SOYBEAN PROCESSING INDUSTRY, JALINGO

(Towards Achieving Hygienic environment

in a Food Processing industry)

By

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(B.Sc Arch. Hons)

A Thesis submitted to the Postgraduate School, Ahmadu Beiio University, Zaria, in partial fulfillment of the Requirements for the Award of the Degree of Master of Science in Architecture.

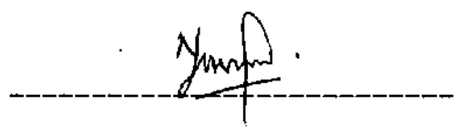
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DECLARATION

I, GARBA, S.S. Solemnly declared that this thesis has been written by my person and it is a record of my research work.

It has not been accepted in any previous application for a higher degree. All quotations are distinguished by quotation marks and the sources of information are specifically acknowledged by means of references, notes and footnotes.



GARBA, S. S.

CERTIFICATION

This thesis entitled SOYBEAN PROCESSING INDUSTRY, JALINGO: TOWARDS ACHIEVING HYGIENIC ENVIRONMENT IN A FOOD INDUSTRY by GARBA, S.S. meets the regulations governing the award of the degree of Master of Science (M.Sc) in Architecture of Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary composition.

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DEDICATION

This thesis is dedicated to my beloved wife, Mrs. Rebecca S. Garba, to my two daughters Miss Lidna S. Garba, Miss Elizabeth Mammilla S. Garba and to the Almighty God who is able to do far exceeding abundantly above what I think and ask to him be Glory and Adoration for ever and ever Amen.

ACKNOWLEDGEMENT

No matter how little a piece of work is, it is entirely impossible to complete such work without being assisted by various sources. In writing this thesis, I am deeply indebted to a number of people.

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I received much encouragement from many of my colleagues and friends such as Bro. James Momoh, Mrs. Ziriah Shadrach, sister Comfort Audu, Sister Mercy Omata, Mallam Lawal Abashe, Mr. Ubangida Musa, Mr. Mamman Solomon Isa, Sister Hannah Gabriel, Sister Georgie Ibe, Sister Arisim Sambo and all members of Postgraduate Fellowship.

My profound gratitude goes to all members of my family, parents for their financial and moral support given to me throughout my stay in school May God Almighty reward you a hundred fold in Jesus Name Amen.

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ABSTRACT

The diet of many million Nigerian is deficient in protein and calories. A whole soybeans is a solution to this deficiency. The whole soybean contain about 40% protein while that of cowpea is 25%, this goes a long way in showing that soybean is rich in protein. The protein is marked by a good balance of amino acids better than the acids from cereals such as wheat and rice, the balance meets the food and Agricultural organisation (FAO) Standards, so the quality of the protein is high.

Soybean products have been produced locally and consumed in the form of soya-oil, soy-milk, soy-meal, soy-ogi etc. the production is done using traditional methods and skill thereby resulting into low quality and sometimes shortages in production, there is need for a modern industrially based production, the proposed soybean processing industry in Jalingo will go a long way in providing employment to the Nigerian Labour market and as well help in conserving and earning foreign exchange for the country.

The thesis 'Towards Achieving Hygienic Environment in a Food processing Industry' is to investigate possible ways of planning effectively for a sanitary environment in food processing industry though architectural design and planning considerations, a make a design proposal for soybean processing industry in Jalingo.

Optimum Sanitary Conditions in a food plant can only be achieved by adequate consideration of sanitary and nygiene requirements in the planning of the total production operation. In doing this factory design factors were divided into two, that is, planning the factory and structure of the factory itself. The planning involves the raw materials reception, preparation land processing of raw materials and finished product storage area. In terms of structure of the factory, the design criteria recommended specifications for floors, walls, and ceilings to Sanitize these elements for easy cleaning and against inflection. Recommendations foi the propel provision of drainage service ducts, adequate ventilation and lighting was enumerated. Pest proof design was also recommended for the building foundations, floor and window elements.

This approach is justifiable, because design would be done within the framework of established principles of factory design to avoid potential contamination sources. This way, even if production patterns change, lit will not affect the structure of the factory since sanitary and hygienic requirements would have been considered in the initial design lay out. It is hoped that the thesis will be a source of motivation for entrepreneurs to invest in the local food processing industry and the design proposal, a working model for architects involved in food processing plant design.

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CHAPTER ONE

1.0 INTRODUCTION

The nutritional concern of the world's population is the ability to supply adequate amount of high protein to the increasing world population. Adequate, complete dietary protein intake such as milk, meat and eggs are currently expensive and scarce, therefore, it is imperative that alternative protein source, that can be easily source identified. the alternative must be protein of high quality and economically feasible. One of such alternative source is soybeans. Among the vegetable foods soybean ranks high for its high protein content of 40% and excellent sources of edible oil (20%) and other essential nutrients. The Federal and State governments respectively have made several efforts to increase soybean production, but utter ignorance have prevented the poor man whose meals are highly protein deficient from the consumption of soybean products or its derivatives.

Even so the versatile soybean, the cultivation of which will create job opportunities thereby reducing the problem of unemployment in the country. Seminars and workshops are being organised for women in both the rural and urban parts of the country on the processing of soybean into various dishes.

Recommendations have been made to the Federal government by Agricultural Experts on how to meet the protein demands. By processing the soybean industrially, this will help in no small ways to enhancing mass production of its products and makes it available in the country.

1.1 PROBLEM DEFINITION

This thesis is an attempt at investigating possible way of creating effective planning for hygienic environment in a food processing industry especially soybean processing industry, through design considerations. It will also find out how certain architectural design aspects like factory planning and structure can enhance sanitary levels in food processing factories to prevent contamination of the finished product.

1.2 AIM AND OBJECTIVES

The thesis is aimed at proposing an integrated soybean processing industry with architectural considerations to providing a good hygienic environment for working conditions for workers in the industry. The project also aimed at the following.

i. To use Nigeria vast soybean plantation potentials to the benefit of the economy and to increase agricultural and industrial development.

ii to meet the demands of protein rich product.

iii to reduce the problem of unemployment and improve the standards of driving of the people around the industry.

iv To create a hygienic work place environment in the planning plant to prevent contamination of the finished product.

The above can be achieved through the following ways:-

v Consideration of hygiene and sanitary requirements throughout the planning and design process.

vi To identify administrative capacity needed for effective accommodation and efficient service suitable for workers in the factory.

vii Developing an adequate planning scheme for effective spatial and functional organisation.

1.3 ARCHITECTURAL SIGNIFICANCE

It is hoped that the thesis will be a source of inspiration for investors and a working model for architects involved with the design of food processing factories by enumerating the design criteria for planning effectively for hygiene in a food processing industry.

Owing to this fact, investigation will be made into possible ways of planning effectively for sanitation in food processing plants through architectural design and planning considerations to prevent contamination of the finished product.

In planning for hygienic environment in a food processing industry, certain architectural design aspect like factory planning, structure including fittings, finishes, drainage and ventilation can enhance sanitary levels in food processing industries to prevent contamination will be looked into.

1.4 MOTIVATION

The motivation of this thesis arises from the concern an architect should have for his country. this topic was chosen in a bid to contribute in a little way in improving the nutritional status of Nigeria diets. Although many people across the

country are now realizing the need for a cheaper source of protein which soybean readily provides. The processing of its many products have been through traditional manual methods the results of which are low quality and shortage in production. Hence the need for modern industrially based production.

This thesis, soybean processing industry. Jalingo, is an attempt to encourage the processing of soybean products in Nigeria and thus help in her industrialization and diversification of the economy. Industrialization is not an end in itself but a necessary means to generate income and achieve the goals of growth, employment and increasing the general well-being of the people. The interest in industrial architecture is also a motivating factor.

1.5 SCOPE AND LIMITATION

The scope of this thesis shall entail the provision of administrative core, production hall, workers facilities, storage facilities and maintenance workshop. Provision will be made for effective road net work, must especially, the loading and off-loading boys. Provision will also be made for future expansion.

1.6 RESEARCH METHODOLOGY

Having established the problem, aim and objectives, scope and limitation of this thesis, the next stage is to tell exactly how the study will be carried out. The procedure for data collection, data analysis, interpretation of data in this thesis will not be different from the normal practice of conducting researches of this type.

The primary and secondary information will be obtained from the following sources.

i Field surveys – adaptation from past relevant write-ups, review of various books, journals, magazines etc.

ii Existing oil mils will be visited to study and analyze their production process and problems associated with them and also oral interview will be conducted with heads of various units in the factories. All these were in addition to library sources.

CHAPTER TWO

LITERATURE REVIEW

2.0 INTRODUCTION

Industrial Architecture can simply be defined as the Architecture of Manufacturing plants and other industrial buildings. This can be traced back to the lower half of the 19th Century when structural steel and reinforced concrete were developed.

In Industrial Architecture, functionality and simple disposition of masses is highly emphasized. The process of any industry governs the basic design principle. The general layout should provide proper working conditions such as lighting, good ventilation acoustic control, atmospheric conditions and social amenities like cafeteria, recreation areas, health facilities, good water supply sanitary services and fire fighting facilities.

Proper choice of site as well as site optimum utilization is absolutely necessary. When locating an industrial plant, the availability of raw material sources, ready market for the finished products, transportation network, utilities and

services should be duelly considered. Parking areas convenient to the plant and highways, future expansion should also be considered.

2.1 HISTORICAL TREND IN DEVELOPMENT OF INDUSTRIAL ARCHITECTURE

The origin of Industries could be traced to the beginning of Industrial Revolution. This simply means that industries may be convincingly said to have started when manual labour was substituted for mechanical labour at the beginning of Industrial revolution.

In the change from machine tools to machines, machinery was used to produce great quantity of products quickly and cheaply. There are three identified and generally agreed periods of industrial revolution. This includes the followings:-

i) 1750 - 1830

ii) 1830 - 1871

iii) 1871 - date

The first period marked the beginning and development of machines. In the second phase of industrial revolution mechanization was consolidated in many parts of Europe. The last period, that is, from 1871 to date industrialization has undergone a lot of changes from simple steam powered engines to atomic power plants.

Proceeding industrialization was the mechanilist period. In this period commence and trade were the most important. Due to inter-municipal, inter-regional or even inter-continental trade, merchants found new markets and the need for increase in production. This period was characterized by growth of foreign markets, individuals becoming richer and this led to the establishment of large guild restrictions. Textiles, coal, iron and steel and steam engines were developed. Factory designs were geared towards mass production. It should be noted before this time "Industries" were parts of the home, but with the advent of machine, the home became too small to accommodate the machines. This called for specialized buildings to accommodate the machines. This marked the beginning of formal industrial architecture.

Frontiers in Architecture, most especially Peter Behrens (1868–1940) was one of the notable architects who developed and came up with architectural form or thoughts that answered the demands of industrialized society. He designed and built turbine factory between 1908 and 1909 in Berlin. This became what some historians called "Industrial Temple". It served as an expression of monumentality to European architecture.

Walter Gropus and Adolf Meyer designed and built the Fagus factory in 1911. This building was a stepping stone in the steel and glass construction. It is a three storey building, the steel supports the floors and glass screens were used as walls. The non-structural character is emphasized by the absence of vertical supports.

Single task performance in industrial building emerged. But the consequences of industrialization was many of which the following were the most important.

i. The advent of industrialization brought about the emergence of industrial class or the capitalist class.
ii. There was over production of goods.
iii. Transportation and Communication networks were very much improved

iv. There was mass migration of rural citizens to urban areas.

v. Industrialization brought population explosion

vi. Emergence of classed society:- This means that division and consolidation of the bourgeoisie and the proletarians as distinct social units.

2.2 HISTORICAL BACKGROUND OF INDUSTRIES IN NIGERIA

Immediately after Nigeria's independence in 1960, much emphasis was laid on industrialization of the country. Industrialization first took off in Lagos when the civil war broke out when there was an embargo on importation of goods from outside countries and this of course helped local items to expand. In the beginning storage houses were converted into factories. Much later structure were erected for industrial purposes.

From Lagos, industries and seaports started growing and moved further inland towards the North. The growth and expansion of industries in Nigeria depends largely on three important but related factors which includes:-

i. Administration

ii. Politics

iii. The Nigeria market.

Out of these factors, the size of Nigeria market has been the most deciding and inducing investment in industries' Regional rivalry, sectional interest – nationalism – all are forces which stimulate the rate of growth of industrial enterprises.

2.4 SITING OF INDUSTRIES

Curtain factors have to be considered before siting an industry, neglect of which will result to a total failure of such an industry. There are a number of factors which influence the location of industries. They are as follows:-

i. Availability of raw materials
ii. Labour – whether skilled or unskilled
iii. Availability of ready market for the finished products.
iv. Site location in relation to the city in terms of commuter services, prevailing winds, level of air pollution water poilution.
v. Physical features – quality of soil, terrain/flat, slop, steep/–sewage and industrial waste disposal.
vi. Technology, machinery, type and quality of production energy supply
vii. Shape of site.

These factors shall be discussed separately.

i. Availability of raw materials

When locating an industry the proximity of the raw material source should first of all be considered. This does not mean that the industry should be situated on the site of the material source. The proximity will reduce the cost of the product of it is sited within the producing area. This means that the distance between the source of raw material and the industry should be as short as possible.

In Nigeria, the raw materials source is not always considered because of politics. Some industries are not located near the raw material source. Even if the commuter services are good, it is still not economical to have a processing industry not located near the raw material source.

ii. Labour

This is another important factor to be considered when siting an industry. This however, can be brought from other places if the labour required cannot meet the demand of the industry. Skilled labour, for examples, is very much needed to operate certain machineries and this requires some level of technology. In most cases the available labour for industries is usually unskilled. Some industries employ local labour and the

undergo special training to acquire certain knowledge in the fields required. The majority of people working in industries are mostly of low category and they cannot effort to cover large distances, mass transportation should be considered.

iii. Availability of ready market for the finished products

Ready market for the finished products is a factor to consider when locating an industry. An industry should be located near a ready market where the products can easily be sold. This does not mean that the factory must be located in a place whereby the finished products must all be sold, however the location should be such that there is a network of road interconnecting the site.

iv. Site Location

Location of industries in relation to city is an important factor as this affects other related land use patterns. The direction of the prevailing wind should be ascertained first and foremost. This is important inorder to protect the city from airborne industrial pollution. To protect the city and neighbouring landuse from industrial pollution such as smoke, odour, noise and dust-buffer zones should be provided.

v. Physical Features

The choice of a particular parcel of land must be decided by the physical factor of the site available. The site should be levelled or capable of being levelled at a reasonable cost. Site falls should not normally exceed 1m 101 land which may require considerable site works should not normally be chosen but where other important considerations exist modern engineering technology can overcome apparently serious disadvantages. The site should be of a size and shape capable of being divided into plots to gave the maximum freedom to meet demands for any size of unit.

vi. Availability of Utilities and Services

The availability of utilities which includes water supply, power supply are necessary in the running of an industry. other services like transport which include road, railways and air transport services are also good factors that affect the location of industries.

2.5 PLANNING OF INDUSTRIES

It is of utmost importance to zone an industrial complex when planning it. This is to ensure less cost of construction and to maximise profit as well as production out-put. Duty therefore calls on the Architect to meet the above obligation

through good planning. To achieve this, proper planning and adequate use of site should be done. There are six distinct zones in the master plan of an industry which includes the following:-

i. Entrance

The size of the entrance gate is influenced by the volume of traffic. There are usually separate access entrance for pedestrians and vehicles. For security reasons, parking spaces or lots meant for visitors are normally located outside the gate or opposite the gate house.

ii. Transportation zone

This zone consists of vehicular routes, off and on-loading areas, parking areas, etc are conveniently located opposite the entrance to avoid traffic congestion.

iii. Production Area

This is the area where production process takes place. All other related areas especially energy distribution are located very close to the production hall and it is also located along transportation zone.

iv. Auxiliary Building

These are services that concern the production area. These are the stores, minor plants etc. it is usually located along the main production hall.

v. Storage

These are stores mainly raw material stores, finished products stores, etc. There should be divisional stores located close to the respective production halls and the main store near transportation zone.

vi. Administrative zone

The administration and other facilities, like laboratories, and services like canteen, changing room, clinic are under this zone.

2.6 THE EXTENT OF SOYBEANS PROCESSING IN NIGERIA

Soybean processing industry is a relatively new industry in Nigeria. There was a solvent extraction plant at Ogbe, near Enugu which was proposed as nucleus for processing soybeans. This plant was originally erected to extract Cashew Nutshell liquid. A flaking roller was added to the plant so as to be able to process soybean. However, the plant was destroyed during the civil war.

Presently, there are only about two industries that use soybeans as raw materials for their processing. They are the Benue Oil Mill at Taraku Benue State the Mill processes oil from the whole soybeans. The other one is the Funtua Cotton seed crushing Company. This industry does it processing using Soybean, groundnut or Cotton seeds as raw materials.

2.7 THE NEED FOR A SOYBEAN INDUSTRY IN NIGERIA

The need for a Soybean processing industry in Nigeria should not be over emphasized. The dies of many millions of people in various parts of the world is deficient in protein and calories. Presently one of the best answers of this shortage is whole soybeans. The Soybeans contains about 40% protein. Since cow's milk is 3.5% and the common red bean is 25%, it is clear that Soybean does have a high protein content. This protein is characterized by a good balance of animal acids, better than any acids from cereals such as wheat and rice, the balance meets Food and Agricultural Organisation (FAO) standards so the quality of the protein is high.

The Soybeans contains about 20% oil, while cow's milk is 3.5% and the common red bean is 1.5%, so the Soybean is high in oil. All the oil could be used for food such as margarine cooking oil, making paints etc. About 97% of the oil free meal is sold as protein supplement for animal and poultry feed.

Economy is a powerful factor here, as animal protein is too expensive for many people of the world. For instance, one of the most efficient animal converters of feed to gain is the broiler chicken, with a conversion of about two pounds of feed per one gain.

