A DAIRY INDUSTRY FOR OFFA

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BY

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DEDICATION

THIS IS FOR MUM, DAD AND BROTHERS BUT FOR WHOM .....

ACKNOWLEDGEMENT ---------- iii

DEDICATION ---------- V

CONTENTS ---------- VI

LIST OF FIGURES ---------- VII

ABSTRACT ---------- VIII

CHAPTER ONE: INTRODUCTION, PROBLEM, SCOPE, PURPOSE AND SUITABILITY OF TOPIC 1

CHAPTER TWO: EVOLUTION OF INDUSTIRES: AGRO-INDUSTRIALIZATTION AND DAIRY INDUSTRY IN NIGERIA 9

CHAPTER THREE: LOCATION, LAND ACQUISITION AND FINANCE 15

CHAPTER FOUR: METHODOLOGY, SITE STUDY AND ANALYSIS 23

CHAPTER FIVE: ARCHITECTURAL PRECEDENCE-STUDY OF EXISTING DAIRY INDUSTRIES 32

CHAPTER SIX: DESIGN BRIEF 41

CHAPTER SEVEN: DESIGN PROBLEMS AND CONSIDERATION 47

CHAPTER EIGHT: DAIRY FARM - COW BREEDING, FEEDING AND HOUSING 64

CHAPTER NINE: MILK PRODUCTION, COLLECTION AND PROCESSING 80

CHAPTER TEN: DESIGN OF INTERNAL AND EXTERNAL SPACE TO THE REQUIREMENT OF PRODUCTION PROCESS 95

CHAPTER ELEVEN: ACCOMMODATION SCHEDULE AND ENVIROMENTAL REQUIREMENT 106

CONCLUSION 119

REFERENCES 122

LIST OF FIGURES

1. Nigeria: Settlement, Communications and Dairy Plants

2. Kwara State: Milk Collecting Centres and Cattle Ranches

3. Process Schedule For A Multipurpose Plant

4. Typical Floor and Wall Structure

5. Milk storage Tanks

6. Cattle Feeds: Collection and Storage

7. Cattle Feeds: Electric Fence Strip Grazing

8. Cattle Infectious Diseases

9. Milking systems

ABSTRACT

TOPIC DEFINITION

This is an industrial concern which makes use of dairy-produce, mainly milk from cow, as the starting material in a processing which culminates in the production of various items such as pasteurized milk, yoghurt, butter, ice cream and powdered milk,

SITE

The site chosen f»r the proposed industry is at Offa. Offa, the second most important town in Kwara State after Ilorin, the State Capital, lies on latitude 8º N and longititude 5 E and is in the Guinea Savanna region with wet warm season (April to September) and hot dry season (October to March),

The Site pr«p»r lies to the North of the town along the Offa-Ilorin road and it is within the industrial zone of the town' s development map. The Site has vast expanse of land (about 8 Hectares) to meet all pre and post planned structures requirements and is devoid of any natural obstructicns. The land slopes gently towards the Southern part. The Site is bounded on the North and the West by vacant undeveloped land while to the South it is bounded by a proposed oil factory and to the East by the highway,

SCOPE:

The problems associated with the revitalization of a nation's economy especially where it is based on a single product like oil in the case of Nigeria, are enormous and numerous and commend painstaking efforts in desirable goals were to be achieved, but since it is humanly impossible to provide solutions to every problem, the scope within which solutitns would be propounded should be limited and defined.

MACROSCOPE:

On a larger extent, this project seeks means to industrialize the nation's economy possibly through an agro-allied industrialization scheme. The Dairy Industry has been chosen to stress this proposal,

MICROSCOPE:

The design of internal and external space to the requirement of production process in a dairy industry would be dealt with as the main area of concentration.

GOAL:

The provision of a production space and environment which enhances the achievement of high degree of effective and efficient productivity is the set goal to which this project is direoted,

OBJECTIVE:

PRIMARY - Material and techniques utilization to achieve longest practicable life with minimum maintenance in spite of relatively severe process conditions in the dairy industry,

SECONDARY - Revamping, Revitalization and Resuscitation of the Nigerian economy by diversifying it through the agro—based industrialization.

BRIEF:

The design emancipates from a critical analysis of economic bedrock of Nigerian which is generally accepted as being in a precarious state. Due to the Country's over dependence on oil, declining oil sales in the world market have the devastating impaot on governmental policies and operations; meaningful development and growth programme are stiffled by the global oil-market situation which portrays no index of a brighter future situation.

The purpose is therefore to analyse the existing situation and synthesize the necessary fabrics which in all its ramifications would ensure a buoyant, self-sufficient and self-subtaining economy. The achievement of a solid economic "bedrock helps provide the nation with an economy devoid of any tentacles, free and independent of outside evil machinations, manoeuvring and manipulations, there would be a development of indigenous economic potentials both in human and natural resources, a producent and meaningful management of the nation's resoucres and an elimination of any form of dependence on the vagaries of economic and political development of other nations. Surely, agro-industrialization of the Nigerian economy is best recipe.

The concept of an ideal state is an utopia one but efforts should be made towards the achievement of its best intentions within the framework of the available human and natural resources. In the annals of nation building no facet of human endeavour could be relegated more so the contribution of architecture towards the salvaging of a dwindling economy through an agro-allied industrialization proposal. Since the architect is the pinnacle of the construction industry, the evolution and successful accomplishment of schematic designs and plans rest on his oars; moreover, the architectural profession is studiously married to the economy, its level and mode of operation in any nation is a reflection tf the state of the economy,, it is therefore in the interest of the former that the economy upon which it is operating is prosperious, viable and self-reliant.

It is my strong belief that in Nigeria this would be best attained through an agro-industrialization scheme, the Dairy Industry has been chosen to illistrate the feasibility of this proposal. The design considers general requirements such as location, site, raw material acquisition, transportation, marketability, labour, capital, and others including flow pattern, circulation, production process, design expression, structure and materials. Because of its acidic and wet processing nature, special consideration would have to be given to the material and techniques applied in the construction; flexibility and the need for high standard of hygiene and sanitation required of the dairy industry production processing imposes special responsibilities on the architect; this is why the design of internal and external space to the requirement of dairy production, process chosen as the main area of concentration would be found to be very appropriate and particularly useful. The design provides for administration, workers, welfare, auxilliary and production facilities as well as water supply and affluent treatment plants have been provided.

Briefly, the write-up commences with an introduction of the topic, its problems, scope, purpose and suitability are also touched upon. Chapter Two deals with evolution of industries with particular reference to Agro-industrialization and Dairy Industry in Nigeria. From location, land acquisition and financing of the industry in Chapter three, the work goes on to discuss the methodology utilized, the site study and its analysis while chapter five deals with studies of existing dairy industries and appraising their advantages and shortcomings.

From brief description of what the design entails in ohapter six, the work highlights problems encountered with the design and considerations for these problems and other salient items in chapter seven. Cow breeding, feeding, housing and management is dealth with in chapter eight while chapter nine discusses milk production, collection and processing into various dairy products. The design of Internal and External space to the requirement of dairy-production process is stealth with in chapter ten and lastly in chapter eleven a schedule of all provided spaces with their areas are given,

ACHIEVEMENT/CONTRIBUTION

This project is highly feasible and contributes immensely to revitalization, revamping and resusitication of the Nigerian mono-cultured economy by offering a viable alternative of diversifying its foreign reserve earning source, that is through agro-industrialization. World-wide, it is accepted that industrialization is the vehicle to a greater tomorrow; agro-industrialization provides employment opportunities, promote wider and more effective linkages between different sectors of the economy, helps develop a prudent management and utilization of natural and human resources; provides abundant, sufficient and reliable food and raw material, stimulate a technological take-off and create wealth to improve Nigerians standard of living.

Particularly, the Dairy Industry chosen as an example of the agro-industrialization scheme, would help improve nutritional standards and contribute to healthy growth and development of Nigerians.

