units, by locating the latter on the highest portion of the site to the north-east.

9.07 WATER RESOURCE UTILIZATION:

Water is one of the most important ingredients in the rural industrial complex.

Water should therefore be stored in adequate amounts in water tanks either situated on roof tops, or at strategic points in surface tanks.

There is to be constructed a fish pond not far from the Anyimade stream, which will not only enhance the visual amenity of the residential and communal zones, but also constitutes a ready source of water for use in the factories and fire fighting whenever the need arises.

9.08 TOPOGRAPHICAL ADAPTABILITY:

In the arrangement of the various units the topography of the site has to be carefully considered to make effective use of gentle slopes, especially for building purposes.

Areas of the site that either have steep slopes, or are liable to flooding should better be used for agricultural purposes.

9.09 AESTHETICS

The provision of well landscaped courtyards throughout the various units of the scheme enables the realisation of a pleasant architectural expression, which is not only sympathetic with the existing morphology of the rural settlement, but also psychologically enhances the workers' productivity.

CHAPTER 10

THE SCHEME

10.01 INTRODUCTION

The project - Rural Industrial Complex is not going to be implemented in a vacuum. The architectural forms that come into use should therefore take cognisance of the existing morphology and architecture of Awaham Nkwanta.

Factories that deal with food processing like gari production, need very neat environments. Where labour is intensive, as in the case of rural industrial schemes like this one, the interior design, production alignments, openings and overhangs should be such as will ensure the comfort of workers.

It is important that the shapes of the various buildings, the forms of circulation, the disposition of facilities and the overall landscape treatment should provide a sense of orientation and direction through the complex.

10.02 DESIGN CONCEPT:

The idea is to design a complex that will be homogeneous not only with the morphology of the rural settlement, but also its architectural forms and massing patterns. At the same time the design should ensure smooth production flows, adequate interior lighting and working spaces, whilst the cost element which should be confined to reasonable limits; and an appealing aesthetic quality of the complex should not be sacrificed.

10.03 ADMINISTRATION BLOCK

The Administration block is the first facility that one meets on entering the complex. It is situated on the northern portion of the complex and is provided with a car park that can take 6 cars, and a cycle rank.

The Administration block, which has been planned around a courtyard on a structural grid of 4m x 4m houses the conference hall, offices for the various officers, with sanitary accommodation and stores on the western end of the block.

The disposition of the offices on an east-west axis helps in keeping out solar glare.

10.04 MAINTENANCE UNIT

The maintenance unit is located between the administration and production blocks.

This unit houses changing rooms, a supervisors office, a service pit with access, a store room and a workshop.

Provision has been made for two fuel points to serve the needs of vehicles belonging to either the complex or workers.

The unit is planned on a structural grid of 4m x 4m.

10.05 WELFARE BLOCK

The welfare block, which is located between the production and administration blocks, is where all workers interact most, especially during break. It is planned on a structural grid of 4m x 4m and houses the health post, kitchen and dining facilities, common rooms, a union office, changing rooms and the clock-in cubicle.

This block is also organised around a courtyard and by means of a covered walkway is linked directly to the production block.

10.06 PRODUCTION BLOCK

The production block is planned on a structural grid of 4m x 4m, and houses production halls for both starch and gari and brushes. There are also supervisor's offices, stores and essential sanitary accommodation.

The production halls ensure smooth production alignments, consistent with the earlier studies done on production processes in chapter 3.

Adequate working areas around the various machinery as well as circulation for both pedestrians and trolleys have been taken car of. The store keeper and tally clerk have been provided with cubicles from where they can efficiently discharge their duties.

10.07 INPUT STORAGE

The inputs include cassava for gari and starch and sisal, nylon and piasava fibres, as well as steel wire for brushes. Separate stores have been provided for these, and treated architecturally (for instance by employing chicken mesh in ceiling) to prevent the encroachment of vermin like rats and mice.

The stores are of adequate size to contain raw materials needed for a week's production.

10.08 OUTPUT STORAGE

There are two output stores. One for brushes, and the other for gari and starch. The sizes of the stores are adequate to contain production for 10 days.

10.09 THE CARPENTRY SECTION

The carpentry section, whose main purpose is to produce timber moulds for use in brushes production, houses a machine room, moulds' store, tools and input store and a supervisor's office. The timber shed is close by.

10.010 ANCILLARY ACCOMMODATION

(a) There is a gate house at the entrace of the complex to check incoming and outgoing traffic be it vehicular or pedestrian.

(b) A power sub-station housing a stand-by generator and switch control facility, as well as a fuel store is provided quite close to the production block.