Hence on both May, 1970 the Federal Government of Nigeria requested the United Nations Industrial Development Organisation (UNIDO) to make a study on the feasibility of establishing on integrated Soybean processing industry. This was followed by a request to food and Agricultural Organisation for technical assistance to evaluate Soy-ogi (fermented maize and soy bean product for infant and child feeding) for its market demands and recommendation for a suitable pilot plant. To avoid duplication and to better assess the long-term benefits, United Nations Development programme asked United Nations Industrial Development Organisation and Food and Agriculture Organisation to send a joint mission to Nigeria with the following but few objectives:-

i. To study the existing situation at the solvent extraction plant at Ogbe in Anambra State with regards to raw material availability, the difficulties encountered in its operation and its suitability as a base for soybean industry.

ii. To study the present production of Soy-ogi and with special reference to the method used for the production of full-fat flour, general acceptability of the product and indication of the future market demand.

iii. To study the market and prospect of production of edible soya flour for formulation into a protein food and for other use.

iv. To recommend the method and the product to be produced (either full fat or edible flour) and prepare the project data sheet including the terms of the reference of the feasibility mission that would follow. The committee came out with the following findings:-

For all practical purposes the entire soybean crop is expected in the whole bean form, mainly to the U.K. They found no evidence of any importance or even casual use of Soybean as human or animal food in Nigeria in 1970.

The pfizer Animal feeds who were the major producers of animal feeds then would use, 5-6,000 tons of defatted Soybean meal if it were available in Nigeria.

Further, there are about 40 million cattle in Northern Nigeria, particularly on Taraba State, existing on nomadic pasturage, which could benefit from supplemental feeding with formulated feed stuffs. Several meant packaging plants in Nigeria working at under-capacity would benefit immediately from an adequate supply of better fed cattle.

The animal feed market is one of the fastest growing agro-industries in the country. A commercial size soybean solvent extraction processing plant producing deflated soybean meal could be justified to supply this growing market. This processing plant would also be the profitable basis for other soybean processing operations including production of concentrates, isolates, milks, textured products, etc.

The increase in the production of poultry and egg and an increasing prosperity has created a growing demand for other products and meat, particularly in the cities. The nutritional gap has been narrowed to some considerable extent but it is still quite large. It will become larger if the gap between protein

available and consumer requirements, brought about by the increasing standard of living are taken into account.

Furthermore, these are people who cannot afford the raising prices of milk, eggs, poultry and meat and their individual protein gap has risen as a result soybean after unique advantages as a means for Nigeria to close its protein gap, benefit to its economy.

2.8 EFFECTS OF SOYBEAN PROCESSING INDUSTRY ON THE LOCAL POPULATION AND SURROUNDING REGION

The siting of our integrated soybean processing industry in Jalingo will go a long way in helping the local population and its environs in that it will create more job opportunities for them and it will improve their economic and social well being.

It will also encourage the local farmers to cultivate more soybean for supply to the factory. Furthermore industrialization stimulates the growth of utilities like water supply and electricity.

The siting of the industry will instigate the establishment of other services such as restaurants, banking services and generally increase trading activities in the area. The provision

of Health Centres, good road network, and other amenities by the industry will go a long way in alleviating their problems.

2.9 HISTORY OF SOYBEANS

The soybeans, originated from the China Manchuria region and is recognised as one of the oldest plant species cultivated by man and is now worldwide in distribution. The success of the Soybean crop is related to its adaptation to a wide range of climatic environments. Moreover, numerous uses are made of it as a major protein source in human nutrition and in livestock and poultry feed compounding procedures.

Soybeans was introduced to Nigeria in 1908 (Ezedinma, 1965). Most of the early research on Soybeans was carried out at the Moor Plantation, in Ibadan. Germination of imported Soybeans proved an obstacle due to the sudden change in the storage temperature. This might also have been responsible for the rapid deterioration of the embryos and the subsequent failure of the seeds to germinate.

Although early attempts to grow soybeans in Southern Nigeria failed, due to the poor quality of imported seeds, subsequent trails in the Guinea Savannah belt proved successful. Soybeans was then established as a cash crop. A

world shortage of oil seeds immediately after world war II accelerated the drive for increased soybean production in Nigeria.

The main soybean growing areas in Nigeria are benue State, Abuja in Niger State, and Southern division of Kaduna State.

2.10 WORLD PRODUCTION OF SOYBEAN AND NIGERIA

Early 19th century, the production of Soybean gained its commercial level worldwide and its introduction in the United States of America. The production of Soybean in America rose from virtually nothing in 1907 to 30 million metric tons in 1971 respectively two-thirds of the total world production (Leakey and Wills, 1977).

The total world hectarage of Soybean in 1980 was estimated at over 52.6 million hectares with a total yield of 83.5 million metric tons at an average of 1,580 kg/ha. (FAO 1980). The leading world producers includes the United States of America, Brazil, and China (Table 2.1).

In Africa Soybean cultivation is presently centered around Nigeria, South Africa, Uganda, Tanzania, Zaire, Zimbabwe and scattered production in the Francophone African Countries. Production figures from Africa both in terms of land area, total output and yield per hectare appear low when compared with figures from most other countries like U.S.A., Brazil, and China (Table 2.1)

Inspite of its excellent nutritional values and desirable qualities, the Soybean has not gained much importance in Nigeria Agriculture.

Table 2.1: Estimated Soybean Production in Major Producing Countries and Regions as at 1980

Country/Region	Total and area (1000ha)	Total grain 1000 metric ton	Grain yield kg/ha
World	52,639	83,481	1,586
North America	27,989	50,468	1,807
U.S.A	27,460	49,454	1,801
South America	11,256	19,552	1,737
Brazil	8,766	15,153	1,728
Asia	11,662	11,964	1,026
China	9,621	10,026	1,042
Africa	324	310	949
Nigeria	197	77	3,888

Source: FAO (1980)

The crop is still not known to a grate majority of farmers in Nigeria. Ashaye et al (1974) reported that the highest tons of Soybean produced in Nigeria was 26,450 metric tons from about 32,000 hectares, this is however expected to have increased in recent times. The production is centered around Benue State which produces the bulk of the country Soybean (Fig. 2.1)

Other production areas include Taraba State (Takum, Jalingo and Wukari), Kaduna State (Kafanchan and Zonkwa) and Federal Capital (Abuja) The most common variety planted in Nigeria is the malayan variety.

2.11 CULTIVATION OF SOYBEAN

Soybean like corn responds to any extra preparation. The field where soybean is to be sown as chief crop is ploughed deep and exposed to the sun for a few days. It is then harrowed twice or thrice at internals in order to break up the lump of soil.

Soybean can be sown in any season. It is both summer and winter crop. However, the best season is the rainy season. In Nigeria, Soybean is planted around May-June in the Southern Guinea Savanna and forest zones, while in the Northern Guinea zone around June and early July. As a sole crop, it is planted at 15 by 90cm spacing on ridges or on flat land at 75 x 30cm. Spacing (mm of Agric Jalingo). Usually super-phosphate fertilizer is broadcasted after ploughing and harrowing. After the establishment of the crop. The second dose of fertilizer can be applied.

MAP OF NIGERIA SHOWING
SOYBEAN PRODUCING AREAS



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KEY

MAJOR PRODUCING AREAS

MINOR PRODUCING AREAS

NEWLY INTRODUCED AREAS

FIG. 2.1

Different weed control methods can be carried out in Soybean fields. Mechanical and chemical controls, or their combination is essential in controlling weeds in Soybean fields.

Soybeans are pho-sensitive, short day plants requiring a mean temperature between 17 C and an annual rainfall of 17-20cm for effective growth and good yields. It is a self-pollinated annual crop and yields high in well-drained loam, sandy loam or alluvial soil with a pH of 6 to 6.5 (Chapman and Cauter 1976)

2.12 RECOMMENDED VARIETIES OF SOYBEANS

Examples of early/medium maturing varieties ie will mature between 98-110 days after planting such as Tax 536-02D, Samsoy 1, Samsoy 2, Tax 1485-1D, Tax 1019 - 2EN, Tax 1019 - 2EB and Tax 1448-2C.

Examples of late maturing varieties i.e will mature between 120-145 days are Tax 306-036C, Tax 923-2C and Malayan.

2.13 HARVESTING AND HANDLING OF SOYBEAN

When Soybeans matures the complete leaf will drop that indicates that harvesting can begin within the next week if good whether prevails. Previous studies showed that the seed

moisture decreases to 15% within 5 days after complete leaf drop (Quick and Buchele, 1974).

Harvesting is done on a large scale by a combine harvester. Harvester losses increase with time after maturity and as seed moisture content decreases. The decision on when to harvest must balance these factors against the need for drying beans if the moisture content is above 13%. Soybeans can be successfully harvested at moisture contents as high as 20% but seed is often damaged. Little damage occurs at 15%, but general recommendations are to harvest it as close to 13% moisture as possible.

The storage of Soybeans comprises besides the conventional way of storing on bags or in bulk on bin and silos, other devices such as elevators, unloaders, cleaners and driers, scales and various types of conveyors.

In factories, particularly Soybean processing industry, all machinery, should be at the elevator department to receive and store soybeans and ensuring at all times, the proper storing and handling of the raw materials. It is the responsibility of the elevator department to deliver the raw materials for the mills processing in the same condition and according to the grades of

quality by which the soybeans have been purchased and received at the mill.

In industries with large storage capacity, soybeans are usually stores in silos rather than in bags. The elevator department consists of raw materials receiving units either from truck or by rail road, elevators also called iegs, the bin or silo, weighing devices plus the necessary units for cleaning and drying.

2.14 CHEMICAL COMPOSITION AND NUTRITIONAL VALUE OF SOYBEAN

The chemical composition of soybeans composed of approximately 8% hall, 19% cotyledon and 2% hypocotyle (Plumule). The proper chemical components of soybean is comprehensively is given on Table 2.2.

Variation in chemical composition of soybeans is strictly depends on the environment and soil condition as well as the variety of soybean.

Table 2.2: Chemical Composition of Soybeans and its Components on Dry Basis

Representative Proximate Composition of Soybeans

Seed Part	% of white seed weight	% (moisture-free basis			
Seed part		Protein Nx 6.25	Lipid	Carbo-hydrates	Ash
Cotyledon	90	43	23	43	5.0
Hull	8	9	1	86	4.3
Hypocotyl	2	41	11	43	4.4
Whole Seed	100	40	20	35	4.9

Source – Cheftel et al (1985)

The fatty acid composition of soybean oil is given in table below.

Table 2.3: Fatty Acid Composition of Soybean

Saturated Acid	% Range	Unsaturated	% Range
Lauric	0.0–02	Dodecanoic	–
Myristic	0.1–0.4	Tetradecenoic	–
Palmitic	6.5–9.8	Hexadecanoic	0.42–1.6
Stearic	2.4–5.5	and Palmitoceic	
Arachidic	0.2–0.9	Oleic	10.9–60.0
Behenic	–	Linoleic	25.0–64.8
Lignoceric	0.0–0.1	Linolenic	0.3–12.1
Total Saturated		Arachidonic	Traces
Acids	15.0	Total unsaturated	85.0

Source: Agricultural Services Bulletin No.11 (1971) FAO

Table 2.4: Carbohydrates in Soybeans

Constituents	Average Amount (% whole bean
Cellulose	4.0
Hemicellulose	15.0
Stachyose	3.8
Raffinose	1.1
Sucrose	5.0
Other Sugars	5.1

Source: Agricultural Services Bulletin No. 11 (1971)

Soybeans is a fairly rich source of minerals and vitamins (Tables 2.5 and 2.6). Calcium and phosphorus in the bean are however, poorly utilized on account of the high content of photic acid.

Table 2.5 Vitamin Content of Soybean

Vitamins	Range (Ug/g of Soybean)
Thiamme	11.0 – 17.5
Riboflarm	3.4 –3.6
Niacin	21.4 – 23.0
Pyridoxine	7.1 – 12.0

Table 2.6 Inorganic Constituent of Soybeans

Constituent	Average Amount %
Ash	4.99
Potassium	1.67
Sodium	0.343
Calcium	0.275
Magnesium	0.223
Phosphorus	0.659
Sulphur	0.406
Chlorine	0.024
Iron	0.0097
Copper	0.0072
Manganese	6.0028
Zinc	6.0022
Alluminimum	0.0007
Iodine	53.6

Source: Agricultural Services Bulletin No. 11 (1971) FAO.

The unique value of soybean in nutrition is derived from its high content of food quality protein. Data on the amino acid composition of the protein indicate that except for a deficiency of sulphur amino acids, it is well balanced with respect to others (Table 2.7). Among legumes soybean offers the most striking example of a material whose protein value is significantly improved by optimal heat processing. Proper heat treatment involving time temperature and moisture control, is of paramount importance in producing soybean meal of maximum nutritional quality, heat treatment also effects marked improvement in the flavour characteristics.

Table 2.7 Amino Acid Composition of Soybean Protein (gm/16gms of Nitrogen)

	Seed	Cake
Isoleucine	4.5	4.8
Leucine	7.8	7.8
Lysine	6.4	6.1
Methionine	1.3	1.4
Cystine	1.3	1.7
Tyrosine	3.1	3.8
Valine	4.8	3.2
Arginine	7.2	7.1
Alanine	4.3	4.5
Aspartic Acid	11.7	11.5
Glycine	4.2	4.5
Pyroline	5.5	5.6
Serine	5.1	5.6

Source: Agricultural Services Bulletin No.11 (1971) FAO

Table 2.8: Composition of Soybean with Similar Oil Seeds

	Caloria per 100g	% Protein	% Fat	% Carbohydrate
Soybean	382	40.3	21.0	33.9
Cowpea	340	22.0	1.5	60
Fresh Groundnut	367	18.0	6.0	60
Dried Groundnut	579	27.0	45.0	17

For a good yield of soybean, choose a flat or moderately sloppy land with good drainage, avoid deep sandy or extremely growely soil or logged soils. Also avoid heavy texture on surface of soil because of potential problems with crusting and poor seedling emergence.

On land preparation, stump, plough and harrow, carry out harrowing at least one or two weeks after ploughing. If operation is not mechanized, stump and clear rubbish away from site completely. Ridging is not necessary. The appropriate agricultural institutions should be contacted for recommended varieties of soybeans.

2.15 PLANNING AND DESIGN FOR HYGIENE IN A FOOD PROCESSING INDUSTRY

2.16 INTRODUCTION

According to Lope, (1975), sanitary conditions are important in food plants not only because of public health and good appearance factors, but also because sanitary practices contribute to better quality and keeping characteristics of processed foods. Present day science and technology afford the food processor more effective and economical means of processing food under sanitary conditions than was possible some decades ago.

The importance of plant design on sanitation seems clearly indicated by the fact that the cleanest plants are usually those of the largest packers, which invariably the best designed and laid out. Sanitation in food processing plants can be defined as the control of the environment in which the raw food stuff product is processed to prevent contamination of the finished product. The architect is instrumental in creating such an environment and in designing any food installation planning to achieve effective sanitation to prevent contamination is important. The architect can achieve sanitary and hygiene requirements with respect to factory design principles.

2.17 THE NEED FOR SANITATION AND HYGIENE IN A FOOD PROCESSING INDUSTRY

Sanitary and hygiene conditions are very important in food processing factories to prevent contamination which may eventually cause food poisoning and spoilage. In 1976 Public Health Departments in the United Kingdom received 13,000 foreign body complaints in processed foods, Robson and Barnes (1980), up to half of which could be traced to poor plant and factory design.

In Nigeria, the story is not different, cases on food poisoning due to contamination have also been reported (Table 3.1). On record produced by the Federal Ministry of Health, 65 deaths were reported between 1971 and 1976 due to food poisoning (Table 3.1).

Sanitation therefore in food plants is necessary for the prevention of food poisoning and to reduce food spoilage. The main factors affecting this are biological but others such as chemical and physical factors also contribute Holms (1980).

Table 2.9: Reported Cases and Deaths of Food Poisoning in Nigeria from 1971–1976

Year	Number of Cases	Deaths
1971	919	18
1972	815	5
1973	977	20
1974	1389	9
1975	1829	10
1976	829	3
Total	6758	65

Source: Statistics division Federal Ministry of Health, Lagos.

2.18 PLANNING AND DESIGN CONSIDERATIONS TO ACHIEVE EFFECTIVE SANITATION

To come up with effect plan for sanitation in a food processing industry, certain basic principles of factory design should be taken seriously with respect to sanitary and hygiene requirements this is important, to avoid contamination sources at all stages in the production process from raw material reception to finished products and eventually filling in drums. Basic factory design principles involve the following:-

i. Planning of the factory considering the site location and planning, zoning of the spatial composite units especially the production zone, with respect to other units and functional relationships, between the units with respect to the production process.

ii. Structure of the factory with consideration for service, appliance and equipment fittings, finishes, construction, provisions for lighting and ventilation. Generally, factory structure should be simple and adequate but within the limits of technological possibilities.

2.19 THE PLANNING OF THE FACTORY

The general planning of the factory should be open and partitions should be kept to the minimum and be used only to isolate operations which otherwise lead to the spread of contamination. Too many separate rooms result in many corners which complicate cleaning. Only areas in the plant where different operations are performed should be separated by partitions.

2.19.1 Storage spaces

Adequate storage space should be provided for raw materials, lack of which can result in these items being kept in production areas which is unhygienic because a high proportion of foreign bodies come in with raw materials. Separate storage of finished products is important to avoid the use of the production areas for this purpose where finished products are stored next to incoming raw materials or share space with cleaning or maintenance materials, there are hazards of dirt and cross infestation and odour tainting.

2.19.2 Reception and Production Areas

The areas of production should be open and free from congestion. Congestion makes cleaning and maintenance difficult to achieve without putting the products and other equipment at risk. Plants are now being designed around a particular production line, sometimes with three different floor elevations, so that the floor drops with the flow of product.

2.19.3 Amenities

Amenities like smoking, canteens, snack rooms for workers should be provided close to or adjacent to production areas to avoid hazards like smoking behind production machinery or the

consumption of food in unauthorized parts of the factory site. Toilets and bathrooms should be separated from but located close to the production area.