CHAPTER ONE

INTRODUCTION, PROBLEMS, SCOPE, PURPOSE AND SUITABILITY OF TOPIC

Like most third world countries, Nigeria used to rely heavily on agriculture for her economy. Agricultural products in 1964, accounted for about seventy per cent of the total exports and by 1967, Nigeria was earning about £54.7 (₦109.4) million from her cocoa sales, which accounted for twenty-three per cent of the total export earnings fo that year. But the discovery of oil in 1959 at Olaibiri gave birth to an oil era whose production became highly intensified during the OPEC (Oil Producing and Exporting Countries) price hikes of 1973/74. With a peak production of eight hundred and twenty-three (823) million barrels being reached, Nigeria became the second largest oil exporter to the United States of America; from about seventy-five per cent in the 1970s, oil rose to ninety per cent in the 1980s and today oil virtually controls the Nigerian export market as the sole foreign exchange earner for the nation. Consequently, the economy has become highly exposed and vulnerable as any slight change in the oil market would drastically affect the nation's growth and development plans. Oil future proppects might not be so bleak but considering the downswing experienced in 1975, 1978; 1981; considering her pronounced emphasis on self-sufficiency, self-reliance and industrialization, Nigeria cannot afford the price of a mono-cultured economy.

In order to forestall the onslaught of economic and political bliss, many patriotic Nigerians have stressed the need to build a sound and solid economic bedrock. This, it has been opined could be done by diversifying the nation's source of revenue. The researcher of this work believes that the best recipe, going by Nigerias economic history and development is to shift the emphasis on oil to agriculture. This then form the basis of this work which seeks to diversify the nation's economy through an agro-based industrialization scheme. The purpose is to analyse the existing situation and synthesize the necessary fabrics which in all its ramifications would ensure a buoyant, self-sufficient, self-reliant and self-sustaining economy.

As a means of industrializing the nation's economy through an agro-basis, the Dairy Industry has been chosen because of its immense contribution not only to the improvement of a developing economy but to life as well. It is the responsibility of the researcher as an architect, to evolve a scheme of plans and designs, the accomplishment of which would bring to fruition the lofty and laudable objectives of this proposal.
The task of evolving design plans for such an industry, involves not only the general conditions of design considerations but also the flow patter, the production processes and the biological aspects. The planning and construction of administrators and technical specialists. The dairy industry imposes unique responsibility on the architect. Firstly, the materials and techniques used in building must be such as to give the longest practicable life with the minimum of maintainence, in spite of working conditions which are often relatively severe from both the mechanical and chemical points of view.

Secondly, repairs, alterations and extensions which may arise as a result of developments, must be possible with the least of disturbance to the production processes. These conditions are fully looked into and solutions are given.

The need for highest standard of hygiene need not be emphasized. Milk is a most suitable medium for micro-organisms growth, every possible measure would therefore be made to reduce the possibility of contamination, particularly after processing. Failure to control contamination may, however, lead to disastrous results and collossal lost especially if the organisms are pathogenic. Hence not only must the plant be easy to clean; the conditions must be such that it is evident to all that a high standard of hygiene and sanitation is being achieved.

Apart from the secondary objective of industrialising the economy, the primary objective aims at creating a functional building, able to house process equipment in the most efficient way, fulfil its industrial purpose and be a pride to the community.

African agricultural performance and its future prospects have been the subject of great concern to the world. Underlying the decline in African agricultural production are various constraints which hinder its proper realization. Climate, amongst other natural constraints, is a principal culprit; for while rainfall is virtually zero in some areas bordering the desert to the country's north, it is too much in others, Rivers state of Nigeria for instance. This creates difficulty in proper animal and crop husbandry. Where rain is high forest is the resulting vegetation but this is infested by Tse-tse fly which transmits disease to cattles.

The high yield per acre of land and agricultural productivity which are conversant with countries like America, South Africa, New Zealand are elusive to Nigeria because the majority of the rural populace who are farmers use crude traditional implements which are laborious and energy dissipating.

Government programmes like the Operation Feed the Nation and the Green Revolution were commendable but their efficiency and efficacy as the right panacea for the nations' insufficiency and adequacy in food production is what we all are witness to.

No wonder then that Nigeria has to import large quantities of rice, milk and meat in spite of our vast arable lands. Government policies are not pursued with the good intentions of the rhetorics.

One inherent problem from the former colonial masters is that Nigeria was brought up as a primary producer. Investiments were concentrated on slender infrastructures, thus denying Nigeria the benefit of rapid development and growth.

Materials have to be imported as locally available ones were not developed. This constitute a drain on the foreign exchange earnings and inadequacy of supply which often leads to less production or no production at all.

Capital adequacy is also a problem to agro-induslization. Most of the successful banking houses in the country were foreign owned, as such their attitude towards meaninful industrialization was deplorable and so is the various financial institutions which

only give fund on strigent stipulations. When money is released, it may not go to the real farmers who are ready to commit the money into feasible projects because the peasant farmer just dont possess the colateral security often demanded as a pre-requisite for loans by Banks.

Like many other developing nations, Nigeria has only semi-skilled and mostly unskilled labour. Managerial and technical staff to man various industries is in short supply. Importation of skilled manpower therefore becomes essential and often this results into more problems. The high facilities and technology required of modern industries may be far fetch within the available resources.

The quantity and quality of social and economic goods and services which a community consume is determined by their national income level. When this is low, the standard of living would also be low and so would be their purchasing power. Consequently, quality and amount of goods and services produced would be affected.

Availability of infrastructural services such as water, electricity, roads etc affect industrialization especially in Nigeria where taps may not run for weeks and electricity cut-off for months. Many manufacturing components and gadgets become damaged. All these are general problems which hinder industrialization in Nigeria and to which solution through governmental and private efforts are variously offered.

Identified problems which exist and whose solutions are hopefully going to be achieved through this design include breeding, housing, feeding and milking of cows, sales of milk and its products and the conservation of excess milk. The modern techniques of breeding with its resultant production of more resistant and healthy cows are unkown to the local producer; cows are mostly left to sleep in the open thus they become exposed to inclement weather and disease; moreover, the cows are fed on poor pasture and the cows have to trek long distances thus expending much of their energy, the pasture is sometimes nutrient deficient. These make the cattle weak, unhealthy and consequently unable to achieve high productivity.

Since cows are mostly kept because of the financial benefits derivable from their sales, milk production is less encouraged. Milking, when done, is under unhygienic conditions. The milk therefore gets easily contaminated and spoilt. Because the producers are not conversant with milk conservation methods, less milking of cow is done so that whatever is obtained could be easily sold, otherwise most milk is thrown away. From all these one can see that the milk industry in this area is in the wrong hands and not being properly utilized. The lucrative prospect both in terms of economic and health benefits derivable from milk and its products is not being exploited. This work would ratify the situation.

The topic chosen is therefore very suitable as a thesis work if just for these aforementioned problems which are dealt subsequent chapters. In 1979, Nigeria spent 1.3 billion dollars on food importation. By 1982, it had risen by almost 79 per cent to 2.3 billion dollars. The annual growth in food import bill is nearly 26.3 per cent and in the last nine months, Nigerians have witnessed an unprecedented 300 per cent inflatory of food prices; as the nation's foreign exchange earnings decline from poor oil sales, the ability to import badly needed food declines too, coupled to this is the fact that while more than 78 per cent Nigerians are farmers less than 12 per cent are engaged in animal husbandry and of this meagre percentage, a very insignificant percentage do rear and breed cattle for just the milk. This dairy industry would hopefully stimulate local food production by inculcating in more Nigerians the idea of producing even more.

The basis aim of the Food and Agriculture Organization (FAO) of the United Nations is to encourage greater and better production and distribution of food and to improve nutritional standards especially in the developing world. Since milk is the cheapest source of meeting this, it would be in Nigeria's interest that milk and milk products be available.

Agro-allied industrialization of which the Dairy Industry is an example, would provide an economy free of external mischief; Nigeria would absolve herself free of any whims and caprices which make nonsense any dream of national dynamism and unity. Today in-spite of their independence, many African states are in perpetual bondage, with the government being teleguided by Washington, Paris or Moscow.

With raw materials being locally procured and with importation of less foreign hands and food, the nation would be able to conserve dearth foreign exchange and develop her human and material resources.

The industry would improve upon standard of living by offering employment opportunities thus increasing their purchasing power. One cannot help but reiterate that the march towards self-sufficiency, economic and political survival has already started and that the industrialization of Nigeria's economy through agro-basis is long over due.