CONCLUSION:

The Rural Industrial Complex, as proposed for Awaham Nkwanta falls in line with the Ghana Government's policy on Industrialization. Furthermore, it demonstrates the efforts of an individual capitalist in trying to organise the human and material resources of a given rural settlement for industrial production in a profitable manner, not only for his personal benefit, but for the total improvement of the lot of the rural folk of Awaham Nkwanta.

The project, as of necessity, has been conceived as an integrated agro-industrial venture - a strategy which will ensure that no sector of the socio-economic set-up of Awaham Nkwanta is left untouched in the client's rural industrialization effort.
The realisation of this objective was highly instrumental in planning an industrial estate for the rural industrial complex, embracing factories, livestock rearing, fish farming, cassava and oil palm

plantations, and of course a residential accommodation and community centre for the use of staff and management.

The Rural Industrial Complex might be a novelty in the Ghanaian Industrial sense, with respect to the client's objectives and strategies as spelt out in earlier portions of this conclusion. It is hoped that this scheme will open up the flood gates for future engagement in rural industrial programmes, by architects, various development agencies and financial institutions and individual capitalists.

APPENDIX A

SCHEDULE OF ACCOMMODATION

ACCOMMODATION	NUMBER REQUIRED	TOTAL AREA IN M^2
ANCILLARY SERVICES		
GATE HOUSE	1	16
OFFICE ACCOMMODATION		
Managing Director	1	28
Secretary	1	12
Administrative Officer	1	24 (shared)
Procurement Officer	1	12
Marketing Officer	1	24 (shared)
Accountant	1	16
Estate Officer	1	24 (shared)
Technical Manager	1	26 (shared)
Farm Manager	1	20 (shared)
General Office	1	20
Conference room	1	24
Store room	1	12
Toilet facilities	2	24
WELFARE FACILITIES		
Changing room	1	108
Staff rest room	1	80
CLINIC		
Waiting room	1	6
Treatment	1	16
Recovery	1	20

ACCOMMODATION	NUMBER REQUIRED	TOTAL AREA IN M^2
KITCHEN		
Kitchen Yard	1	168
Kitchen	1	72
Food stuffs store	1	24
Matron/Domestic Bursar	1	48 (3 offices)
Changing room	1	24
Canteen (junior & Senior Staff)	2	176
Union/Time Office	1	16
GARI & STARCH FACTORY		
Production Hall	1	120
Input store	1	48
Output store	1	48
Office (Supervisor)	1	16
Storekeeper	1	4
Tally Clerk (office)	1	4
Frying Section	1	64
Firewood Shed	1	32
BRUSHES FACTORY		
General Input store	1	48
Assembly Hall	1	76
Office (Supervisor)	1	12
Finished Goods store	1	48

ACCOMMODATION	NUMBER REQUIRED	TOTAL AREA IN M^2
CARPENTRY		
Timber shed	1	28
Input store	1	20
Office (Supervisor)	1	16
Output store	1	16
Workshop	1	64
MAINTENANCE WORKSHOP		
Workshop/Machine room	1	72
Welding bay	1	12
Spare parts store	1	8
Office	1	12
Changing room	1	24
Outside parking	1	736
with 2 fuel points		
Service Ramp	1	
SERVICE BLOCK		
Generator and Switch room	1	20
Fuel store	1	12

BIBLIOGRAPHY

1. INDUSTRIAL BUILDING AND FACTORIES - Oswald W. Grube

2. URBAN PLANNING AND PUBLIC TRANSPORT
(Page 145 - 149 - Editor: Roy Cresswell

3. BUS OPERATION IN RESIDENTIAL AND
INDUSTRIAL AREAS - Department of Environment Circular 82/73, HMSO, London 1973

4. LAND-USE PLANNING - SUCCESS OR FAILURE - The Architect Journal 19th January 1977, Page 93-134 By Coleman, A.

5. COUNTRY PLANNING, MANCHESTER
UNIVERSITY PRESS, MANCHESTER 1971 - Green, R.J.

6. FARM BUILDINGS, (CONVERSIONS AND
IMPROVEMENTS) - W.G. Benoy

7. FARM BUILDINGS FOR SCOTLAND - Committee appointed by Secretary of State for Scotland

8. INTRODUCTION TO LIVESTOCK PRODUCTION - H.H. Cole (Editor)

9. BUILDINGS FOR STORAGE OF CROPS IN
WARM CLIMATES - W.H. Ranson

10. DESIGN AND PLANNING OF FACTORIES
(Reinhold Company) - Van Nustrand

11. THEORY OF THE LOCATION OF INDUSTRIES - University of Chicago Press, Chicago

12. PRELIMINARY TECHNICAL SURVEY OF SITES
FOR THE PROPOSED SMALL SCALE SUGAR - Dr. Allotey &
FACTORIES Dr. H.N.A. Wellington