2.19.4 Service and Maintenance Areas

Sufficient space for service and maintenance operations should be provided, without which will results into many problems. Workshop for technicians should also be provided because technicians forced to work in cramped dirty conditions will find it difficult to conform to the required hygiene standards when working on production areas. Lack of storage space for temporarily disuse equipment often results in it being kept in production areas. Such equipment is frequently infested because it is not being cleaned before and during storage. Equipment cleaning centres should be located close to production areas to avoid temptation to neglect cleaning materials including concentrated detergents to be kept in production areas.

2.19.5 Waste Disposal Area

A separate waste collection room should be provided in the production area. Short and direct routes for waste disposal are essential because it is undesirable to have waste passing through open production areas.

2.20 THE STRUCTURE OF THE FACTORY

Contamination sources associated with the factory structure and its fittings are numerous, some of the problems frequently encountered are as follows:-

2.20.1 Service or Overhead Fittings

The reduction of service fittings to the minimum is one of the sure ways of reducing contaminants sources. It is uncommon in conventional buildings to see ceiling covered in a network of ducting pipe work, lights, cable trays etc. The problems are obvious:

i. This causes problems of maintenance work overhead, difficulty in cleaning and provide easy roosting for birds. Dropping on equipment and raw materials are unpleasant.

ii. Direct contamination of product or contamination of equipment, and subsequently, of product, result from maintenance work takes place after production hours and only after production lines are covered. In practice this requirements is often ignored or cannot be met, owing to emergencies.

2.20.2 Walls and Ceilings Finishes

Generally, material finishes to the structure should be selected for minimum maintenance. This reduces the need to employ contractors whose labour is often difficult to discipline to food factory standards. Ceilings in the processing areas and ware house should be washable. This helps prevent moisture condensations on ceilings which could be a nuisance and cause product contamination. The walls in the ware house should be smooth and light coloured. Painting must be controlled to avoid tainting of finished products, raw materials and filling in containers. Walls should be kept freshly painted if it looks clean, the employees will keep it clean. Prefabricated sectional walls are preferred because of easy and speedy erection and dismantling which minimizes hazards to production and their salvage potential which is not the case with conventional cement block construction.

2.20.3 Floor Finishes

Floor design is worth considerable thought and high initial investment. The disruption caused by defective floor may be very costly and piece meal repair is difficult to achieve. Many floor defects arise from poor planning and preparation and not from the actual finishing material. Floors resistant to food acid spillage and washing detergents should be used such

floors are suitable, but should be sanitized by a cover of brick tiles set over it with corrosion resistant paint can also be used. Floor attack from spill damage can be reduced by sloping all floors and providing sufficient floor drains. Care must be exercised to avoid uneven areas that will hold up liquids.

2.20.4 Drainage

Adequate provision must be made for floor drainage in the production hall as it is important in the control of insect infestation and odours. Drains should be provided under equipment where spillage is likely or water is discharged.

2.20.5 Ventilation and Lighting

Because of heat produced by machinery, adequate ventilation is important to prevent condensation of moisture and discomfort. Air intake and discharge may need filtration to bring in air free of micro-organisms. Therefore an optimum ventilation system is necessary in order to achieve a high standard of personnel and production hygiene.

Lack of adequate ventilation causes problems of corrosion, plaster damage, peeling paint work and insect or mite attraction to mould growth. Wherever possible, steam or heat sources should be tackled by extraction at source, as ceiling or wall

ventilators are not adequate. It also causes personnel discomfort. In excessively warm and humid conditions head covers will not be worn properly, and other manifestations of poor discipline will result.

Good industrial lighting is a production tool that markedly affects employee accuracy, efficiency and morale. It has been proved that good lighting, that is a well designed and maintained lighting system, results in more and better production through faster more accurate seeing. However openings should be minimal to prevent just.

2.20.6 Foundations and Pest Proofing

Building foundations should be raised up to at least 600mm or 900mm above the assumed natural ground level, this is to prevent rodents coming in the building. Openable windows and doors should be screened with wire mesh to protect against entrance of insects and rodents. Door ways can be tackled by using self-closing mechanism overlapping heavy-duty plastic strips or double door construction incorporating a lobby containing either an electrical trapping device or an insecticide vapourizer.

2.21 OTHER CONSIDERATIONS

It is imperative to consider the following for effective sanitation in a food plant, this includes:-

i. Personal hygiene
ii. Raw Material Handling
iii. Quality Control
iv. Legislation, Statutory Laws and Regulatory Agencies.

2.21.1 Personal Hygiene

Good health of all personnel working in the food process industry is very important. As a matter of fact, people with respiratory diseases should not be allowed to work in food processing factory. Applicants should be thoroughly examined and tested before are employed to work and ensure that they are not carriers of communicable diseases. Food Processing Personnel that must handle food with their hands must whenever possible wear rubber gloves.

There should be a feeling of cleanliness surrounding the worker. If things are kept freshly painted and look clean, the employees will kept it clean. One thing more important than all others in maintaining sanitation is the specific delegation of

individuals responsibility for every phase of sanitation. According to Avon (1967), this is even more important than modern equipment, regular cleaning schedules of inspection.

2.21.2 Raw materials Handling

Many foreign bodies are associated with raw materials hence, correct screening procedures must be practiced. The use of bulk handling system obviates such foreign body sources as iron, nails and wire which come with raw product package. mechanical cleaning should be applied to as many raw materials as possible. Screened raw materials should be protected from further contamination, by dispensing them in properly controlled areas.

2.21.3 Quality Control

The quality control department should set up adequate and relevant control programme to assure compliance with Government Regulations and Maintain or improve the quality grade, thereby enhancing product value in the market place and also to reduce the probability of spoilage and resultant hazards to consumers.

2.21.4 Legislation, Statutory and Regulatory Agencies

Total sanitation involves every day compliance with statutory laws and acts of sanitary regulatory agencies such as Food and Drug Administration (FDA) and requires a well organised program of total sanitation.

First, the principal aspects of the Food, Drug and Cosmetic Act, what they are and how they work must be understood. Second, potential contamination and infestation problems inherent in industry and plants must be known and recognised. Third, actual and potential contamination problem must be known and coped with, and a total programme of effective prevention sanitation and pest control developed and maintained.

Finally, contamination of raw materials or finished products by insects, rodents, mould, bacteria, micro-organisms is considered as adulteration and is subject to seizure and other FDA actions. Further, it is not necessary for FDA to find or prove that a product is actually contaminated. FDA can act on the premise that contamination could or may occur under insanitary operating conditions or an insanitary environment.

2.7 CONCLUSION

Sanitary conditions in a food proceeding industry will only be achieved by detailed and adequate consideration of sanitary and hygiene requirements with respect to the planning and design considerations enumerated above together with consideration of the other factors discussed. However, total negligence and failure to note the considerations of numerated factors coupled with poor design will result to contamination. Therefore, in planning and designing a food processing industry adequate thought should be given to the following:-

1. Planning the factory with consideration for:-
   - i - Storage spaces
   - ii - Reception and production areas
   - iii - Amenities
   - iv - Service and maintenance areas and
   - v - Waste disposed areas

2. The structure of the factory with consideration for service:

i – Fittings

ii – Walls and ceiling finishes

iii – Floor finishes

iv – Drainage

v – Ventilation and lighting

vi – Foundations and pest proofing.

CHAPTER THREE

3.0 CASE STUDIES

3.1 INTRODUCTION

This chapter entails visitation to some of the existing oil mills. This is wholely to study existing situation of the oil mills, such as the types of machines used, mode of production, means of transportation and general problems associated with them with the view to solving them when designing the proposed industry.

3.2 FUNTUA COTTON CRUSHING COMPANY

3.2.1 Location and Topography

The factory which solely an oil mill is duelly located within the industrial zone of Funtua on the outskirts of Funtua town. The land is relatively flat with a water table of 18 inches (44mm) during the rainy season.

3.2.2 Landscaping and Surrounding Building

The whole site is marked on few trees and some flowers planted infront of the administrative building of the factory. Grass and weeds could be seen cropping up all around the factory.

The only advantage of the bare landscaping of the factory is the tree movement of air and this air can dispel smoke from the expeller room.

Air and noise population have their source from the expeller room and the refinery. Surrounding the factory are other factories which are located at reasonable distance from the factory.

3.2.3 Factory Layout

The factory as a whole can be divided into three major zones. This includes:-

i - Administration

ii - Ware House/Storage

iii - Production/Workshop

The units which are clearly absent are the workers facilities and clinic or dispensary.

The factory design is based on 6m x 6m modular grid. The tarred road separates the administration block from the ware house and this road is being used as off-loading bay. Another route leads from this area to the despatch area via the production hall.

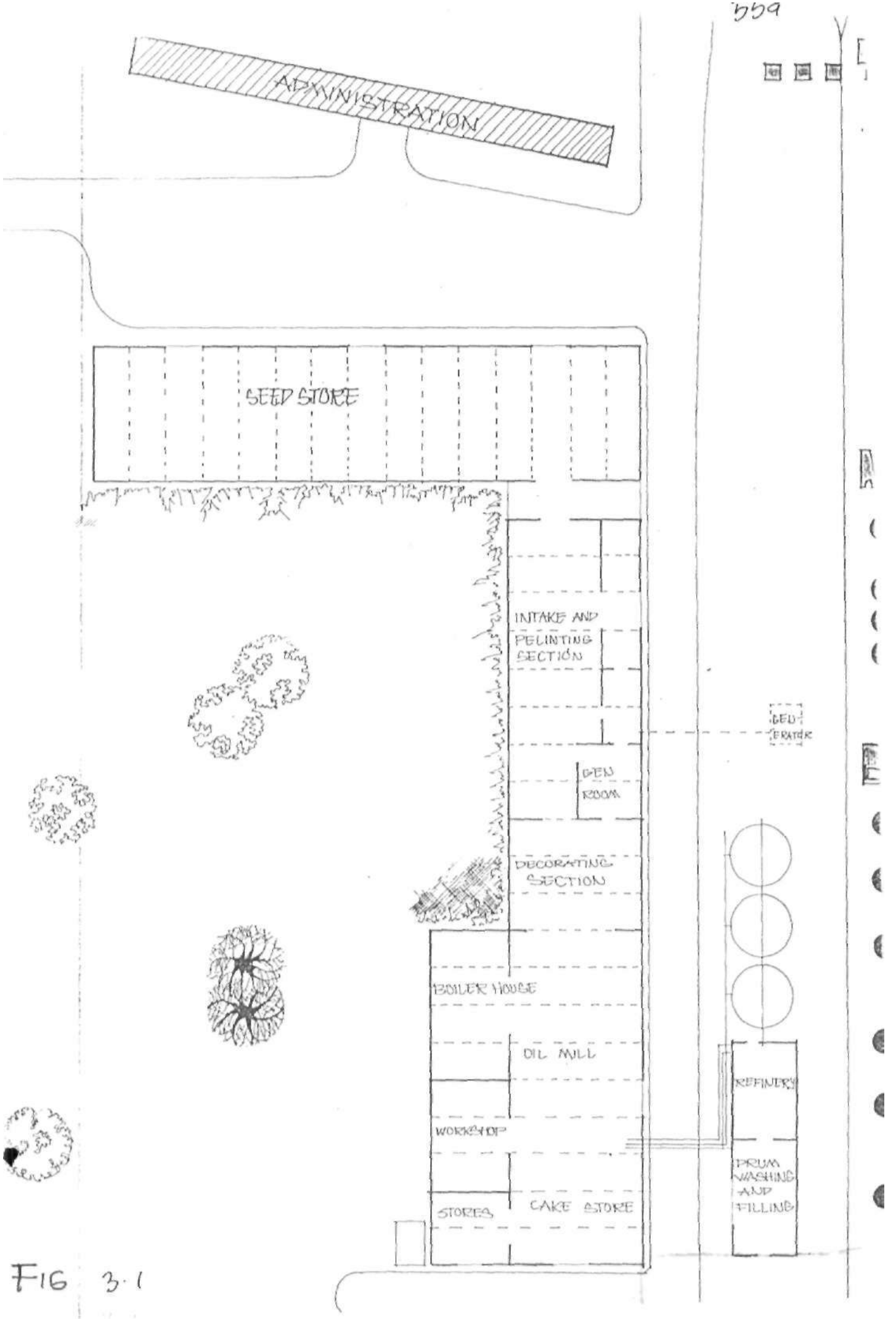
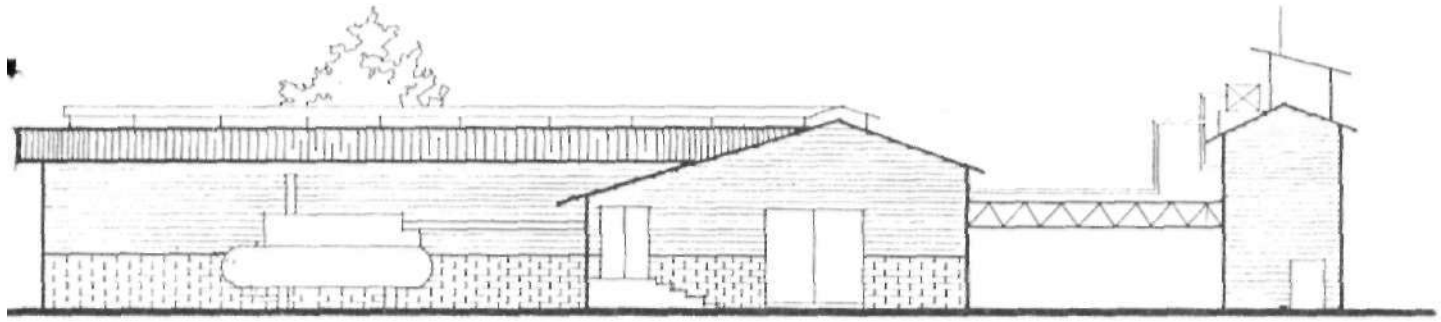
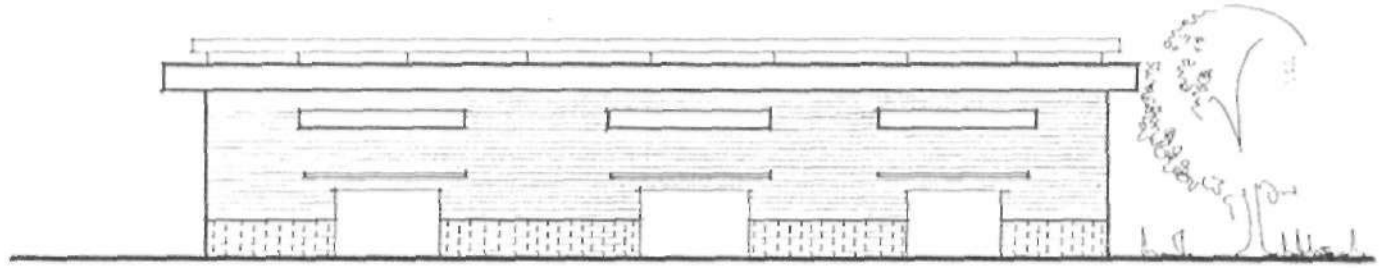

ADMINISTRATION
SEED STORE
INTAKE AND
PELINTING
SECTION
BED
ERATOR
DEN
ROOM
DECORATING
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BOILER HOUSE
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REFINERY
WORKSHOP
DRUM
WASHING
AND
FILLING
STORES
CAKE STORE

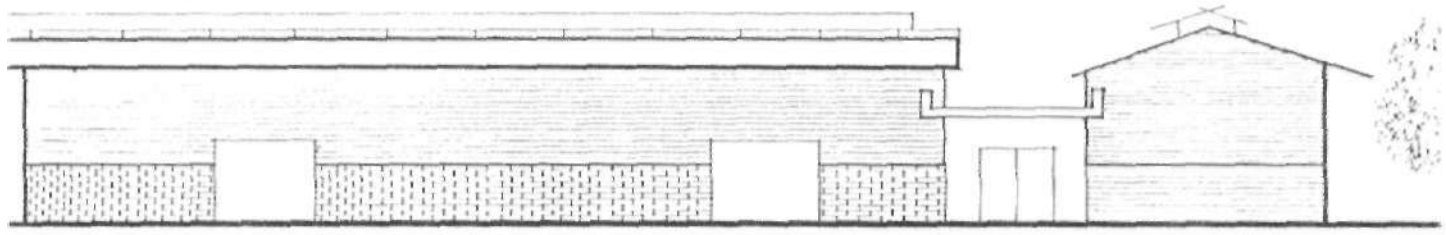
FIG 3.1



BACK ELEVATION

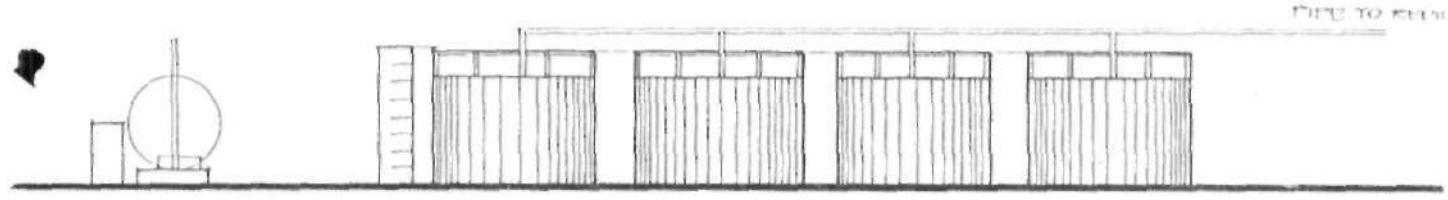


FRONT ELEVATION OF WAREHOUSE



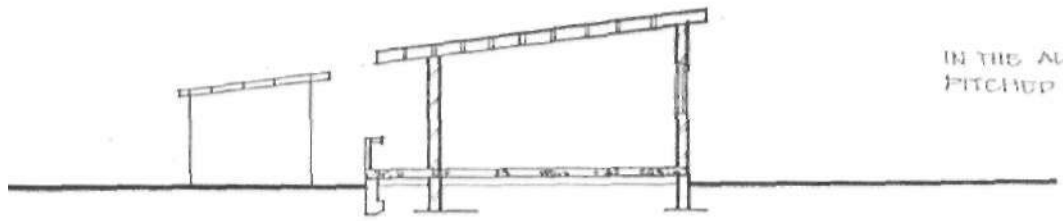
LEFT SIDE ELEVATION OF PRODUCTION HALL AND WAREHOUSE.