Painstaking efforts are commended if desirable goals were to be achieved to the enumerated enormous and numerous problems. But since it is humanly impossible to provide solutions to every problem, the scope within which solutions are to be propounded should be limited and defined. Having opted for agro-allied industrialization scheme, emphasis would be on a design which would enhance efficient, smooth and effective running of the industry; attention would therefore be focussed on needs and requirements which are indispensable to successful operation of dairy industry. Problems are being envisaged mainly around the production area; complex but very schematic design is the only recipe to technology and technique required of a modern day factory. This is why the production areas has been chosen as the area of specialization with the design of internal and external space to the requirements of production process as the specific area of concentration.

CHAPTER TWO

EVOLUTION OF INDUSTRY -

AGRO-INDUSTRIALIZATION AND DAIRY INDUSTRY IN NIGERIA

The intensive and fundamental process of transformation and adjustment of traditions and civilizations of a society to a new world of machinery and steam started in 1815 in the United Kingdom and Western Europe from where with great impetus, it spread to Germany, Italy and Russia. The basis of industrial revolution was the application of steam power to machinery for purposes first of production and then of transport.

In much of the world today, the same transformation is being undertaken as a matter of deliberate policy by government. The impact and repercussion of industrialization varied according to the condition and character of each country and according to the precise time and stage at which it operated most fully in each country. In Nigeria as in most developing nations, the process is slow.

The race between industrialization and increase in population is very narrow, propensity to same for future investments is low and the income elasticity of the demand for consumer goods is high because of appallingly low income. Thus,'the curse of the poor is their poverty' aptly applies here; for even if population is checked, an initial impetus towards development caused by improved food supply may fade away if the community has a low propensity to save. Thus for countries undergoing the early stages of development (that is, the developing nations) the nineteenth century was more favourable to capital formation than the twentieth century because of the restricted demand for consumer goods by governmental policies.

Since the sole aim of the colonial masters were to develop her colonies only up to the stage of under-development, the colonies were held in perpetual bondage of exploitation. Nigeria was not spared the spectre of this situation as she was only developed to become a continued source of raw materials necessary for industries back at home. With independence, the Nigeria government realised the importance of industrialising her economy but since she had been brought up as a primary producer, the initial stages were marked by dearth of resources, reliance was placed on the colonial master,s and this obtains even up to date! There is gradual but substantial increase in the importation of capital equipment as well as of raw material. The imported machinery requires the imported inputs, thus the industiralization that has been taking place is heavily froeign oriented. An industrialization programme where the machines, the raw materials and the management are all physically imported from the industrial countries whose interests are obviously in conflict with those of Nigeria, cannot be expected to have impact and so the manufacturing sector makes no significant impact on the structure of the economy.

The main constituent of the economy of developing countries is agriculture and the part which it plays in the economy of various nations is partly determined by the volume and direction of international trade. The fact that less than 10 per cent of the British populace is engaged in agriculture, while about 21 per cent New Zealanders and 75 per cent Nigerians are involved in farming indicates the level of industrialization going on in these countries. Britain is an industrialized nation and exports her techniques, machineries and goods to developing nations like Nigeria.

New Zealoand is a developing nation like Nigeria but her ability to adopt a suitable industrialization programme of her primary products has catapulted her to the position of a privilege in the community of nations, she has successfully managed her dairy Industry to such an extent that her meat and milk products are common commodities the world over.

In Nigeria, agriculture almost wholly dominated the economy in the 60's. Agriculture was relegated to the background and massive food importation and poor contribution to Gross Domestic Product by the agricultural sector became rampant thus creating a bottleneck in the economic growth and development of the nation. Institutional framework was created and in order to achieve self-sufficiency both in raw material supply and food production, which are necessary parameters of a self-sustaning economy, well planned and co-ordinated development of agriculture was launched to stimulate agricultural industrialization.

Industries involved in the processing of agricultural produce, forestry, fishery and livestock are broadly referred to as agro-allied industries; agro-input industries such as the manufacture of fertilizer, animal feed, pesticides and insecticides, farm tools and implements are also classified under this industry. Being essentially raw material oriented, agro-industrialization would lead to much greater dispersal of industrial activity while at the same time generating employment opportunities. For a primary producer such as Nigeria, any programme of change, any programme of industrialization should avail itself of the country's potentials in terms of agricultural resources.

Agro-allied industries in Nigeria include Fruit and Vegetation Preservation, sugar, oil seeds processing, Flour milling, cassava products, kenal, Taning, Timber, paper and pulp, plywood, Veneer, Fishing, Fertilizer, Animal husbandry and livestock products.

The industrial sector of the Nigerian economy is mainly dominated by light and some medium industries, an example of which is the dairy industry. The large expanse of grassland covering about two-thirds of the country gives her a natural habitat for cattle rearing. Most of the over 12 million cattles are owned by the Fulani herdsmen who had been identified with no other occupation in the country. Their dexterity and deligence at animal husbandry is unequalled and the great strides they have made in the production and use of dairy products is second to none.

Milk is processed into pasteurized sour skimmed milk (nono), cheese ('wara') and various body lotions and then sold by the Fulani ladies. Milk production as a source of protein from the indigenous cattle breeds was found to be insufficient, expensive and moreover, unhygienic preservation was poor and the milk was not economically utilized.
The government therefore waded in but in spite of the initial euphoria, the trial did not meet much chance of success mainly because of bad planning and mismanagement, thus the expenditure of such ventures far outweigh their benefits. But the great proppects of the industry led the government to further intensify its effort towards the establishment of various cattle ranches.

In 1978, a livestock project unit under the Federal Livestock Department was created to make loans available to small scale cattle holders. This department is concerned with experimental schemes on development of grazing areas, feeding, breeding and others.

Ever since the establishment of the pioneer project at Vom in 1946, many others have been established either through private or public efforts. Such dairies as obtainable in Nigeria today include Madara Limited, Agege Dairies, Kaduna Dairy, Fan Milk, Foremost Dairies, and the Ilorin Dairy Pilot Scheme among others.

Nigeria still import about 90 per cent of her dairy products (milk) and almost all the existing dairy industry do not exploit the locally available starting material but import it from abroad. This hampers development and growth and thus not encourage improvement in both manpower and natural rsources.

It is pertinent to stress here that livestock and the dairy industry, has not received as much attention in funds, men and equipment to facilitate its development and improvement if only to improve upon our protein intake which is of plant origin as at now. Productivity in livestock could be improved through improved nutrition, improved housing and management, improved range management techniques, utilization of permanent pastures, better control of disease and better processing and conservation/preservation of products.