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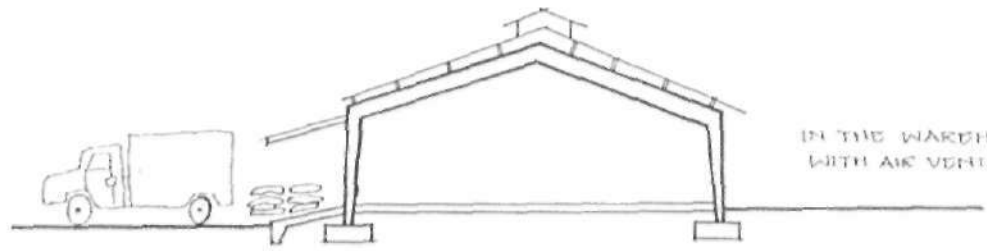
ELEVATION OF OIL TANKS.

FIG. 3.2



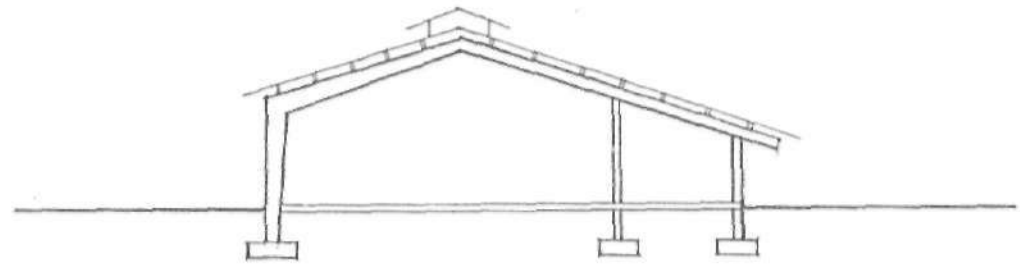
IN THE ADMINISTRATIVE BLOCK PITCHED ROOF IS USED

SECTION THRO' ADMINISTRATIVE BLOCK.

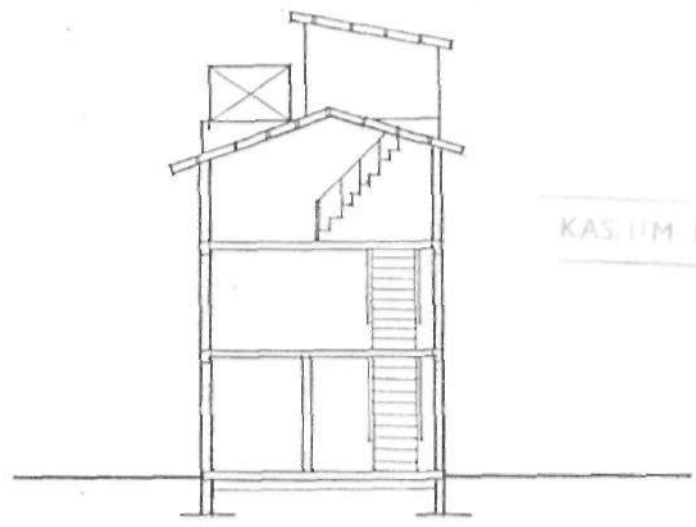


IN THE WAREHOUSE PORTAL II WITH AIR VENTS ON TOP

SECTION THRO' WAREHOUSE.



SECTION THRO' PRODUCTION HALL.



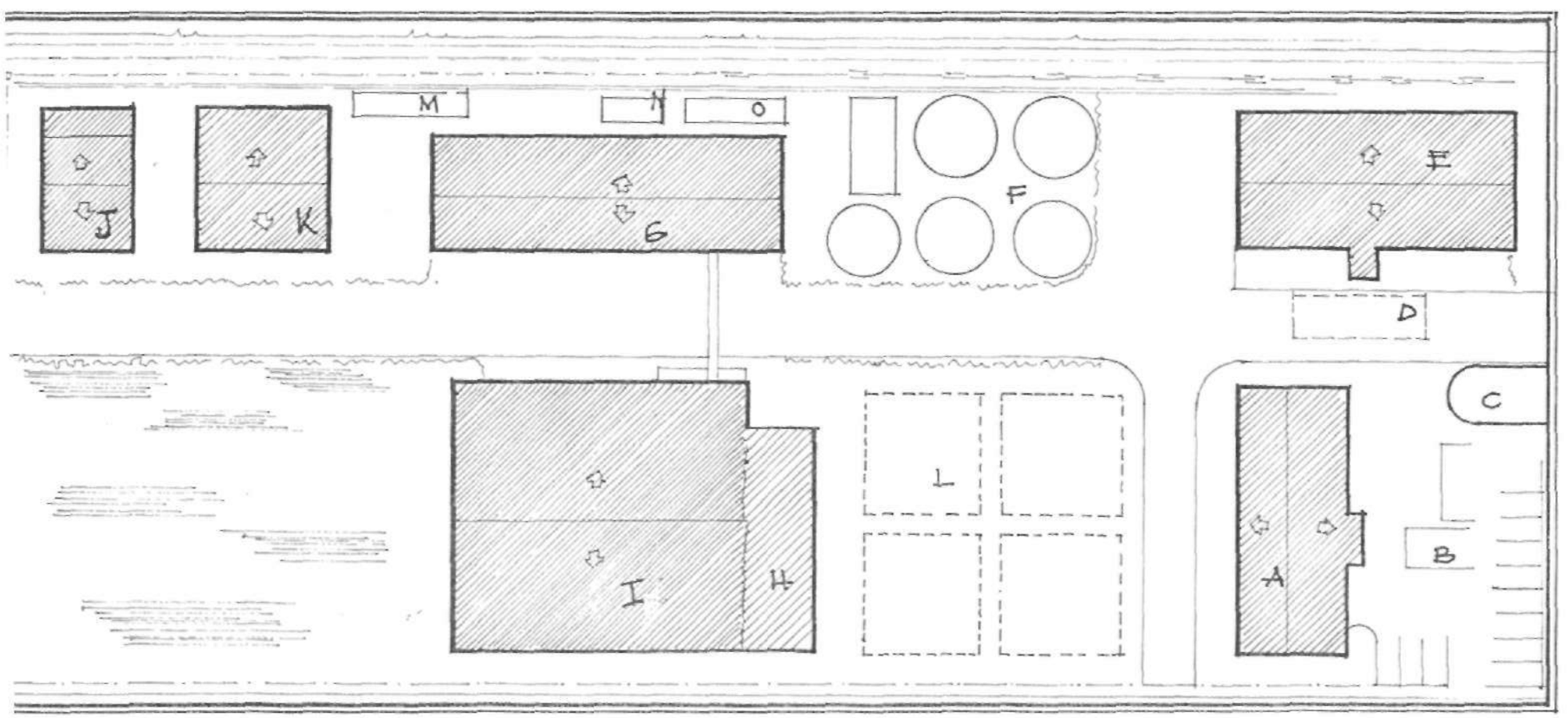
SECTION THRO' REFINERY.

KASSIM IBRAHIM LIBRARY

FUNTUA COTTONSEED CRUSHING COMPANY.

IG·3·3

SHARADA OIL MILL, SHAR
KANO.



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SITE PLAN

FIG. 434

The linear administrative block has all offices accessible from the main and only one corridor infront of the ware house. Along this corridor, there is covered car parks, for about 8 - 10 cars for both officers and visitors to the factory.

The raw material, store is also accessible from the road. This makes unloading of raw materials into the store very easy. Just beside the ware house, there is a fodder preparation room where cake (a by product) is being mixed with some grains, grinder together with maize calcium carbonate, etc to produce livestock feeds. The feeds are then packed into bags and stored in a ware house. The entrance doors are 3m x 6m i.e (height and width respectively).

The production flow is a continuous process and so there is no need for any sophisticated internal means of transportation. The workshop area is adjoining the production area on one side while the refinery is on the other side. The boiler house is also located on the same side as the workshop with fuel tanks closely placed to it for the boiler and other fuel driven machines in the factory and refinery.

3.2.4 Commuter Service - Transportation Facilities

Presently the only mode of transportation is by road but there is a rail siding tapped into the factory yard from the main tail-line. When there is an increase in production and subsequent demons, this siding will be used for transporting raw materials and for the evacuation of finished goods.

Major zones to which vehicular access is needed are the administrative zone, raw material store, despatch zone, ready made products ware house and the workshop. But there is no direct access to the workshops.

EXISTING INTERNAL TRANSPORTATION

Fork Lift

This is used in the raw material ware house to arrange bags of cotton seeds, soybeans and grain. It is also used for carrying the bags to the cleaning room for processing.

Elevators

It carries the cotton seeds or soybeans (depending on which ever is in for processing) from the fork lift into the hopper before seeds are placed in the cleaning machines.

Distribution Conveyor

This is an over head conveyor system and it connects the hopper to the cleaning machines.

SCREW CONVEYOR BELT

This is an underground conveyor system and it is used in transporting the seeds from the cleaning machines into the delinting machines. This conveyor system is also used in transporting the seeds into the rotary chamber for decorticating before being to the pressing machines.

3.2.5 Existing Buildings and their Function

The various buildings on the site includes:-

i. Gate
ii. Administration
iii. Raw material store
iv. Main production hall
v. Auxiliary technical buildings
vi. Refinery
vii. Ready-made products ware house or despatch room.

Gate House

This serves as the enquiring post and as weigh bridge. Any vehicle carrying raw material will first of all stop here and the same vehicle is weighed on the weigh bridge before proceeding to the raw material ware house. After off-loading the raw material, the vehicle is weighed again, this is to ascertain the actual weight of the raw material brought in.

Administration

The administration is made up of Personnel and Accounts sections. The administration department is responsible for management of the company such as organisation and general welfare of workers, purchasing of raw materials and equipments, sales of by-products and refined oil and record keeping and accounts of the company.

Ware House

The ware house is used for the storage of raw-materials and also for the storage of livestock feeds from the fodder preparation room.

Main Production Hall

The production process takes place here. The production stages involve the following.

i. Seed preparation and seed cleaning. At this stage, air blowing device is used to blow off sand from the seeds which are then cleaned by seed cleaners.

ii. Dehuting (takes off hut from the seed)

iii. Decorticating and rotating

iv. Pressing of Cake

v. Crude oil production.

Some by-products are produced during production processes e.g lint from delinting stage, and cake from pressing stage. This production process is for cotton-seed, for soybean only a slight change in the sense that some stages are omitted e.g the delinting stage but apart from that it involves the same process.

The lints are compressed and stacked up in bales and stored in bales ready for despatch. The cake is stored and sold as a by-product after it has been prepared to enrich its value for livestock.

The production capacity of cotton seed per annum is 12,000 tones while that of soybeans is 9,000 tones on a 24 hour shift basis, 3 shift per day.

Auxiliary Technical Services

In the production hall some rooms adjoining the main production flow are used for mechanical installation equipments, repair workshops and electrical installation. These are:-

i. Generator room

ii. Boiler and Furnace room

iii. Mechanical workshop where repairs work takes place.

iv. Spare parts tore.

Refinery

The crude oil from the production hall is process in the refinery.

In this building is a laboratory and a despatch room. There are also four tanks installed outside the refinery building. One is for the storage of crude oil from the production hall while the other three are for the storage of refined oil. Crude oil is taken to the refinery by centrifugal force. There are two tanks for semi-refined oil while the last tank is for fully refined and de-odourised oil.

Despatch

In the despatch room, the already refined oil is poured into barrels weighed on a balance to achieve uniform filling of barrels and stored after the barrels are sealed.

3.2.6 Structure

Foundation

Foundation of the production hall is not strong enough and it is evident from the sinking floor in the boiler room. Additional design for the machines at foundation level was not done. At the initial stage of the design, consideration was not given to the laboratory strength of the machines the water table within the site is also low.

Flooring

The floors are concrete finished except in the first, second and third floor of the refinery. The floors are finished with steel and wood with wood resting on steel joists, and steel staircase for access.

Walling

The ware house and production hall are constructed with hollow block from foundation level to a height of 2.1m level (lintel level), while hollow blocks are used throughout the administration and refinery.

Opening

There are very few openings in the production hall and the ware house except for the roof lights present in both buildings and air vents in the production hall for the expulsion of smoke.

There are adequate openings in the administrative block and the refinery, where cross ventilation is essential.

3.2.7 Merits

i. The location of the workshop close to the main production hall facilities repairs of damaged machines.
ii. Adequate space for the storage of raw materials
iii. Minimal use of partitions in production hall
iv. Adequate space provided for maintenance operations in production area.

3.2.8 Demerits

i. There is no separate parking space for customers or visitors. They are allowed to park anyhow within the factory premises, thereby encouraging security risk.

ii. No provision is made for workers facilities such as canteen, clinic, changing room etc.

iii. No adequate lightening in the production hall hence causing psychological problem to the workers comfort and their productivity.

iv. The on-loading bay is not properly designed as crisis results whenever more than one truck are loading at the same time.

v. The steel portal frames are not coated or painted with fire-resisting paint and hence vulnerable to collapse in the event of fire out-break.

vi. The floor finished is of ordinary cement, sand creed. Chemical stains are not easily washed away.

vii. Finally, there is lack of proper disposed of hazardous by-products like lecithin and soap stock. They are seen running off-down the gutter.

3.3.0 PROTEIN DERIVATIVE LIMITED SHARADA PHASE III, KANO

3.3.1 Location

This factory is located in Sharada Industrial layout in Kano. The factory was constructed in 1987. The production has since started due to very high demand for vegetable oil.

The site slopes very gradual towards the entrance making surface drainage very easy as well as the construction of waste disposal channels. The surface of the ground is very sandy and turns marshy during the wet or rainy season.

3.3.2 Landscape

There is a single tree opposite the gate house but shrubs and grasses are all over the ground surface. The road leading to the factory is not tarred, the same with the roads within the factory premises.

It is bounded by a sugar factory to the North, a Battery factory to the East, the access to the West and a Rail track to the South. The premises is well fenced with high walls provided with only one entrance.

3.3.2 Factory Layout

There are only three major zones in the premises which includes:-

i – The crushing and pressing hall

ii – The refinery hall

iii – The administrative zone.

The whole complex is divided into two equal parts by the internal route thereby separating the crushing and pressing section from the refinery. The oil tanks and the boiler fuel tank are located at the right hand side of the entrance gate. The generator room is at the extreme end of the site. The temporary administrative offices that is the Potakabin Caravans are situated on the left hand site of the entrance gate.

Empty spaces within this key areas are littered with machines part, they could actually be called "junk yards".

Absent on site layout is the workers facilities.

3.3.4 Circulation

The factory has only one entrance or route. It serves the trucks, cars and even pedestrians. It's like transportation of goods are done manually. In the production halls, conveyors and elevators are used for the transportation of materials under processing.

3.3.5 Existing Structures

The existing buildings are Gate house, Caravan used as part of the Offices, refinery, generator house, production hall, oil tanks, office block and fuel tanks.

3.3.6 Demerits

i. There was no architect employe in the design and planning of the oil mill.

ii. As a result the building construction and relationships are based on trial and error.

iii. The landscape is poor

iv. No workers facilities at all

v. The laboratory is very far from the production hall

vi. One access serves trucks, cars and pedestrians

vii. No fire fighting unit.

3.3.7 Merits

i. Generator plant is well located at the extreme end of the site so as to reduce noise reaching the office block

ii. The industry has a good location interms of

(a) Accessibility (b) Within the industrial estate

iii. The production hall is well lighted using translucent plastic roofing sheets.

iv. The diesel (fuel) tank is well created adjacent to the boiler room.

3.4 CONCLUSION

From all the case studies conducted it is evident that workers facilities are absent. These include changing rooms, clinic, canteens and other recreational facilities.

The loading and off-loading bays are not clearly defined. The staff and visitors park their cars at the same place, which security wise is not proper. The maintenance workshop is an after thought as part of the production has cleared to serve this purpose. Flexibility in design is not achieved due to rigid planning therefore making future expansion impossible.

The production hall lacks adequate natural light making working condition for workers uncomfortable. Even though roof lights are provided which lack maintenance and therefore do not do the purpose meant for.

The main advantage of these factories is that the structures are simple and economical but the planning is rigid as only the initial flow was considered. The columns interfere with the production flow thereby making it difficult to have straight flow process. One other problem with the factories is that the structural steel stanchions are not encased with concrete column as guides against fire out break. The

production hall lacks monitor roof to allow smoke escape into the atmosphere in the event of fire out break. There are no fire extinquishers around. No single fire unit. The various units of the factories are not adequately far apart and fire can easily spread to the neighbouring unit.

Hence I proposed a design that a steel stanchion will serve as a constructional skeleton. The steel truss shall be encased with concrete and finished fire resisting paint. The production hall shall be finished escape routes to allow workers to escape within small time in the event of fire out-break. Roof monitor roof will be provided at the production hall to provide natural light and for the escape of smoke. Openings shall be fixed louvered glass for smoke escape and cross ventilation. The walls of the production shall be of burnt bricks which has required fire resistance.

All these design considerations create a comfortable working environment for the factory worker thereby increasing the efficiency of the production.

CHAPTER FOUR

4.0 USES OF SOYBEAN, PROCESSING AND UTILIZATION

4.1 USES OF SOYBEAN

The uses of soybeans started in the orient where both medicinal and food value was assigned to this legume. Various types of food were prepared from it including beverages, pastes, curds and fermented some resembling milk, cheese and meat. In Nigeria other user of Soybeans are in form of Soybean cakes (akara), soybean pottage, pudding etc.

4.2 RAW MATERIAL: PERCENTAGE OF OIL AND PROTEIN

The percentage of oil and protein in the soybean grain is as follows:

16 – 20% of oil and

40% of protein.

4.3 THE SOLVENT EXTRACTION PROCESS

4.3.1 Operation Principles:

The process consists of the following stages:-

i. Receiving and Storage of Soybeans

ii. Preparation of the raw materials for extraction

4.3.2 Receiving and Storage of Soybeans

Nowadays, soybeans are received at the factory, almost exclusively in bulk, by truck or rail: They are weighed, unloaded and conveyed to the main storage silos. The size of the silos depend on the frequency of reception and the availability of other storage facilities in the region. Normally the main storage volume should correspond to the raw materials needed for a few months of operation at full capacity. It is extremely important to maintain good sanitary conditions on and around the receiving areas and especially, to protect the seeds from contact with moisture.

As soybeans are purchased by grade, it is necessary to draw representative samples for quality evaluation from each lot at the point of reception. The samples are analyzed for moisture foreign materials, colour, broken beans etc. in order to determine the compliance of the lot with the specified grade criteria.

The typical storage facility in soybean oil plants is the vertical cylindrical silo. In recent years the conventional concrete silo is being replaced by steel silos of different types. One of the advantages of the metal silos is the speed of erection.

4.3.3 Preparation for Extraction

This stage comprises drying, tempering, cleaning, cracking, dehulling, conditioning and flaking.

i. Drying: If the soybeans are to be dehulled before extraction, they must be dried to a moisture content below 10% in order to facilitate separation of the hulls. This is achieved in vertical gas or oil fired forced circulation driers. If the natural moisture content of the beans is 10% or less, or if dehulling is not practiced, drying as a preparation step can be omitted.

ii. Tempering: After cooling, the dried soybeans are stored in bins for 2 to 5 days, in order to allow for moisture equilibration by diffusion. This is called tempering. The tempering bins, which are usually out doors silos of the vertical type, also serve as working bins (day bins) to secure uninterrupted feeding of the plant. As all the subsequent steps of processing are continuous, it is necessary to monitor the flow of soybeans from the working bins to the processing plant, in accordance with the planned processing capacity.

iii. Cleaning: The soybeans are subjected to a number of cleaning operations throughout the process. Tramp iron is removed by magnetic separators. In moderate capacity installations these can be magnets attached to conveyors or chutes carrying a stream of beans. Stones, sand, dust and other foreign materials are usually removed by conventional seed cleaners. Typically, the seed cleaner consists of a two-deck liberating screen. The upper screen retains the beans and other coarse materials but allows whole soybeans to fall through. The lower screen retains the soybeans but finer particles such as sand to pass through.

iv. Cracking: The purpose of this operation is to break the seeds into smaller particles in preparation for flaking. If the beans have been dried to 10% moisture and tempered, cracking also loosens the hulls and permits their separation by aspiration. Ideally, the seeds should be broken to 4 to 6 pieces of fairly uniform size.

4.4 METHODS OF PRODUCTION

Basically, there are two agreed methods of processing soybeans, which includes.

i - Solvent - Extraction Method

This method is not generally accepted, because 99% of oil is extracted from the seeds. The chemical (hexane) used may not be completely recovered and the method is not recommended for any oil mills.

ii - Press-hexane or Press - Extraction Method

This is an improvement on the extraction method used in the extraction of soybean-seed oil and solvent extraction method. The chemical hexane is available in Nigeria and is cheap to buy. This method is advantageous because 99% of oil is extracted from the grain. Hexane is recovered by evaporation since the boiling points of water and oil differ respectively. This method is highly recommended and shall be discussed in details.

4.5 PRESS - EXTRACTION

Pressing and Extraction is aimed at recovering the oil contained in the seeds. In the seeds the oil is enclosed in cells which is necessary to break before further processing takes place. This is obtained by grinding and pressing. The product emerging from the presses must then be processed in order to render it permeable to the solvent for the complete extraction of oil from the cake. The sequence of the operation is as followings:-

i. Weighing – to ascertain the weight of seeds used

ii. Cooking – Thermal treatment of the seeds to make the breaking up of the oil bearing cells.

iii. Pressing – Extraction of most of the oil is then done here by means of a screw press.

iv. Grinding – The cake coming from the press is broken up at this stage.

v. Flaking – This operation turns the cake into flakes which are easily percolated by hexane.

vi. Extraction – The oil is completely extracted from the cake by washing it with hexane.

vii. Soventization– This is aimed at recovering the hexane used to remove the oil which is still in the meals. It is done in a stacked steamed heated desolventizer.

viii. Distillation – The hexane is recovered by evaporation from the material and the residue of the extracted oil.

4.5.1 Refining

Refining is the process whereby extracted crude oil is processed into edible oil for human consumption. In the process of refining the following component are eliminated.

i – Fatty acid

ii – Pigments

iii – Odouriferous and Sorpid Components

The process of refining involves three stages.

i – Neutralization

ii – Bleaching

iii – Deodourization

Each shall be discussed independently.

i Neutralization

This is the process whereby caustic soda is added to the content of fatty acid in the crude oil. The chemical reaction between the fatty acid and the caustic soda, results in the formation of a hard soap which settles in flakes and can be mechanically eliminated from the neutral oil. The amount of neutral oil is proportional to the amount of soap formed which in turn is proportional to the initial free fatty acid content.

Since the market value of the oil is vastly superior to that of the soap stock, the economy of refining is to a large extent determined by the content of free fatty acid in oil.

Therefore to eliminate the free fatty acid completely, more caustic soda is used with water and passed through the centrifugal machines which does the separation.

ii Bleaching

This is the separation of coloured pigments from the oil. This results from poorly matured or broken seeds which give poor quality of oil. In order to remove the undesirable colouring matters, adsorption agents are used. In this case a bleaching earth is used. This is mixed with hot oil and stirred. The stirring process precipitates the colouring matters on its surface. The oil is separated from the colouring matter and earth laden by filtration.

iii Deodourisation

This is the last phase of refining, which is to separate odoriferous and sapid components from the crude oil, and it is done by injecting steam under the highest possible vacuum in the neutral bleached oil, at a fairly high temperature. In accordance with well known physical laws the sapid and odoriferous components are carried away by the steam. The losses resulting from this operation rarely exceeds one percent. The refining process is then completed by polishing filtration. Oils are then stored in drums and cans.

4.6 METHODS OF PACKING

There are a number of ways in which refined oil can be packed. Apart from filling into storage, drums, cans, rail road tanks can also be used to preserve the oil.

4.6.1 Tin Cans

The cans used today, is known as the 'Sanitary Can'. It is made up of steel plated with tin. Can enamel is applied to the interior of the can to prevent unfavourable reaction between the can and its contents. The external surface is coated with non-toxic paint or enamel to prevent corrosion and provide camouflage. Cans are labelled by various methods such as lithography, stamping, and paper labelling. Numbers or letters bearing coded information such dates of pack etc. are stamped on the cans.

4.6.2 Aluminum Cans

This type of cans is most preferred to tin plate because of the freedom from sulphide discoloration and resting, easy opening feature like 'pull out' type of opener.

4.6.3 Glass and Plastic Containers

A wide variety of canned good products are packed in glass or plastic. This is so because they are less susceptible to attack by the product it contains, but the risk of breakage is great.

CHAPTER FIVE

5.0 THE STUDY AREA

5.1 HISTORICAL BACKGROUND OF JALINGO LOCAL GOVERNMENT AREA

Prior to the coming of the Fulbe in the early part of the nineteenth century, Jalingo Local Government Area was Sparsely populated. Almost all the ethnic groups in the six Local Government Areas of Zing, Karim-Lamido, Bali, Yerro, Lau and Jalingo were under the religious-political control of the Jukun-Kona. It was based more on mutual understanding rather than conquest of warfare. The Mumuye, chamba and riverain-ethnic groups of wurkun, Jenjo, Karinjo, Bandawa, Kunini, Jiru, Lau-habe etc. brought in all forms of tribute in return for religious and Government Supervision.

The Kona had a centralized Government under the 'Kuru' (Chief) who was assisted by the Chief Priest and Councillor each with a definite function. Much of the land known today as Muri Emirate were under the spheres of influence of the Kuru. The Kona were on ambassadorial level with the Bachama and paid, their due respect to the supreme Jukun King, the 'Aku' at Byepi (Kwarrarafa). Ethno-political up-heavels in the Gongola valley

led to massive exodus of the Kitaku Fulani from Kiri with Buba Yero re-stressing his steps back to Gombe, one unit gone to Tibati in the Cameroon and a clan under Hammaruwa moved Southward into the middle Benue valley and settled at Muri. At the inception of the 1804 Jihad, the Fulani commenced full scale arms struggle which led to the establishment of Hammaruwa Kingdom, and after ratification of Sokoto, the Muri Emirate was established.

However, the conflict in Muri from the 1860's to the 1890's was basically intra-dynastical, with the sons of Hammaruwa struggling for supremacy. This led to the temporary balkanization of the Emirate which led to the establishment of Gassol, Sandirde, Wurio, Bakundi, Ibbi and Bantaje towns. Presently, the whole of the Muri Emirate is divided into four Local Government Areas as a result of the 1976 Local Government Reforms. Jalingo Local Government is one of them. Two of those Local Government were later splitted giving birth to Lan, Ardo-Kola and Yerro Local Government out of Karim-Lamido and Jalingo respectively. There is only one royal family in the town known as Muhammed Yari. There are five Kingmakers and they are responsible for the selection of the Emirs. The Waziri is the adviser to the Emir. He is, in the absence of the Emir, responsible for the ceremonial and

traditional administration of the town. The Waziri is usually selected by the Emir who also ensures that he is an educated man with considerable knowledge of the town and the people.

The town is divided into five wards namely, Turaki, Dawaki, Sintali, Majin-dad, and Barade. Each ward is headed by ward heads.

5.1.1 Geographical Location

Jalingo town lies on latitude 8o 50' North and Longitude 11o 25' East. It is bounded by Kona village in the South and Nukkai village in the North. The town lies at a strategic road junction linking Wukari and Bali in the South, through Jalingo, to Mayo-Lope and Numan (Adamawa State) in the North.

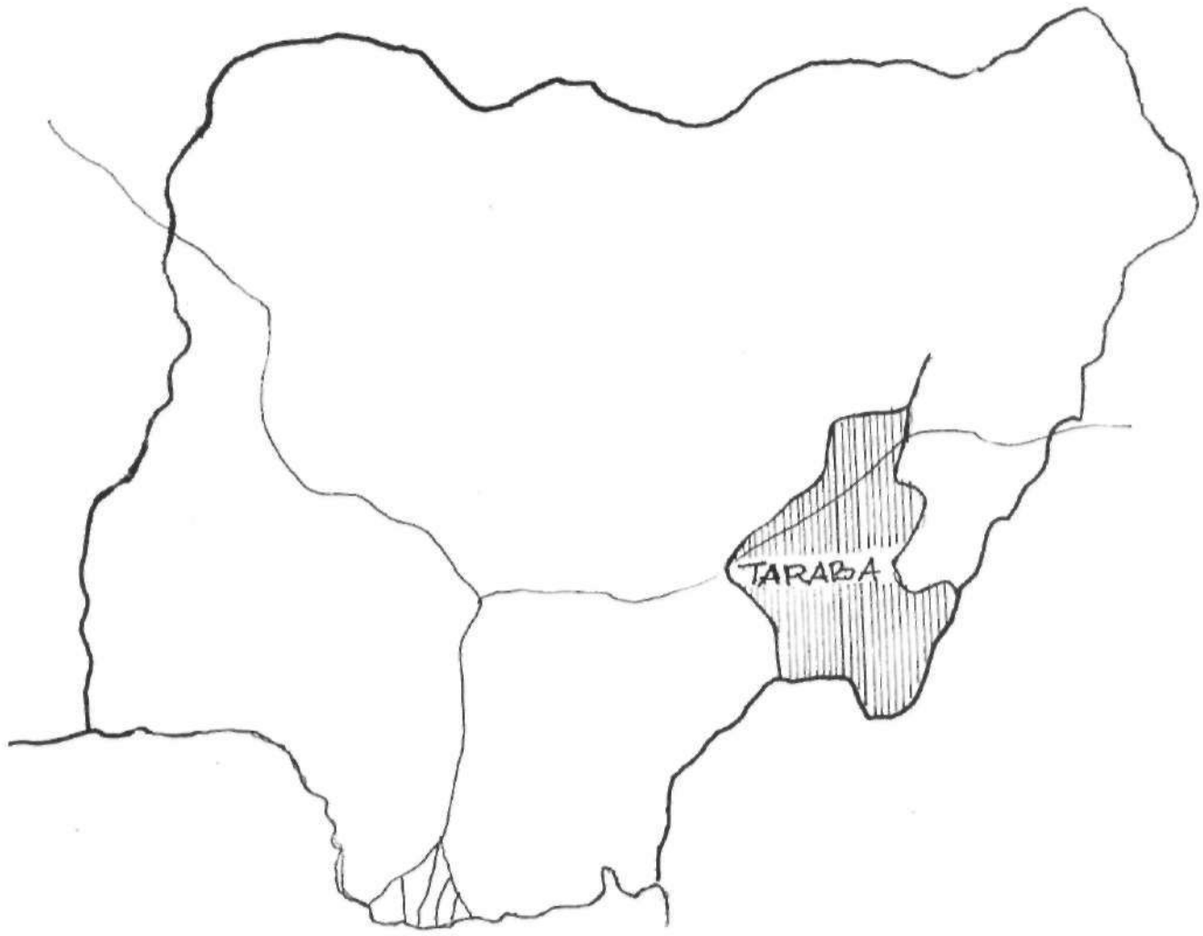
5.1.2 Population

With the release of 1991 figure by the National Population Commission (NPC) and subsequent endorsement by the Federal Government, Taraba State has the provisional figure of one million, four hundred and eighty thousand, give hundred and ninety (1,480,590). Jalingo town the headquarter of Taraba State as well as Jalingo Local Government Area has the provisional figure of 48,805.

5.1.3 Culture and Tradition

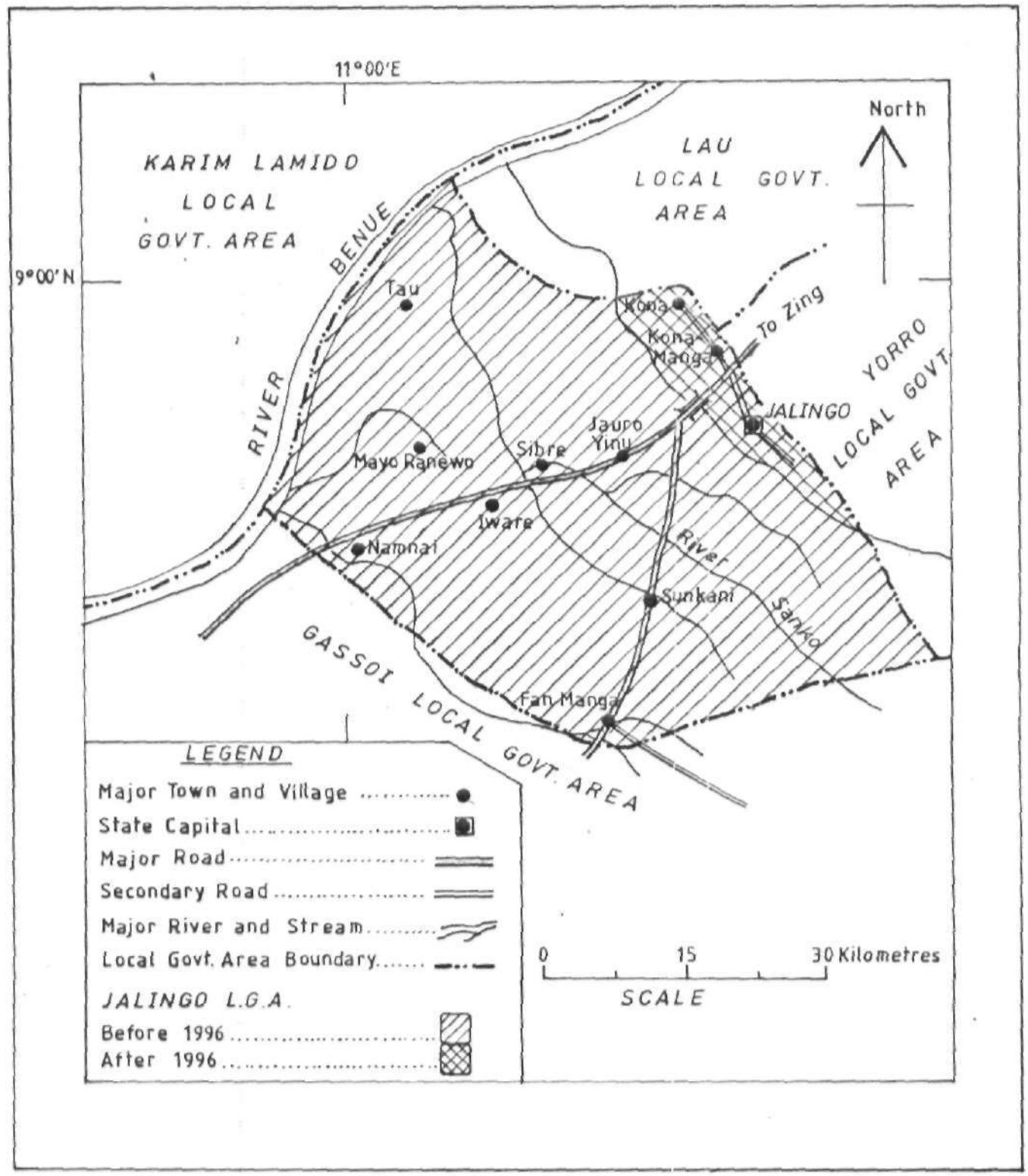
Prior to the advent of the 1804, Sokoto Islamic Jihad, Jalingo town was absolutely under the Jukun-Kona animist influence. The Jukun-Kona dialect was the spiritual language of interaction. At that material time, the area known today as Jalingo was basically inhabited by the Jukun-Kona, Mumuye, Jiru, Shomo and most of these ethnic groups operated stateless societies and live in scattered clans. Interclan cases were referred to the Jukun-Kona who arbitrated in all communal issues. These settlements were of patrineal relatives and each group recognised a single priest as the representative of a supreme being and was confined to the priests Panti-Girin were the bonds that knitted clans together.