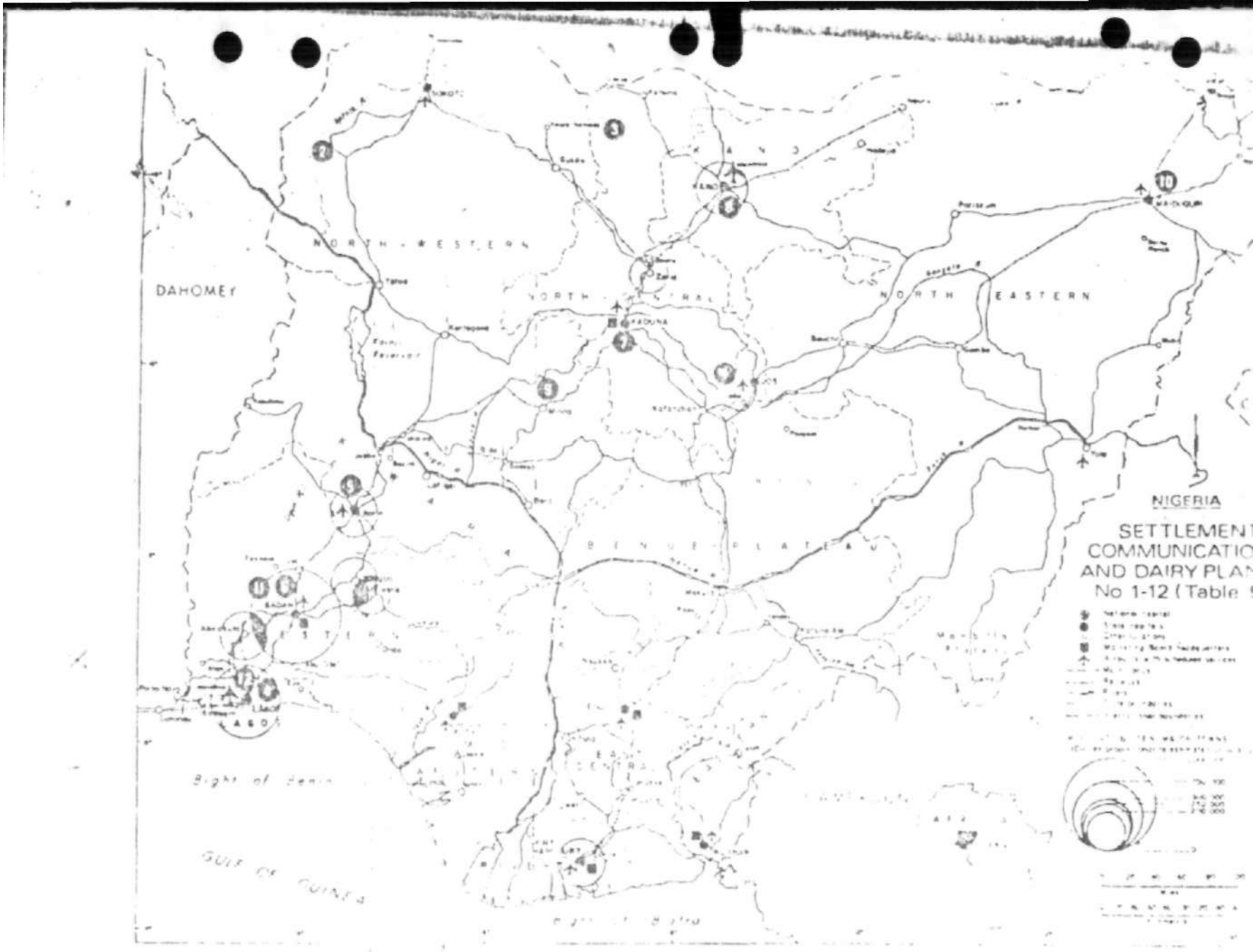


FIG 1 NIGERIA: SETTLEMENTS, COMMUNICATIONS AND DAIRY PLANTS

SOME EXISTING DAIRIES IN NIGERIA

Name/Owner	Location	Products
Madara Ltd, MAE Plateau State	Vom	Pasteurized milk, Butter, Fermented milk
Bulassa Dairy, Sokoto State	Birnin Kebbi	Pasteurized milk, Butter
Rnka Dairy, Kaduna State	Ranka	Pasteurized milk, Butter, Fermented milk
Agege Dairy, Lagos State	Lagos	Pasteurized milk
Ilorin Dairy Pilot Scheme, Kwara State	Ilorin	Pasteurized milk
Iwo Road Dairy, Oyo State	Ibadan	Pasteurized milk, Butter
Kaduna Dairy, Kaduna State	Kaduna	Pasteurized milk, Yoghurt
Kano Dairy, Kano State	Kano	Fermented milk, Ice cream
Minna Dairy, Niger State	Minna	Pasteurized milk, Butter
Fan Milk Company Oyo State	Ibadan	Pasteurized milk, Fermented milk, Ice collies, Ice cream, Yogo
Sona Dairies Lagos State	Otta/Lagos	Pasteurized milk, Fermented milk
Samco Foremost Dairies Lagos State	Lagos	Pasteurized milk, Fermented milk, Ice Collies, Ice Cream

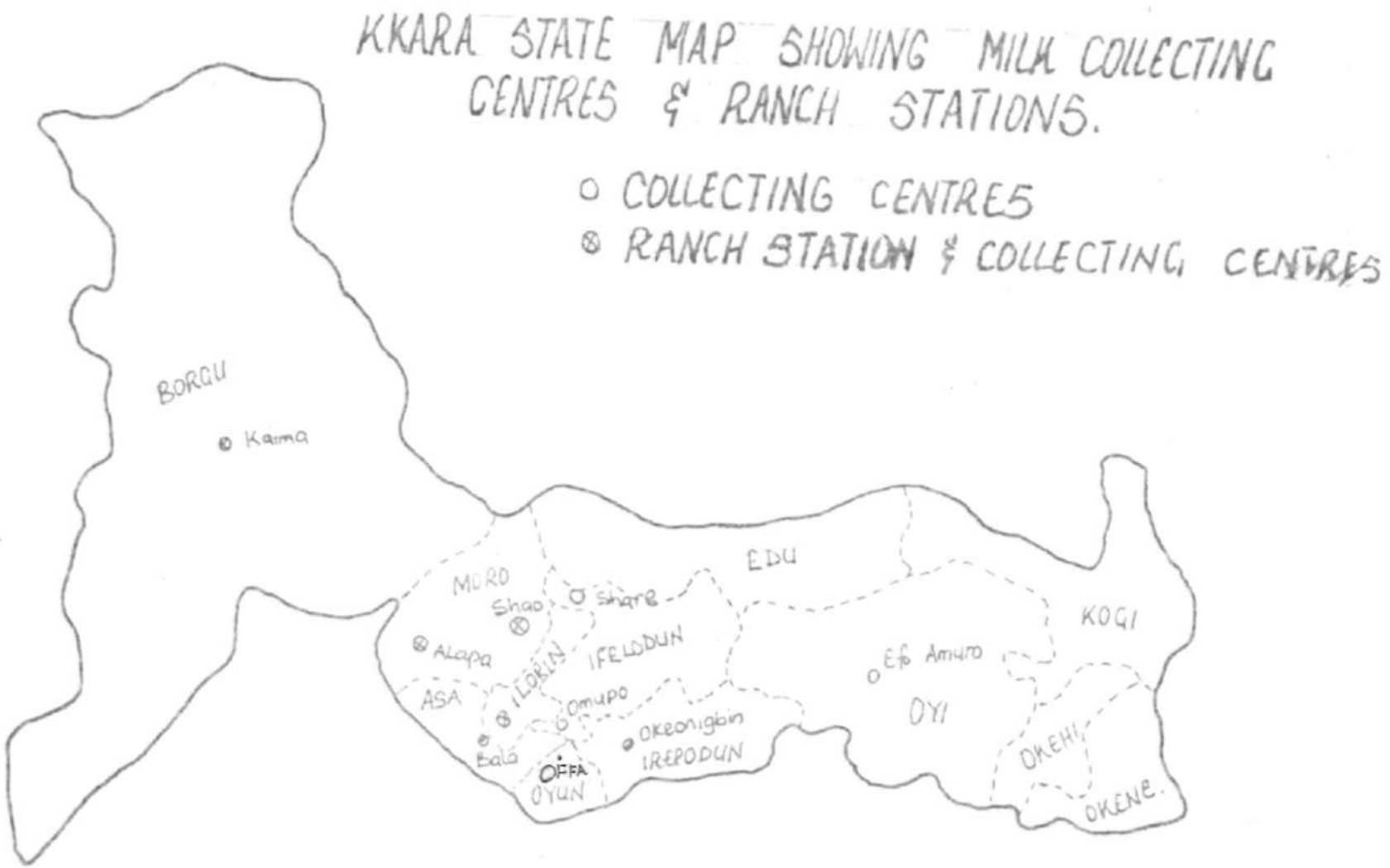


FIG 2 KWARA STATE: MILK COLLECTING AND RANCH STATIONS

CHAPTER THREE

LOCATION, LAND ACQUISITION AND FINANCE.

The viability and prospects of a manufacturing facility is influenced by its location because this partially determines the operating cost and capital cost while the resulting physical factors influence the layout. Since the main objective of an industrialist or any other entrepreneur is to maximise profit at the least cost, all factors affecting location must be carefully considered. Reasons would be given and deduced to show that Offa, a fast developing town which concedes premiership only to the State Capital, is a logical choice. Offa is a town latitude 8°N and longitude 5°E.

In locating an industry in an area one factor which assumes importance for almost all factories is the avalability of raw material within the vicinity. The importance of the source of raw material to the location of an industry depends on the nature of the raw material, transportation system and the finished product. And so, just as the vegfru industries make use of vegetables and fruits abundantly available in its location so does the Dairy Industry, most of which are located in the Northern part of Nigeria (Kaduna, Sokoto, Minna for instance). Kwara is the gateway to the South, from the North and it is one area where, although cattle is reared and bred, no industry exist to utilize the potential. There are about one million cattles in the states and a sizable percentage, more than twenty, is available in the area of location. With each cow producing 5-10 litres of milk per day, not less than 400,000 litres of milk is daily available. At present, this is not being exploited but left to the local herdsmen who milks

them in an unhygienic enviroment and uses the resulting milk to produce 'nono' (sour milk), wara (cheese) and some body lotions. The proposed industry would therefore exploit and fully utilise this raw milk and even seek means of improving upon its procurement.

Milk, and its products is one of the most nutritious food which nature endowes man. And because it is essential to growth and development, every human being requires it. The Food and Agricultural Organization of the United Nations has an average estimate of 300 ml of milk per person per day for every Nigerian. With a population of two million, Kwara State of Nigeria would require 600,000 litres of milk. This figure potrays the demand potentiality. It is therefore believed that even within the four corridors of the state, there is a ready market to absorb the projected supply level. The products may be taken to neighbouring states like Bendel, Oyo, Ondo, Ogun and others.

Transportation facilities available for this industry when located at Offa include the road, the trains service and the air-ways. Referigerated vans would be mostly use to transport the products to all distribution centres. This gives the location advantages over similar industries sited in say, Lagos, where unreliability in transportation facility contributes to the use of imported powdered milk from foreign countries as the starting material. The cost of transporting the starting material, milk, to the centres of consumption where a factory had been located, is more costly than transporting the finished products from the chosen location.

Availability of labour is also another factor which affects the location of an industry. In the Dairy Industry, Labour would be required to handle the livestock, the machinery and plants as well as for managerial, administrative and technical responsibilities. The skill, technique and expertise required of a complex modern industry is not available as industrialization is just in its infancy in Nigeria. The cost could however be reduced if a carefully scheduled training programme is drawn and implemented. The Dairy industry is however fortunate in that the local herdsmen who are available within this area, are recognised throughout West Africa for their diligence and prowess at cattle rearing and milking. The proposed industry would make use of this opportunity by exploting means of training and exposure which would culminate in the improvement and modernization of their traditional method. This would be in the best interest of the government in the long run.

Talking about infrastructure, there is a prevailing conducive atmosphere which is ready to absrob more and can foster a successful industrialization programme. The Kwara Breweries, Okin Biscuits and Foam among others are testimonies. There are good roads, pipe-borne water is not much of a problem as the town is blessed with Oyun, water Dam project and there is a 300 bed General Hospital. Judging by the standard of the national electricity supplies , Offa could be counted among the few that enjoy a fair and stable light supply and with the various hydro-eletric projects presently being undertaken by the authority concerned (National Electric Power Authority) it is hoped that power failure would soon be a thing of the past.

Climate, geographical location and landforms play a dominant part in the way man utilises the natural resources of the earth. While people living in an area with abundant rainfall the year through and with good soil specialise in agriculture, those living in areas where rain is scanty would most likely engage in animal husbandry. Climate, therefore has a great influence in the choice of a location since it affects the availability of certain raw material. Since Offa is within the Guinea Savanna, pasture for grazing would be abundant and the climate is quite favourable to sustain a successful livestock based industry.

The geology of the area chosen as the location of an industry would affect the design of the building particularly, the foundation: an unstable land would require expensive and eleborate foundation types such as pile or grilled foundation. Offa has a stable and firm substructure which can conveniently hold the structure being proposed.

It had been the feverish wish of every government, past and present, of the Federal Republic of Nigeria to develop, emancipate and enhance the betterment of the populace, in every location. Siting the industry at Offa would be in line with this government policy.

All these factors cannot be divorced from one another and certainly, have their own limitations when considered solely on their own merit; however after all the pros and cons one certainly, would come to term with the logical choice of location.

The area chosen has already been mapped as the town's industrial zone. Siting the industry here is therefore a means of off-setting preliminary costs especially in terms of infrastructures and services already available at the site. Other alternate sites available are along Offa-Erinle road, Offa-Igbonna Road, or Offa-Irra Road. These sites are not suitable; the best among them is the Offa-Erinle road in that it is near a major highway and enjoys the benefit of some existing small scale industries. However, infrascture is poorly available and above all, this stretch of land has been an issue of litigation protracted by the communities of the area. For quite a long time, it has led to civil strife and enmity between the two neighbouring community (Offa and Erinle) which culminated into wanton destruction of properties and even deaths on both sides, as to who is the legal trustee of the said land. The land could therefore be aptly described as a time bomb ready to explode at any notion of utilization. In fact, a community market built on the land has been overtaken by weeds as all desert it. Of the other alternatives, the presence of the state and Federal Governments housing projects and some educational establishments render these areas unsuitable, because industires within such an environment would be inimical and unhealthy to the welfare of the people which it had wanted to serve at the first place.

With all these in mind, the choice of site and location is logical.

Capital,may be broadly defined as goods employed but not utilized in the course of production together with the money which gives power to buy such goods; an entrepreneur's capital may consist of fixed capital, working or physical capital.

Fixed Capital is made up of the land and the buildings on it, if the entrepreneur is a free-holder, his working capital consists of machineries and equipments while his balance or overdraft at the bank, his shares in some company, his life insurance make up his financial capital. These sources of capital are rarely enough or available to any Nigerian entrepreneur. For the purpose of this project, the main channels through which capital would be raised are through shareholders (selling shares) borrowing loans from industrial development banks and government share. Business entrepreneurs would be invited to buy shares from the industry and the interest accrueing from the sales of the products be shared according to the amount of shares purchased. Capital to be so raised would constitute about 43 per cent of the total initial investment; also a long term loan expected to have one year moratorium and at an interest rate of 10 per cent on the annual outstanding balance, would also be secured to constitute about 49° per cent of the cost while a short term loan 8% of the cost would be secured to meet the working capital requirement, the interest rate is expected not to be more than 9 per cent and be repayable within the first two years of operation.

Short term loans would be secured from financial institutions while the long term loans would be obtained from governmental and/or world Project Development agencies with financial assistance programmes, like the World Bank and its concessionary lending affliates, the International Development Association which must be said, have been contributing much to enhancing food production capabilities in Africa especially in Nigeria. Other finance lending organizations such as African Development Bank and the UNICEF, which are increasingly turning their attention to financing food production after many years of funding infrasctural development; the Nigerian Industrial Development Bank, and the Nigerian Agricultural and Co-operative Bank would all be consulted. There is a hope of a substantial promise for a better future, for after many years of focussing on huge infrastrutural development programmes, most of these international institutions are increasingly realising that developing nations need to harness their resources to increase their food production - capacity. Apart from utilising their own funds, multi-lateral institutions are increasingly examining prospects of combining their efforts with those of private lending institutitions in what has come to be called co-financing.

Until 1976, the provision of long term financing for industrial projects was considered to be exclusive responsibility of the development banking institutions. Although the commercial banking system did not consciously provide long term capital, they did , in fact make de facto long term capital available. Overtly, short term facilities by being continually renewed and increased operated effectively as long-term loans.

Because of the then prevailing atmosphere of monetary stability, industrialists employed short-term borrowing by way of over draft and along with internally generated funds, finance the acquisition of fixed assets. Today, however this may not be possible in view of the economic recession which dictates that the lending institutions strictly adhere to stipulations and stringently monitor the activities of its beneficiaries.

Financing items include Land and Building, Machinery and equipments, preliminary expenses and working capital, Delivery vehicles, Furniture and Fitings.

Land and Building covers all expenses incurred in the process of acquiring the land and the final cost of the building. Machinery and equipment cost covers machineries required for all ancilliary facilities, like compressors, boilers etc, production processes, packaging and cooling store facilities. Included also are freight charges, insurance, clearing and customs duty, inland transportation erection and commissioning.

Preliminary expenses cover consulting services, legal fees and local travels.

Working capital projection estimates involve direct materials, direct labour, costs, sales and administrative overheads.