The two most important items of trade were salts of Bomanda Jebjeb and Wuju (now in Karim-Lamido L.G.A) and the 'Taje' (iron bar) of the Mumuye. These along with ivory were coming from Chamba area to be exported. With the coming of the Fulbe and the commencement of the 1804. Jihad, there was a power tussle between the Fulani and the Jukun-Kona for the socio-economic control of the Jalingo area. This led to the amalgamation of the Fulani, Jukun-Kona and Mumuye traditional influence over the area. The Fulani inter-married with the various aboriginal ethnic groups and today, Hausa Fulfulde,



MAP OF NIGERIA SHOWING TARABA STATE.

FIG. 5.1



~~Fig 3~~. Jalingo Local Government Area (L.G.A.)
Source: Taraba State Survey Office

~~FIG.~~

FIG · 5·2



MAP OF TARABA STATE SHOWING JALINGO L.G.A

FIG. 5.3

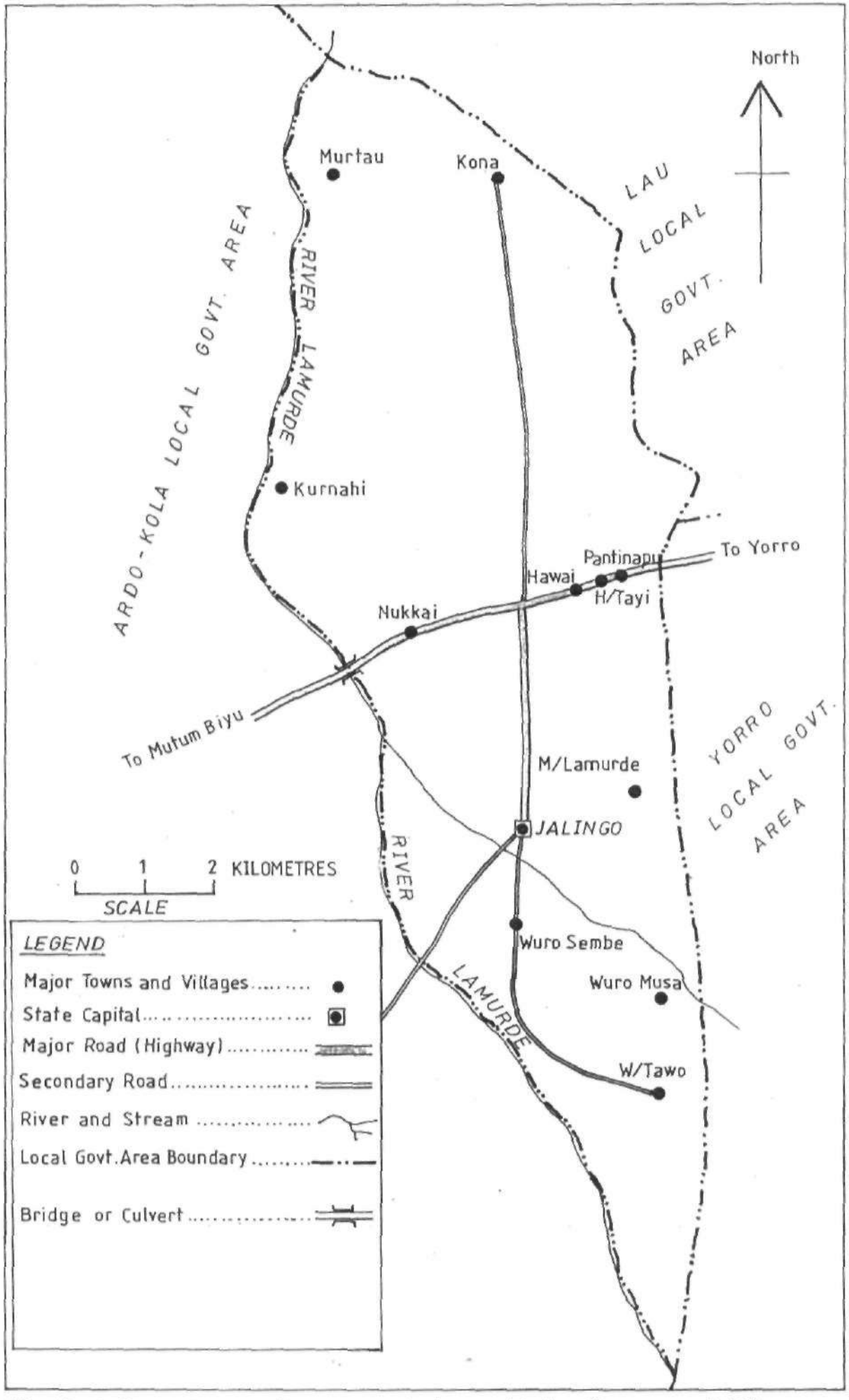
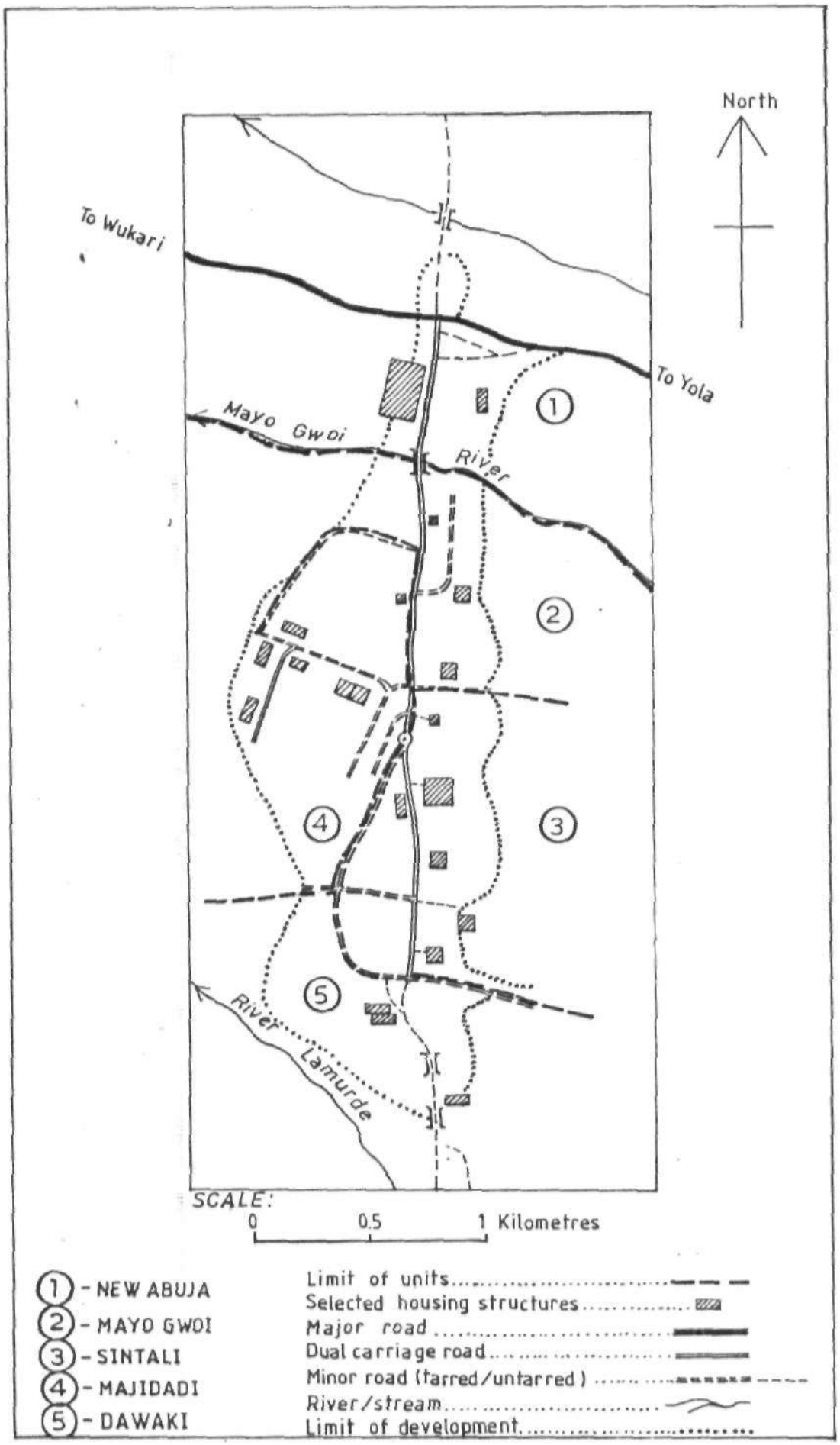


Fig. 1. Jalingo Local Government Area : Major Towns and Villages.



~~Fig. 2:~~ A Map of Jalingo city: Developed and "Administrative" units. *(Source: Survey, 1999)*

FIG. 5.5

Mumuye and Jukun-Kona languages are all strong languages of interaction. A percentage of the population adhered to the traditional ways of worship and like. With the coming of the missionaires in the 1830's conversion to christianity from the various ethnic groups commenced. The larger proportion of the population of Jalingo are christians and with a considerable muslims counterpart.

5.1.4 Economic and Commerce

The commercial life of Jalingo is centered on trade and livestock. Food items merchandise and professional services such as tailoring, cobbling, electricians etc formed the basis of commercial activities. In terms of industries, there exist a number of furniture factories e.g Nagarta Furniture Factory, Haske Furniture Factory, Stainless Furniture Factory etc Farm, block making Industries, a soap making industry and a large cattle market, which is the second largest in the State. Electricity is provided to Jalingo town through the National Grid and there is a good supply of pipe-born-water in the town.

5.1.5 Education

On Education, the first primary school in Jalingo was opened in 1932. At present there about 10 primary schools in the town with total enrolment of 9,463 along side with 467 teaching staff (Local Education Authority).

There are about 10 Secondary Schools to cater for most of these pupils. There exist three post-secondary institutions in the Headquarters these are College of Education, College of Agriculture and Taraba State Polytechnic, and School of Nursing and Midwifery.

5.1.6 Health and Social Services

Jalingo General Hospital was commissioned in 1965, to assist this hospital in the proper administration of health care, there are three dispensaries, one maternity clinic, three basic clinics and four leprosuim clinics in the town. There are four good private hospitals and clinics in operations in the town Jalingo. These are of great help in administering of health services to the teaming population of Jalingo town.

Sporting and recreational facilities are recently developing. At present, there is the Afolahan Square which contains a football pitch and stands of other indoor games.

Others are Television Viewing Centres, Cinema houses, Motels etc. Work is in progress to complete the Ultra-modern Sports Complex Stadium. Permanent sites for Taraba State Television Cooperation Station was completed and since been commissioned. Nigeria Television Authority and Taraba State Broadcasting Corporation have been providing skeletal services.

5.1.7 Communication and Transportation

Jalingo town is situated between the Northern and Souther States and also as a link between important commercial centres of Gembu, Wukari to the South and Karim, Zing to the East, Jalingo town is a passage. As such the major tarred roads are Yola-Wukari and Jalingo-Bali Federal Highways. There are other several untarred roads that linked Jalingo with other villages and Local Government Areas surrounding. There is also an air strip and a missionary air craft that lifts people from Jalingo to Karim and other parts of the country.

As for the media and communication, a telephone system has been established, as such, Jalingo can be linked with the outside world. There is also a State owned monthly News Paper 'Taraba Insight', Taraba Television Corporation (TTV) and Nigeria Television Authority (NTA) all rendering skeletal services.

5.1.8 Agriculture

Jalingo town is one of the areas that has the most fertile land suitable for growing almost all types of sub-saharan crops. It is so fertile that farming do take place even on hills. The open indulating plains make clearings less strenuous. Among the variety of grains and tubers grown are:- Yams, Cassava, Maize, Guinecorn, Soybeans, Cowpeas, Groundnut, Cotton, Rice, Millet, etc. From time immemorial, Jalingo has been producing in surplus, the above mentioned crops and has been supplying some to places within and outside the country. Along side this, the environment is healthy and tsetse fly free. The dry season last for five months while the rainy season takes the larger proportion of seven months, which allows for enough water to equip the needs of farms. The rivers and streams around holds a reasonable sum of water which provides suitable environment for dry season farming and a very lucrative animal husbandry.

5.2 GEOLOGY AND SOILS

Around Jalingo, one finds the Volde formation which is veritable sequence of sandstones, sandy, mudstones, shales and limestone which mark the transition from the marine to continental sedimentation. In some areas, there is an alternating sequence of shales, sandy mudstones with subordinate sandstones. Jalingo falls within the

undifferentiated basement complex. The structure of the area has been determined largely by earth movements of late cretaceous age with the structural pattern dominated by a series of folds which are remarkable for their great length, narrowness and relative simplicity. Faulting, the main period of which followed, is of considerable importance and has affected the rocks of the sequence.

The principal water-bearing soil of the area around Jalingo are the sandstones formation. Where the outcrops occur, groundwater normally occurs under water-table conditions. Sometimes they consist chiefly of fine grained sandstones this limestones and shales which do not normally form good aquifers.

5.3 SITE SELECTION CRITERIA

There are number of factors that would influence the location of soybean processing industry Jalingo, Taraba State. These factors come together to providing a choice for the siting of the industry. The industry is one which requires a large expanse of land and closeness to its major source(s) of its raw materials. This is made more interesting by the geographical dispersion of these raw materials sources.

i. Economy

There is a ready and available market for the industry's products on Taraba State on the first hand where continuous developmental projects are taking place and a taste exist for top-quality of sugar and also in the rest of the country, where these same needs exists. Ultimately, the foreign market is the target.

ii. Transport

The industry should be located along a traffic route which serves the state and other parts of the country. Proximity to Adamawa, Benue States as a route for export is also important.

iii. Manpower Resources

There is a generous output of skilled labour from our country's higher institutions like the Federal University of Technology, Yola, Taraba State Polytechnic, Wukari of proven capability. These may be employed as skilled workers in the industry. Semi-skilled and unskilled workers may be employed from the residents of Jalingo town and its environs.

iv. Availability of Raw Materials

The nearness to its source of raw materials is an important factor of siting an industry. This is compounded by the geographical dispersion of these sources. The best choice of site would be one located near a cluster of these soybean plantations thereby reducing the cost of transportation of the raw material which would otherwise be reflected in a greater overhead cost.

v. Physical Features of the Site

Industrial sites are best flat or gently rolling as most industrial processes are carried out on a single level.

vi. Power Supply

There must be an adequate supply of energy for the proposed industry to meet its energy requirements. This may be in the form of electricity, petroleum or natural gas fuels. The soybean processing industry demands an adequate supply of electricity to generate its machines and natural gas to blast its boilers.

vii. Government Policy

The Taraba State Government is committed to the rapid industrialization of the state owning to the backward nature of the state. Investors are dully called upon to contribute in this respect by establishing their industries in the state to release this noble goal.

viii. Water Supply

Soybean processing industry needs water in its production. For this reason, it is important that the industry is located near a steady source of water supply. A lot of other factors must come into consideration. These would include the social amenities in the town to be considered. If the town meets all other requirements, it is important to note that would the employees be able to live under the social conditions of the town? Is adequate housing for the staff readily available? Would there be need to establish staff housing scheme. Are there existing medical facilities? Is there a land acquisition problem? What is the crime rate in the town? The industry should come where as to allow safe despation of finished products primarily by road and by sea, by air for exportation. Good roads are of paramount importance here.

5.4 SITE CHOICE – JALINGO (JALINGO LOCAL GOVERNMENT AREA)

The site is located in Jalingo – the headquarters of the Local Government Area of Taraba State. Jalingo is fairly large town strategically located along Wukari – Yola road in Northern Nigeria Highway. And it is estimated that 60% of the raw material is to be source locally at Jalingo.

Jalingo, which is also the Headquarters of Taraba State, enjoys various social amenities such as steady supply of electricity from the National Grid, pipe-born water from a central treatment plant, a relatively developed educational sector which includes a College of Education, College of Agriculture, which has an elaborate agricultural engineering department. The town is also enjoys telecommunication facilities like the NITEL earth station from which effective telecommunications to any part of the world is possible and a specialists hospital.

5.5 DESCRIPTION OF SITE

The proposed factory would be sited in the Northern part of Jalingo toward Wuro-Sembe village which is bounded on the East by River Lamurde which is the tributary by River Benue. This is part of the area set aside for industrial development of the town. The site is about 4 kilometres from the town.

5.6 CLIMATIC ANALYSIS

The micro-climate of Jalingo can be treated under three main headings, namely: Rainfall, Temperature and Relative Humidity. These three climatic conditions interact to form the detailed weather situation in Jalingo at any point in time. Variations experienced with regards to rainfall, temperature and relative humidity during the dry and wet seasons often determine whether the inhabitants of the town find weather conditions soothing or inconvenient. In general, however, the micro-climate of Jalingo is somewhat ardons with relatively wide and rapid changes in temperature and humidity.

Below are the analysis of the climate data:

i. Temperature

Jalingo experiences the highest temperature in April. These often range between 33℃ (95℉) and 41℃ (105℉). The lowest temperature are in January and these range between 7℃ (45℉) and 13℃ (55℉). The mean range is relatively extremes of hot and cold temperature within twenty-four hour period places a strain on the inhabitants of Jalingo. Such a strain is often aggregated by considerable changes in relative humidity. Table 6.1 below shows the average monthly temperature at Jalingo.

ii. Rainfall

In terms of rainfall, Jalingo has some 195mm, that is, from May to October. The rainfall rises to a peak from late July to early September. As mentioned earlier, however, considerable variation can take place both on monthly and annual totals. This is often due to the high intensity of many rain storms and the narrow front with which they sweep across Jalingo's country side.