CHAPTER FOUR

METHODOLOGY, STUDY OF EXISTING DAIRIES, SITE STUDY AND ANALYSIS

The research design involving the arrangement which governs the conditions for collection and analysis of data used by this work is that of Formulative or Exporatory nature. What constitute the necessary parameters for choice of method is the availability of rsources to execute and implement the proposed programme. The function of the research is therefore to explore means of industrializing Nigeria's economy. This may result into the formulation of a goal achieving and pace setting concept or scheme by which a definite area of industrialization would emerge. The need for diversification of the nation's economy to particularly agro-based industrialization culminates from this analysis and the Dairy Industry is chosen as an example of the viability of this proposal.

Because of its nature field techniques of observation will be used as the means and ways by which information and data would be obtained. Secondary and Primary sources would be utilized for data collection. That is, use would be made of pre-existing data obtained from records and those which would be obtained directly from the source, which in this case is, existing Dairy Industries and others of related nature. Reliance would therefore be placed on official reports and statistical data of existing industries (of some nature), Institutions and relevant ministries (Ministry of Trade, Commerce and Industries etc).

Magazines and Newspapers to be consulted include the Business Times, Business Punch, Business Concord, Agricultural Development, Tropical Agriculture, West African Farming, Agricultural and Rural Management Training Institute and the Food and Agricultural Organisation (FAO) publications.

The review of all available literature related to agro-based industrialization programme of Nigeria's economy would enable one to know whether same or similar problem had been tackled before; if so, then the work would seek avenues where such a work could be improved upon, but where none is in existence, then a direction be established for tackling the same. A survey of people with practical experience of this problem and work and those familiar with the problem of industrialization in this area would be contracted. Interviews would be conducted with staff of some existing Dairy Industry in the country. All interviewees would be forwarned by writing or booking directly, giving an indication of the direction which the interview would take. The interviews are expected to be conducted by the researcher.

In order to ensure that every aspect of the work is given the due attention, proper planning would be done with time allocation to each activity involved from preparation of materials necessary for the take-off till the final writing up of the report.

Proximity to data and other information sources may impose a fairly high cost in terms of finance and time resources available at the disposal of the researcher.

This is even made worse when one considers the austerity trend which has created an unprecedented inflatory rate of over 300%. However, prudence and thrift would be used to limit the cost within beareable limits.

It is believed that a committed adherence to this scheme of methodology would lead to the evolution of a solution which would go a long way in determining the best modus operandi to be adopted in curbing the social and economic degeneration which plagues this nation. There is no gainsaying in the fact that Nigeria's economy is fast hitting the rock and the nation is going bank-rupt; should we wallow in it and allow it to go headlong into the on-coming slaught of economic bliss, posterity would not forgive us.

If the suggested methodology and method leads to the achievement of the set objectives as earlier on expressed, then the whole exercise is justified. And with the available facts and findings, I do make bold to express here that this research work is competent at providing the best solution for the revitlizing, revamping and boosting the Nigerian economy through an agro-allied industrialization scheme of which the Dairy Industry is an instance.

The realizatinn of a new development creates a new equilibrium in an enviroment and provides for some purposes and offers new possibilities. The design of a site develops through phases following one another, with each succeeding one more detailed and exact than the preceeding. The phases include analysis, evaluation and synthesis and these would enhance stability,

productivity, comfort and beauty. Site selction therefore requires intelligent study of the requirements of the proposed building and of its workers. No matter what a site may offer to a probing eye, its suitability to purpose should always be the guiding criteria for its selection.

The site chosen for the Dairy Industry is within the Industrial Zone of the town Development plan for Offa, and the area is situated along the Offa-Ilorin road. The plot measures some 800 metres by 1000 metres and is about one hundred mettres away from the highway. The site is therefore large enough to accomodate the building and all pre-planned facilities. There is ample space for parkings, roads and side walks to ease movement of vehicle and people on the site. Provision for landscaping is also guaranteed. Since the possibility of future development arising from the expansion of business cannot be ruled out, the capacity of internal services as well as adequate land should be made available.

The site offers easy access to power, water and telecommunication facilities. The cost of procuring these has been greatly reduced as provision has already been made for them by existing industrial set-ups in the area.

To ensure that its demand is adequately met, necessary information including load at peak hour would be made available to the respective boards such as the National Electric Power Authority, Water Corporation.

Test borings done by Ministry of works for existing industries in the area have shown that the site is free of any subsrface problem and that the ground is sufficiently stable to hold up the proposed structure without resorting to any costly footings and foundations. The result of the test borings have also indicated that eh land is fertile enough to sustain and ensure the growth of shrubs and plants for land scaping.

The condition of the site in terms of the building plan should be one that takes advantage of natural ventilation and avoid excessive heat rays from entering the building. Otherwise this would result into expensive air conditioning throughout the life of the building.

To get to their working place, employees must travel the shortest possible distance, however this may not pose a serious problem where there is effective and efficient public transport system. But this is not the case in Nigeria. In choosing the site due consideration has been given to the distance to be travelled which is just about three kilometres from the town.

The sorrounding neighbourhood is a vital factor to be considered in selecting a site. The enviroment should be able to accomodate proposed industry without any danger to its own continuity. Since the area has already been earmarked for commercial and industrial development, incompatibility is a non-issue, it would blend with the existing environ; and attempt would even be made at enhancing the ideals of a good industrial neighbourhood.

The site is free of any peculiar obstruction which would inhibit proper and adequate light, ventilation or security, except some few shea butter and mango trees which could easily be removed where necessary.

There is a large market to meet the aspirations of the industry even within the state. However, products of the industry would be distributed to neighbouring states for a wider market coverage.

Both skilled and semi-skilled labour would be required and the location would not be found wanting in the provision of semi-skilled labour which could become highly skilled after few months of exposure.

Offa, a relatively quiet historic town was one of the most powerful Yoruba towns. Founded by Olafagangan, Offa was sought by weaker and troubled towns for protection against attack by other powerful towns, thus the town became one of the most powerful in the then Ibolo Area. Agility and strong dedication to cause led to the offer for appeasment to a god, the only son of Moremi, an illustrious Offa daughter, when the whole area was beseiged by evil spirits and demons. From that year on, the people were able to live in a peaceful and conducive environment. In the appreciation of the great sacrifice done and offered on their behalf by Moremi, the people gather together every year in September to commemorate the event. People from all walks of life, especially the Yorubas come to the town to witness the occasion.

Being a town at the outskirt of the forest area, Offa by virtue of its geographical location, is a gateway to the North or the South, depending on where one is approaching the town, the highway that serves and link the South to the North also passes through the town. It is on record that at the advent of modern trends in the Yoruba land Offa was one of the earliest town to embrace it. While others were shunning the train service because of their erroneous impressions, Offa warmly accepted its advantage; one of the earliest secondary school in the country was also built in 1943.

The climate of Offa is characterised by a wet and dry season. The wet season starts from March and ends in September while the dry season commences from October and ends in February. The main climatic factor which influences the Nigerian climate is the wind which is of two different characteristic - the hot, dry dusty harmattan which blows from the North East and the South West winds which are moisty and cloudy. Their prevailing periods are marked by the dry and wet seasons respectively.

These winds blow in response to changes in pressure which are in turn due to different temperature. By October, the Sahara desert becomes comparatively cool, a high presure develops and winds blow carrying the Saharan condition southwards. By the time it reaches Nigeria, the winds would have been deflected by the earths rotation and they appear as North East trade winds. This is the harmattan and is so strong as to obliterate the tropical sun turning it into a pale ball.

However, by the time it reaches Offa, the winds effects would have been decreased by the moisture it encounters. Thus cases of extreme dryness with subsequent skin cracking and sores are rampant, amount of dirt and dust is increased by bush fires. In the wet season, warm wet conditions prevail, low pressure develops over Sahara and winds blow from the ocean inland. This brings rain to Offa as in many other towns.

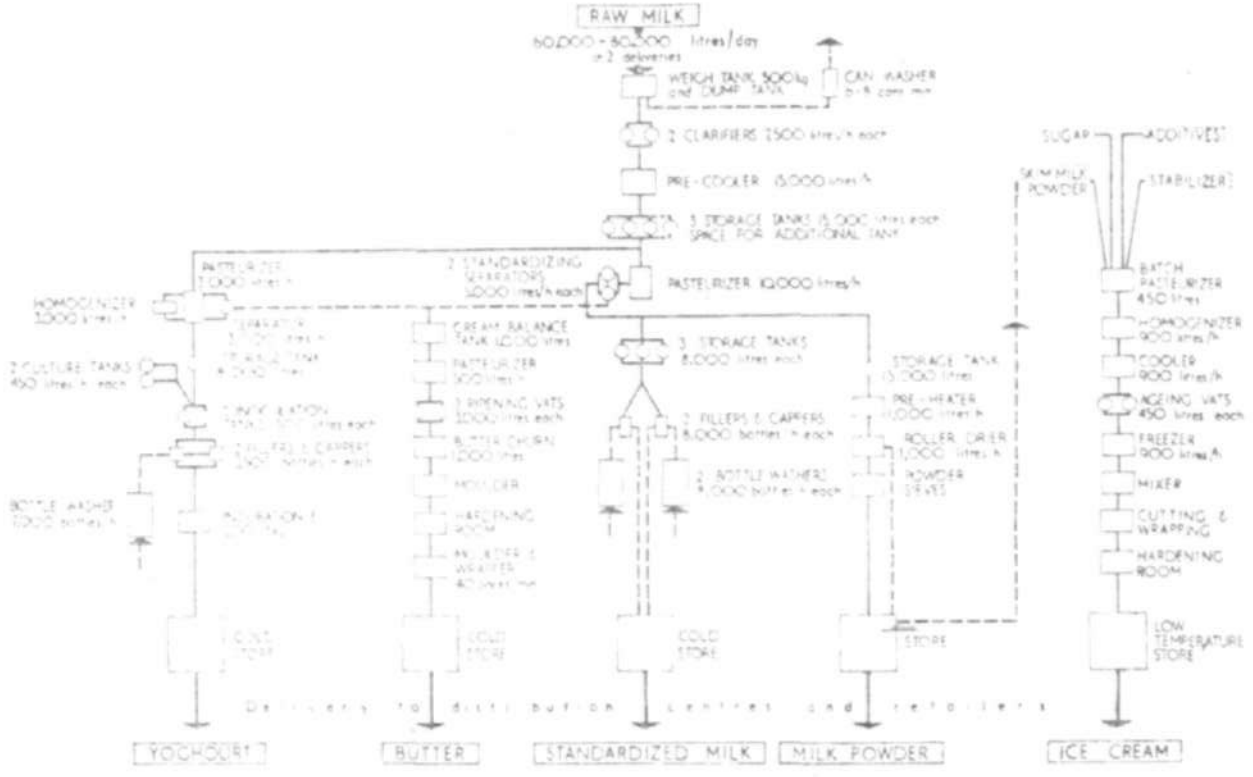
Temperatures are almost high everywhere in Nigeria though wide seasonal contrasts are found in the North because of the dryness and its distance from the sea. The temperature range at the North is therefore high, for Offa it is $50^{\circ}F$ ($10^{\circ}C$).

The rainy season which lasts from March till September, coincides with the period when Nigeria is under the influence of the South West Monsoon winds, which reduces as one moves inland, for while Lagos recrods 177cm annual rainfall, Offa receives 125cm.

Offa is located at the descent of the Yoruba hills at roughly 200 metres above sea level and the soil is laterite with a profile layer of red colour, its thin humus layer is often removed by decaying, leaching and erosion.

Because it is situated at the outskirt of the forest region, the grassland vegetation obtainable at Offa could be said to be a derived one through activities such as farming, burning and overgrazing. Of the Guinea Savanna type, the grass grows so tall in the wet season that they become almost impenetrable but dies off leaving behind roots firmly entrenched in the ground, in the dry season.

FIGURE 3. PROCESS SCHEDULE FOR A MULTIPURPOSE PLANT



Useful trees such as locust bean, shea butter and mango trees are popular. Livestock represent a large part of the agricultural wealth of the area and because of abundant availability of pasture, the nomadic fulani are found here with their cattles in a more settled environment.

Nigeria has a rural rather than urban population with a fundamental contrast in the pattern of settlement in the North, South-West and the South-East, the core of each of which has one or more centres of very dense population concentration. The Yorubas live in the South West of Nigeria and form a large and powerful inquistic group. The territory extends over the frontier into the Dahomey and into the Northern region where it is bordered by Kwara State.

Offa is located at the fringe of this area of high population density, with a population of 150,000. The indigenes are naturally, Yorubas but non-indigenes include Ibo, Hausa, Fulani, other Nigerian tribes and some foreigners. The settlement is fast developing one and most of the populace do engage in farming activity; the women are mostly traders and apart from private businesses there are some governmental and public establishments providing job opportunities. The town is not industrialized and presently can boast only of four industries, yet the level of infrastructural development is highly commendable and could support a successful industrialization programme just by improving upon the existing facilities. Ilorin and Oshogbo are two important towns which are just about an hour's drive from the town. An international airport is available at Ilorin.

CHAPTER FIVE

ARCHITECTURAL PRECEDENCE

Architectural contribution towards revamping and boosting of the nation's economy cannot be overlooked because not only do they offer theoretical solutions, feasible design works, well planned and schemed with all necessary requirements fulfilled are also proposed. Similar architectural works preceeding this research include the Dairy Industry at Kaduna, Minna, Sokoto, Sona Dairies at Lagos, Fan Milk at Ibadan and a pilot scheme, at Ilorin.

Geographically all these industries are situated in Nigeria, thus in common, they share the so many factors affecting industrial goods and service production. From the most southerly point of Akassa, $4\frac{1}{2}^{o}$ North of the equator to the most Northerly point at 14^{o} North, Nigeria stretches over some extensive land of high and low areas; geographical situations therefore differes from one area to another.

The Kaduna Dairy, Fan Milk (Ibadan) and the Dairy Pilot scheme (Ilorin) have been chose as case studies. Apart from the Fan milk at Ibadan, the others are located in the Savanna belt of Nigeria where cattle rearing and breeding is practised. Although the Savanna areas vary in their vegetation and length of dry season, they have a unifying charactersitic in the occurence of grass. The environment dictates that pastoral and settled cultivation be practised; the cattle Fulani, who owns about 80% per cent of Nigeria's 14 million cattle live in the Savannas.

For most part, the North consists of a broad plateau which rises to more than 600m above sea level in the centre and falls away rather sharply to the south but gently towards the North, northeast and North-West. The Jos plateau which rises up to 1200m above sea level gives rise to a landscape of a type not found elsewere in Nigeria; without any forest cover, the grassland is typical with wide exposure of bare rocks.

The geology is of ancient crystalline rock but earth movement in remote times have resulted in the superimposition of extensive tracts of cretaceons and tertiary rocks. The soil at Offa, like most of the northern soil, is laterite and only fertile enough to sustain growth of the few Savanna trees.

The climate at Offa is similar in some ways to the North and the South because of its location inland. While it shares a small temperature with some southern towns, its rainfall amount of 138cm compares of high altitude northern towns like Minna, Jos.

While relative humidity is about 95 per cent in Lagos, the year through, only at dawns during the wet season do Minna enjoins a relative humidity of 90 per cent but 45 per cent.

As in most other African nations, Nigerians way of life is a reflection of the societal beliefs, ideals and values. Whatever is accepted as norm and practised as a habit assumes a cultural identity. In this vein, any attempt at alienating religion from culture would be an exercise in futility and a negation of reality.

Traditional religion was practised with great pomp and pegeantry from the coast to the shores of the Lake Chad. However, due to differences in location, the mode and form differs but the essence was not lost. With the on slaught of foreign ideas and values, the people lost grip of their traditional bliefs; the north was overwhelmed by the spreading influence of Arabic religion while the South, due to its proximity to the coast, became more inclined to the European religions and beliefs.

Because of its location, Offa shares both values with either side, influences of both European and Arabic culture and religion are manifested by the existence of mosques and churches side by side in the town.

There are three major linguistic groups in Nigeria - the Hausa, Yoruba and the Ibo corresponding respectively with the 1939 Norther, Western and Easter regions. By mere share coincidence what now constitues the present Kwara State fell to the Northern region, thus Offa, though a Yoruba town, was then under the reign of a northern leadership, who like their southern counterparts, were powerful emirs and chiefs.