Table 5.2 below shows the mean monthly rainfall at Jalingo.

iii. Relative Humidity

The relative humidity in the dry season is often well below 10% in the afternoon and about 30% at dawn. However, in August, which is a relatively cooler month because of the rains, the relative humidity at noon may be over 70% during the night and at dawn as high as 95%. Table 5.3 below.

iv. Vegetation

The typical vegetation around Jalingo consists of rather open Savannah wood land with all grass varying in height from about 1.5 metres (5ft) to 3.00 metres (10ft) high and trees with usually short boles and broad leaves. There is a well marked seasonal periodicity in the appearance of the vegetation around Jalingo. Distinct zonation of the vegetation is observed around

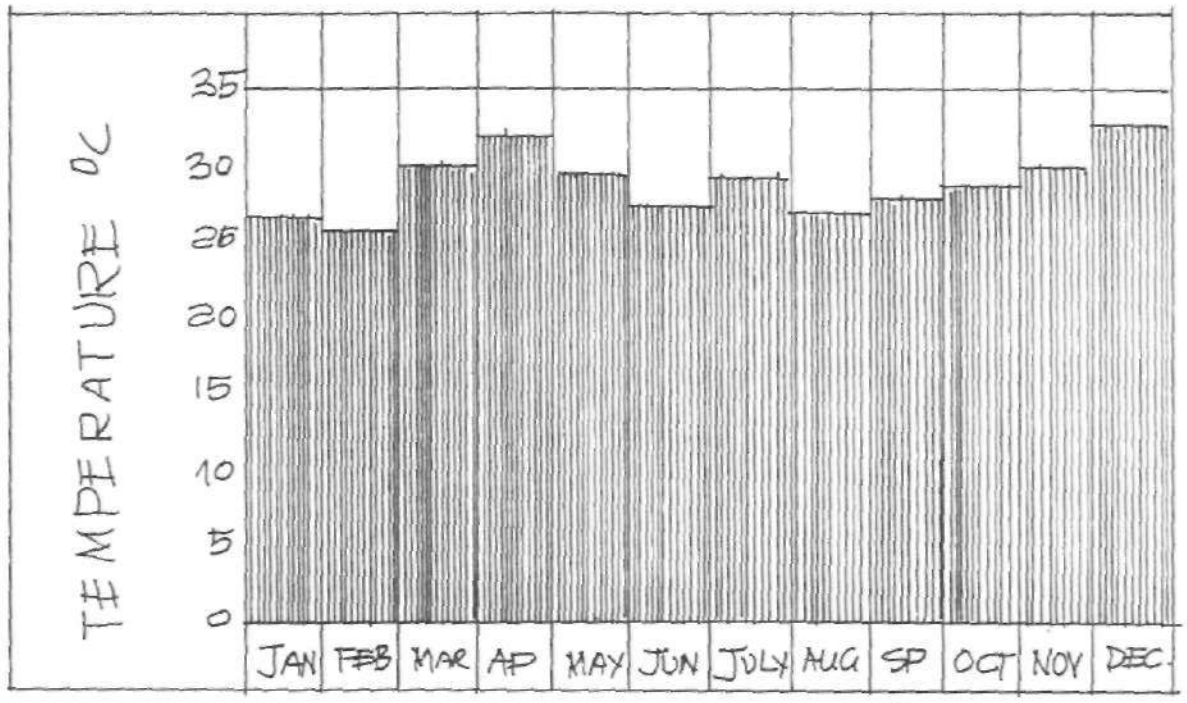
Jalingo. At the town surrounding, much of the land is permanently cultivated and all vestiges of the natural wood land. In the farther away farms and villages around the town valuable fruit trees and well-grown trees are kept for their fruit and shade.

v. Topography

Jalingo lies between 305m and 610 metres above the sea level. It lies on a gently rolling slope that leads to the great plain of Muri. To the South-East of Jalingo, the land rises to a peak of about 914 metres. This peak forms a watershed for River Lamurde and other streams which drain into the River Benue. To the North of the town are a number of hills and rock outcrops with heights ranging between 323 metres to 349 metres.

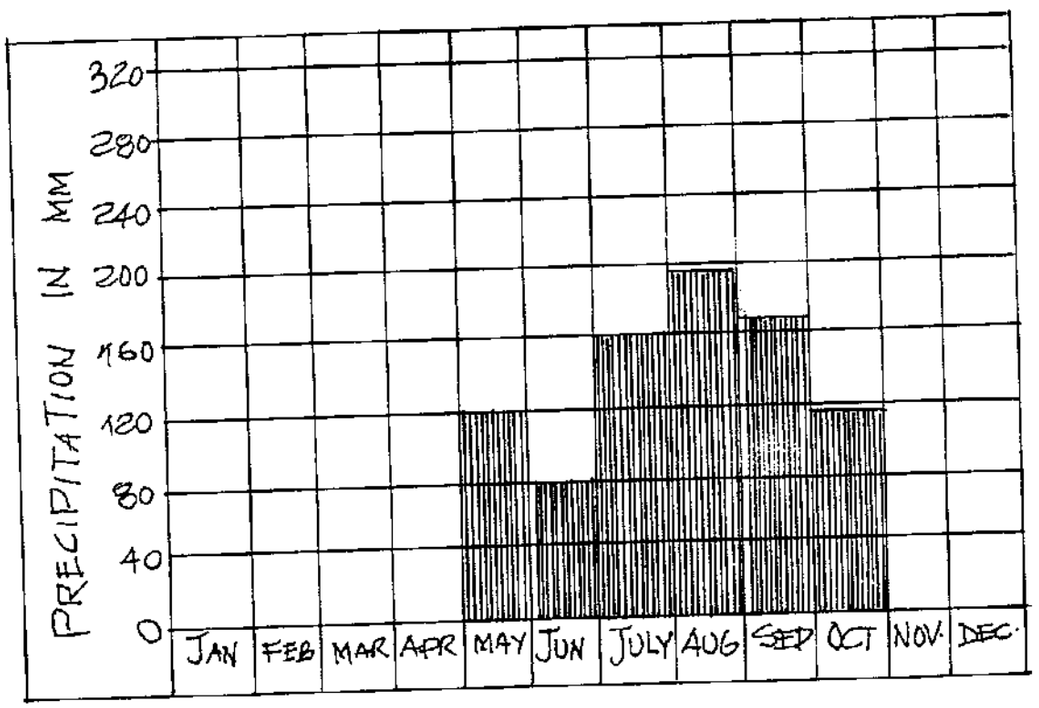
vi. Wind

Two different types of air masses blow through Jalingo. During the dry season, November to March, the dust-laden harmattan wind blows from the North-East straight off the Sahara and Sahel regions. On the arrival of the rainy seasons, that is, around April and May, the prevailing wind. Veers to the South-West and continues in that direction from May to October. However, the rainstorms, which are often experienced here, come from the North-East.



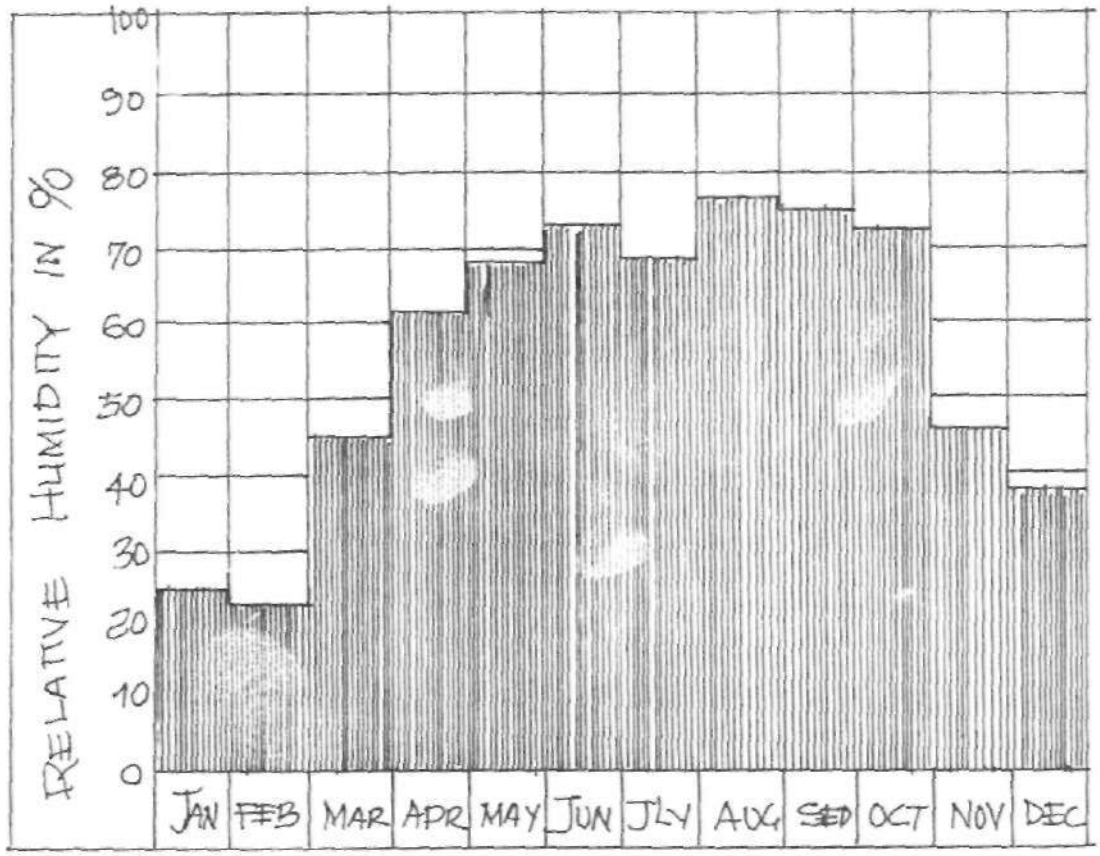
MEAN MONTHLY TEMPERATURE °C

Table 5.1



MEAN MONTHLY RAINFALL IN MM

Table 5.2



MEAN MONTHLY RELATIVE HUMIDITY IN %

Table 5.3

CHAPTER SIX

6.0 THE DESIGN REPORT

6.1 BRIEF DEVELOPMENT AND ANALYSIS

The design brief constitute the clients requirements. The brief essentially identifies the problems intended to solve through design. Furthermore, when the brief is fully developed it gives useful design information by evaluating design data and establishing their influence on design elements.

The whole purpose of this thesis is to solve the problems of an industrial set up, such as the processing of soybeans, with special emphasis on ways of minising to the bearest minimum non-microbial contamination of products. This requires thorough and decisive understanding of the processes involved in the production, that is, the type of equipments to be housed by the industrial building, the production flow, the staff strength for the industry, required workers facilities, flow of incoming and outgoing goods, and safety precautions.

An industrial design is considered as a functional design, a design that must be seen to work efficiently. In designing this industry emphasis should be placed on creating a sanitary

environment especially in the production hall to prevent product contamination.

To achieve a sanitary and hygienic environment the architect should think and evaluate the following factors:

1. The planning of the factory with consideration for:
   - i. – Storage spaces
   - ii. – Reception and production areas
   - iii. – Workers amenities
   - iv. – Service and maintenance areas
   - v. – Waste disposal areas

2. The structure of the factory considering the underlisted factors:
   - i. – Service fittings
   - ii. – Walls and ceiling finishes
   - iii. – Floor finishes
   - iv. – Drainage
   - v. – Adequate ventilation and lighting
   - vi. – Proofing of foundations, door and window elements.

3. In addition to these factors, other factors of a good industrial design includes:

   i. – A good functional plan

   ii. – Good services layout

   iii. – Provision for all required functions

   iv. – Provision of adequate space for people and machinery.

6.2 DESIGN CONSIDERATION

6.2.1 Production Hall

The following factors are of paramount importance in the designing of the production hall.

i. – Flexibility

ii. – Number of floors

iii. – Shape of building

iv. – Possibility of expansion

v. – Provision for lighting and ventilation

vi. – Types of floor

vii. – Types of roof and ceiling

viii. – Structural support system

ix. – Layout

x. – Mode of transport.

In the proposed soybean processing factory, the production flow is linear so the coming in raw materials and going out of the finished products should have separate delivery bays. The production process starts with the reception of the raw material in the raw material store, where the raw materials are weighed, treated and dried and eventually elevated into the silos after which is the materials are elevated into the bin of various capacity depending on the capacity of the factory. The finished products are stored in the finished product store. There is a provision for future expansion.

6.2.2 Administration Building

The administration is responsible for the management of the industry. All transactions are done in this part of the industry. The administrative department in general, deals with workers welfare the accounts section takes care of staff salaries and allowances. Infact, it is the nerve centre of the company and also controls the company's expenditures.

It also deals with the purchase of raw materials, machinery etc, and the sales of products.

For this reason, the administrative unit is usually situated near the entrance because all business transactions are conducted within the administration.

6.2.3 Workers Facilities

The quantity and quality of product depend not only on the sequence precision and efficiency of the factory tools and machines but on the proficiency, pride, mental and physical fitness of the personnel. The workers facilities are best linked to the production hall by a covered walk way. The court yards are well landscaped to create a visual change of scene. Among the facilities provided are canteen, clinic, changing and rest rooms where workers can rest between shifts.

6.2.4 Auxiliary Facilities

The production hall is the main hub of the design however, its operations are successful only with support of the auxiliary facilities which in turn must be designed for optimum efficiency of the factory as a whole. These facilities include the boiler house, generator room, water treatment maintenance and car repairs workshops, equipment and useless materials stores. The auxiliary facilities are located very close to the production hall.

SCHEDULEOF ACCOMMODATION

1. ADMINISTRATION	NO OF OFFICERS/SHIFT	NO OF SHIFT	TOTALNO OF PERSONS	AREA/PERS /(M2)	TOTAL AREA(M2)
GeneralManager	1	1	1	28	28
Secretaryto Gen. Manager	1	1	1	16	16
Asst. Gen. Manager	1	1	1	24	24
Sec. to Asst. Gen. Manager	1	1	1	12	12
Administrativ€fficer	1	1	1	24	24
Sec. to Admin. Officer	1	1	1	12	12
PersonalManager	1	1	1	24	24
Sec. to PersonalManager	1	1	1	12	12
CompanySecretary	1	1	1	24	24
Sec. to CompanySecretary	1	1	1	12	12
Exhibition/Sales	1	1	1	24	24
GeneralOffice	8	1	8	24	24
Chief Security	1	3	1	16	16
Receptions	2	1			
WaitingSpace					
ProductionMan.	1	1	1	24	24
MaintenanceMan.	1	1	1	24	24
BoardRoom	8-12			64	64
StandardsOfficer	1	1	1	16	16
PublicRelationsofficer	1	1	1	20	20
CoffeeRoom	2	1	2	2	4
TelephoneRoom	2	1	2	2	4
Messengers	4	1	1	16	16
Drivers	7	1	7	16	16
WelfareManager	1	1	1	16	16
ACCOUNTSDEPARTMENT				12	12
Accountant	1	1	1	12	12
Sec. to Accountant	1	1	1	16	16
SalesManager	1	1	1	6	48
AccountsClerk/Typist	8	1	8		
Toilets/Circulation				15%	12.56

SCHEDULE OF ACCOMMODATION

2. CLINIC	NO OF OFFICERS/SHIFT	NO OF SHIFT	TOTAL NO OF PERSONS	AREA/PERS /(M2)	TOTAL AREA(M2)
CLINIC					
Nurses	2	3	6		20
Treatment/Waiting	3				20
Rest Room					16
Pharmacy	1	1		12	12
Store				15%	9
Toilets/Circulation					
CAFETERIA					
Catering Officer	1	1	1	9	9
Kitchen(Cooks)	6	2	60		18
Staff Canteen					252
Storage					12
Toilets/Circulation				15%	
CHANGING					
Male Changing					108
Female Changing					72
Common Room					84
First Aid					48
AUXILIARY					
Generator Room					30
Water Treatment					54
Equipment Store					54
Useless Machines Store					54
Boiler Room	2	3	6		60
Car Repairs/Workshop	2	3	6		54
Mechanical Technician	2	3	6		30
Electrical Tech.	2	3	6		30
Maintenance Suprintendant	1	1	1		12
Welder	1	1	1		12

SCHEDULE OF ACCOMMODATION

3. STORAGE	NO OF OFFICERS/SHIFT	NO OF SHIFT	TOTAL NO OF PERSONS	AREA/PERS /(M2)	TOTAL AREA(M2)
Raw Material Store					576
Checking of Raw Material	1	1	3	12	36
Collection of Raw Material	1	1	3		36
Warehouse(Finished Prodt.)					1296
Cake Store					288
Silos					
Forklift Truck Driver					
Expedition Officers	3	1	3	12	36
PRODUCTION					1872
Machine Operators	4	3	12	12	48
Head Operator	1	3	3	12	36
Patrol Officer	1	3	3	12	36
Production Supervisors	1	3	3	12	36
DEHULLING/CRACKING					
Foreman	1	3			
Skilled Labourers	3	3			
Unskilled Labourers	6	3			
EXTRACTION					576
Foreman	1	3	3		
Skilled Labourers	2	3	6		
Unskilled Labourers	2	3	6		
PELLETISATION					576
Foreman					
Skilled Labourers	1	3			
Unskilled Labourers	2	3			
	2	3			

SCHEDULE OF ACCOMMODATION

4. REFINERY	NO OF OFFICERS/SHIFT	NO OF SHIFT	TOTAL NO OF PERSONS	AREA/PERS /(M2)	TOTAL AREA(M2)
REFINERY					532
Lab.	1	3	3	36	36
Refining(Neutralization)					
Foreman	1	3	3	3	
SkilledLabourer	2	3	6		
BLEACHING					
Foreman	1	3	3		
SkilledLabourer	1	3	3		
UnskilledLabourer	1	3	3		
DEODOURIZATION					
Foreman	1	3	3		
SkilledLabourer	1	3	3		
UnskilledLabourer	1	3	3		
BOILERROOM					72
Foreman	1	3	3		
SkilledLabourer	1	3	3		
UnskilledLabourer	1	3	3		
DRUMWASHING/FILLING					216
Foreman	2	2	4		
SkilledLabourer	2	2	4		
UnskilledLabourer	4	2	8		
ForkliftDriver	1	2	2		
QualityControlOfficer	2	2	4	36	36

STAFF ALLOTMENT

DESCRIPTION	NUMBEROF PERSONNEL
Production	81 (3 Shiftsof 27)
Refinery	25
Auxiliaryand Technical	10
Administration	63
Kitchen	7
Clinic	4
Total	190

6.3 DESIGN BRIEF

The Soybean Processing Industry, Jalingo is an Industrial Complex comprising of the administrative core, which is sub-divided into sales, accounts, general administration and personnel units.

The workers facilities like a clinic, a canteen, a rest room and changing rooms. The other units like production hall, the auxiliary and the service and maintenance zones.

6.4 SITE ZONING

The site for the proposed industry is zoned based on the criteria for site zoning. This includes:-

1. Function
2. Noise and
3. Physical as it relates to security and circulation.

The site is zoned in such a way that areas accessible to the factory's customers or public areas, are those areas that will serve the immediate needs of the customers. Such areas are the administration and ware house areas. The production area is considered strictly private. The zoning of the production area separately from the administration area is basically to make it easier to control the movement of customers.

In evolving the design concept, orientation, functionality and simplicity were taken into considerations in cognisance with the site zoning criteria, to achieve a simple and functional site.

Access to the site is via two gates, one gate is meant for customers, staff and raw materials while the other one is for workers and finished products trucks. All building on the site are oriented such that the long axis lies along the East–West.

In evolving the various floor plans and elevations of the various buildings, their functions were first considered as such two sets of buildings evolved, viz: the industrial and non-industrial buildings. Then the incorporation hygienic measures to realise the objectives of this thesis.

The concept for the industrial buildings were based largely on function, as such a simple "rectangle" was adopted as their floor plans.

The administration block was also conceived along the lines of simplicity, but with a view to make it "dominate" the factory sky line. As such, the block should be attractive to sight. The offices in the administration block are single banked, and has a sizeable courtyard, help to improve both ventilation and lighting.

6.6 DESIGN OVERVIEW

6.6.1 Site Plan

The site plan is simple, efficient and functional. All buildings on the site are well oriented for solar radiation and winds. Short sides of all buildings face the East and West, to reduce the effect of solar radiation on interior spaces. The longer sides of the building as such face the South and North. Thus, good cross ventilation is achieved without causing a draught of air in the interior spaces.

Access to the site is by two sets of gates for good, effective and simple circulation. One gate is used for raw materials trucks customers and staff. Visitors to the site, park outside the gate near the gate house for security purpose whereas parking for staff of the factory is infront of the administration block. Motorcycle and bicycle parking is provided for the staff near the workers facilities so that they have easy access from the parking to the changing rooms. Customers and members of staff who do not have vehicles are dropped of by taxis or "achaba" at the taxi and bus drop off located outside the gate.

6.6.2 Buildings

All the industrial buildings designed, have portal frames. The portal frames span 24m and are spaced 6m centre to centre. The East and West walls of the production hall are blank walls. The exterior walls are built from sand-crete blocks while all internal partition walls are built from aluminum sectional walls with rubber cladding for easy cleaning. Service pipes are carried in under floor channels while drainage channels covered with steel grating pass through the processing hall. North roof lighting is provided over the steel frames, this is to provide enough lighting in the production hall. However, all windows in the production hall will be unopenable to control dust. The processing hall will be fully air conditioned to control amount of dust. The walls are treated with white ceramic tiles up to a height of 1.25m for easy cleaning and to sanitize the walls. The foundation of the production hall is 600mm to 900mm about the ground level to guide against rodent and pest infestation. The workers facilities building is built of simple load bearing sandcrete blocks. The administration block is a concrete framed one storey building with sandcrete block infills.

The offices in the administration block are single banked with spacious courtyard to enhance cross ventilation and adequate lighting.

The roof structure of the cafeteria, changing rooms, clinic, and the administration block are made up of timber roof truss. Aluminum roofing sheets are used throughout.

6.6.3 Lighting and Ventilation

Adequate lighting and cross ventilation in the production hall enhances the comfortability of the workers hence their productivity.

Lighting could be achieved through Natural and artificial methods. Natural light can be admitted into the production hall by provision of openings on the walls and also through the air vents. Artificial lighting is provided through electricity to supplement it.

Effective cross ventilation prevents the accumulation of odours and dust, it also eliminate the feeling of stuffiness. Natural lighting can also be achieved by orienting the openings to face the prevailing winds, roof vents are also provided for this same purpose.

6.6.4 Planning

In planning factory units, functional flexibility should be achieved. This is to say that various units are functionally related and spatially integrated.

In planning, the factory is grouped into three units, that is, the production hall, the administrative unit, and the workers facilities. The production unit comprises the auxiliary facilities which includes the maintenance and repair section and the service facilities, that is the boiler house, water treatment and the generator house. The production hall contains all the production operations and is divided into three zones.

i. The dirty zone - raw materials collection or reception.
ii. The semi-clean zone - the processing hall and
iii. The clean zone - the finished products store.

The zoning was based on the potential possibilities of contamination from the three sections. The dirty zone is where contamination is most likely, so the raw material store and the production hall are separated from each other. The processing hall is a cleaner zone, it should be air conditioned to check dust and ensure filtered air supply. The floors are sanitized with floor tiles and so are the walls.

The finished product store, the ware house, comes at the end processing operation and drum filling. All the production operations are housed in the production hall. and none of the operations is exposed.

The raw material delivery and finished product loading bay are well separated. The boiler house is located close to the production hall to minimize heat lose through steam travel. The other auxiliary services including the generator room; equipment store, repair workshop, and water treatment plant are placed together. Separate from, but close to the production hall. The workers facilities is placed next to the administration building and ample parking for cars and bicycles is provided. It is a single storey structure, creating aesthetical balance on the side of the administration building. Facilities provided include the changing rooms with showers and water closets. The water closets are separated from the locker rooms for security reasons. A canteen is also provided and a clinic with space for resting is provided. A common room is placed near the production hall for workers to rest and snack between shift and during break time.

The administration building is a storey building. The receptionist, the accounts department, sales office are placed near the reception lounge and entrance lobby, because they are the most frequented places by visitors who come to the building. The ground floor contains the general administration and accounts offices, while the senior managerial personnel have their offices upstairs. The offices are single banked with central courtyard to enhance cross ventilation and lighting. To staircases are provided. One close to the entrance lobby and the other close to the executive. They are accessed from the passages, along the offices. The general planning principle was simplicity, however, the functional relationships between the units was a strong determine factor in layout the spatial arrangement of each unit.

6.6.5 Expansion

As factories need large expanse of land, therefore, in the design of any factory, provision must be made for future expansion of the factory as the need for expansion may arise in future. Thus, it is important and economical to provide enough space for expansion. Enough land is provided for the expansion of the warehouse and that of the production hall. Demountable partitions are also employed in the production area for this purpose.

6.7 CONCLUSION

Hygienic environments are of paramount important in food processing factories, that is to ensure high quality and good keeping characteristics. Unsanitary and unhygienic environment in food processing plants give birth to contamination. Hygienic condition can only be achieved only by detailed and adequate adherence to sanitary and hygienic requirements with respect to factory design principles.

Therefore in planning and designing for a sanitary food processing factory adequate thinking should be given to the following:-

1. Planning of the factory with consideration for:-
   - a - The factory site
   - b - Storage spaces
   - c - Reception and production areas
   - d - Amenities
   - e - Service and maintenance
   - f - Waste disposal areas and

2. The structure of the factory with considerations for:-

   a - Service fittings

   b - Walls and Ceiling finishes

   c - Floor finishes

   d - Drainage

   e - Ventilation and Lighting

   f - Foundation and pest proofing of door and window elements.

The proper consideration of these factors together with sanitary specifications for finishes will ensure a sanitary environment in a food processing plant. However personnel attitude and a change in the pattern of production are factors that have to be considered as well to ensure and create a total sanitary environment.

In the design of a food processing plant the role of an architect cannot be over emphasized. It is extremely important that when architects design buildings for soybean processing installations, they should first of all, consult a hygiene specialists, so that allowance should be made in the total cost of the building, for proper hygiene. In conclusion therefore, the industrial design solution for planning effectively for sanitary food processing plant can be said to be a product of three factors, viz:-

1. The scope, kind and quality of finished products desired.
2. The economy, power and installation factors
3. The architectural considerations necessities and possibilities with respect to hygiene and sanitary requirements.

However, it is imperative to note that the instruction of factory workers in hygiene routine and the delegation of individual responsibility for every phase of sanitation in the factory is extremely important. When a worker is assigned to work in a certain area, he should be aware that the sanitary of that area squarely lies on his shoulder. Workers should be sanitation conscious all day long and not just at closing time or prior to inspection.

Strict enforcement of legislation by regulatory agencies like the food and drug administration department of the Federal Ministry of Health is also very important to ensure compliance with sanitary requirements. Hygiene should be regarded as an asset rather than a liability, an asset to sales, an asset to production, an asset to consumer and public relations and an asset to employee morale, cooperation and interest. It is hoped that the establishment of the soybean processing industry, Jalingo will help to eliminate shortage of soybean products and towards the promotion of industrial development in Jalingo. It

is also hoped that entrepreneurs will be motivated to invest in the local food processing industry, because of its latent monetary gains and the abundance of raw materials, labour and land to carry out such a venture. However, for any food processing installation, sanitary conditions are very important to ensure quality products. It goes without mention that poor sanitation in a soybean processing plant remains a totally unnecessary and expensive luxury that is better done without.

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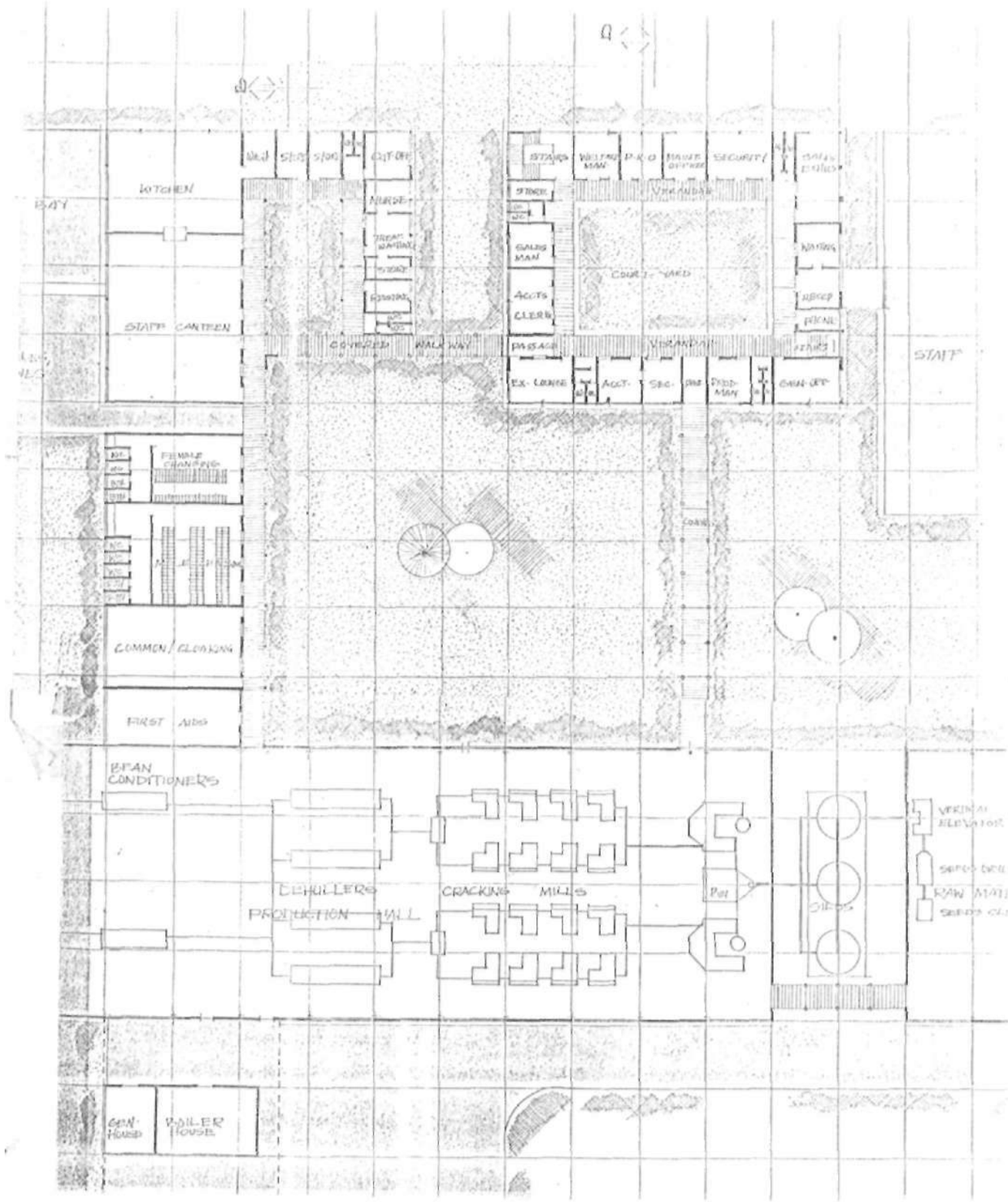
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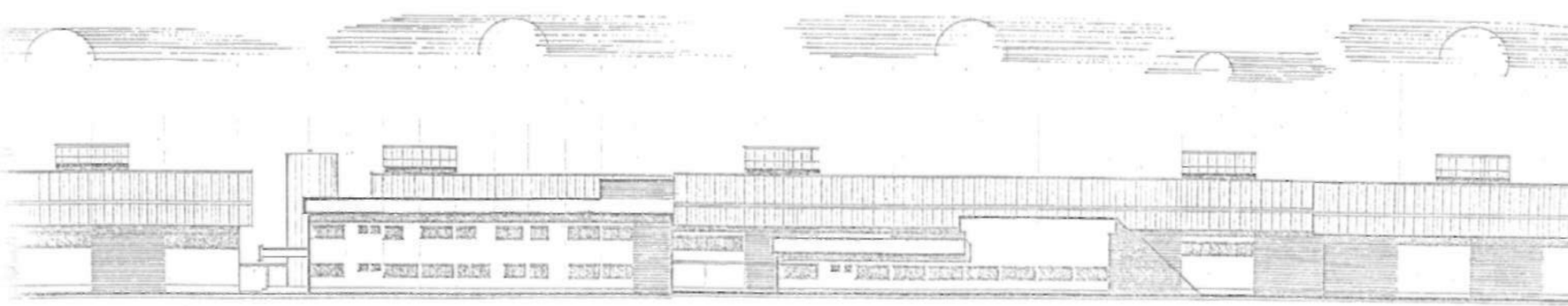
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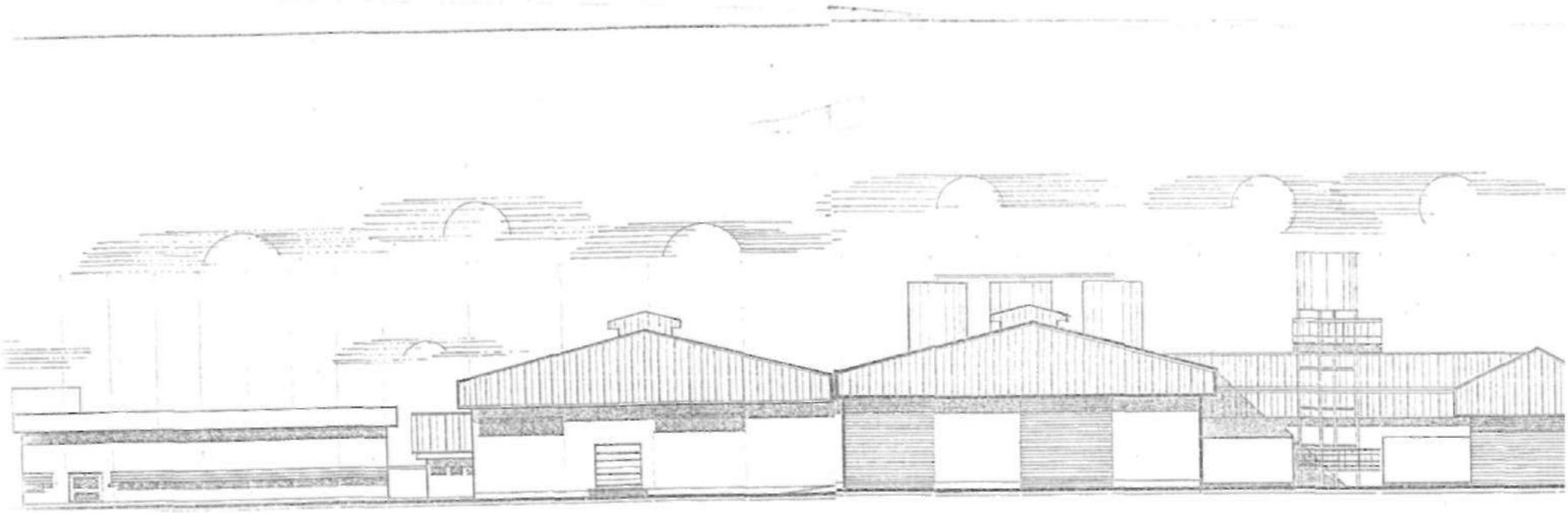
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KITCHEN
STAFF CANTEEN
COVERED WALK WAY
VERANDAH
STAFF
FEMALE CHANGING
COMMON / CLOAKING
FIRST AIDS
BEAN CONDITIONERS
DEHULLERS
PRODUCTION HALL
CRACKING MILLS
SIEVES
GEN. HOUSE
BOILER HOUSE

PRODUCTION HALL
PRODUCTION HALL



- Elevation



Elevation