The striking similarity in some aspects of the southern and western regions culture was borne out of historical facts; for the Yorubas were said to be desandants of Oduduwa, a man who migrated from the far East and settled in the Oyo area of Nigeria.
One would like to recall here that most of the Hausa's culture as it obtains now, is a direct influence of the far East inspirations.

Generally, the Dairy Industry in Nigeria is public owned, especially those in the Northern part of the country. Their design and even mode of operation are therefore very similar, if not the same. The Kaduna Dairy has therefore been chosen as an example. The Fan Milk plant at Ibadan potrays what occurs in most of the southern dairy industires just as the Kaduna dairy plant does.

As an architect, the planning and design, types of plant equipment used, manufacturing processes, safety measures applied, the relationship between the various units which make up the industrial unit, and the general functionality of the industry would be considered. In the dairy industry, these responsibilities could effectively be met after a thorough understanding of

- basic knowledge of biological process involved in the production process
- basic knowledge of production milk and its properties
- basic knowledge of production process leading to various products
- basic knowledge of machines and equipments involved in the production
- health, hygienic and safety requirements
- demand and attitude of consumer

KWARA DAIRY, ILORIN

Established in 1973, the Kwara Dairy Pilot Scheme lies to the north eastern part of Ilorin along the Jebba road. It occupies an area of about four hectares and is bounded on the North by the Veterinary Department, West by the Midland Supplies Limited Warehousing, the East by Ministry of Transport and the South by a road whish is tapped for access on to the site.

The Scheme was completely funded by the UNICEF which supplied the equipments and technical staffs to man the operations. Lack of co-operation from the then Kwara government finally saw to the near collapse of the factory. Working capital was not available and gradually the project grounded to a halt. Today, however, efforts are being made to rejuvenate the Scheme and very soon Yoghut, Ice Cream and milk would be available for the public.

The project is highly enviable although too modest to its approach. It has its own cow pens, milking parlour and facilities for collecting milk from local farmers. The ancilliary and production facilities are all housed in a building measuring some 6 metres by 9 metres. It has been extended to provide a reception bay and a cold storage area. Ancilliary facilities such as compressors, generator, storage tank and a water supply source are provided. There is also a small laboroatory attached to the office accommodation which is in a separate building. All buildings on the site are constructed of stone and have pitched wooden trusses, with Zinc sheets for the roofing. The floors and walls of production area are not tiled and this creates a problem to effective cleaning.

There is no proper organization and buildings are not well oriented on site with regards to excessive sun heating and ventilation.

Wells provided are too close to waste disposal field and this makes them liable to contamination.

The production process follows a simple straight line form of production with the raw milk starting from one edge of the production line and coming out through the process as a final product (milk, yoghurt) from the other edge. The production activity is vulnerable to dust, insect and air contamination. Milk reception and despatch areas are not properly designed and facilities for excess milk storage are absent.

FAN MILK FACTORY, IBADAN.

Situated at the Eleye-ile industrial layout, Ibadan, the Fan Milk Factory occupies some 100 metres by 50 metres stretch of land. It specialises in the production of Yoghurt, Ice cream, Fan Ice, Lollies, chocolate. The factory has a joint ownership with expatriates controlling the technical and managerial aspects while Nigerians are involved in the administrative functions and also provide the bulk of semi and unskilled labour required.

The receptionist office is at the entrace, beside the gateman. Of the two main buildings on the site, one is yet to be completed and is used as the starting material store. This building is 15 by 30 metres in size and is 9 metres high.

The other building which houses the production facilities is about 30 metres away from the former and it spans 12 metres by 30 metres and reaches a height of 6 metres, is 1.0 metres above ground level; expansion work is being carried on this building which houses all the equipment and machineries and the ancilliary facilities necessary for the production process.

The office accommodation is provided by air-conditioned pre-fab buildings.

The production process follows a compact 'U' form with one edge of the 'U' serving as the final storage area. The main processing takes place along the form and the space between the two legs of the 'U' is used for starting material reception and as a despatch dock. The level of technology involved in the manufacturing process is medium and quite moderate for a factory of this nature. It uses 100,000 litres of milk daily.

Although the general layout is not unaccepted the design of each facility leaves much to be desired. At best, the office accommodation area is a make-shift and does not potray the level of activity which the factory is engaged in. The space provided and the functions therein are just inadequate.

Welfare and workers facilities are obviously absent and these have some telling on the production acitivity because some corporate time is always wasted by workers who have to go to the town to seek for these needs whenever the need arose.

The space for reception and despatch is a bottleneck to the easy and smooth flow of production as customers disturb the easy flow of workers.

The building is too close to the road and parking space is inadequately provided.

The design does not avail itself of the advantage of abundant sunlight and reliance on imported starting materials is unhealthy and does not help in the drive to develop local human and natural resources.

KADUNA DAIRY.

Located at the outskirts of the town, along the Kaduna-Zaria road, the Kaduna Dairy Industry has a site area of about 150 metres by 100 metres. It uses powdered skimmed milk to produce yoghurt, ice cream and milk. The main building on the site is a compact one and houses both production activities and ancilliary services; entrance to the site is via a main gate and the main storage area is located behind, at the back of the production facility area. Part of the storage space has been coverted to office space for the administrative staffs of the industry.

The production area building measures some 30 metres by 36 metres. It has reinforced concrete framework structure with concrete slab roof and concrete blocks are used for infilling. The form of production process is straight. The factory has facilities for initial treatment and processing of raw milk reception and powdered milk reconstitution and the level of technology utilized is medium.

Provision for electricity generating is provided and so are plants for water supply and waste treatment. However, facilities for workers are neglected. This is an oversight for it has direct bearing on the workers. Their dispensation at wor is directly proportional to their physical and psychological well being. Many hours would be wasted under the pretext of securing those needs. With all honesty, it seems the main concern was to provide accommodation for the production process. No wonder then that the industry is not working in spite of the great potentials and prospects available.

The site is too close to the highway and parking space for customers and staff are not adequately provided.

With a staff strength of 80, the plant produces 18,000 litre of yoghourt per day, 5,000 litres of ice cream per day and 18,000 litres of pasteurised milk daily.

CHAPTER SIX

DESIGN BRIEF

The design emancipates from a critical analysis of the economic bedrock of the nation which had been shown to be in precarious situation. A gradual but well planned diversification from oil to agro-industrial based economy is the best receipe and the dairy industry has been chosen to illustrate the viability of this proposal.

Several anti-developmental consequences of transferred technology have been observed: job destruction arising out of its generally high capital-intensity; greater technological dependence and hence increased economic and political dependence, of the third world on the advanced nations; high costs with ensuing debt problems and enviromental pollution. The technology in use in the under-developed periphery of the world capitalist system has performed so well the task of fostering the development of underdevelopment that it has been declared inappropriate. But technological change in particular, whether it comes about by original invention, imitation, adptation or a combination of all, is induced by the critical needs and overall dynamics of the society.

Footnote: Monthly Review (New York) Volume 32 -
W.A. NDONGKO AND S.ANYANG

This is why a rigorously and scientifically formulated technology which would not degenerate into a spineless utopianism is being aimed at by this work. To meet betterchance of success, appropriate and adaptable technology developed through the utilization of local material both in terms of human and natural resources and be able to draw a greater part of Nigeria's excess un-skilled labour force into the production process.

The dairy industry would be making use of milk, obtainable from cows, in a production process which would culminate into the production of milk powder, pasteurised milk, yoghurt, ice cream and butter. Milk would be supplied from collecting centres using tankers.

A daily milk through put of 200000 litres would be used for the production of which 70,000 litres is for milk powder, 10,000 litres for butter, 40,000 litres for pasteurised milk, ice cream and yoghurt respectively.

A manpower force of about 200 made up of skilled, semi-silled and unskilled labour would be required for a two shifts running. The main facilities provided for by this design include the administration, social and welfare facilities, recreational, storage facilities, production facilities and an ancilliary area. Facilities for water supply and affluent treatment have been provided also. After identifying the various facilities needed consideration was given to spaces to be accomodated within each of these facility buildings. In allocating these spaces circulation spaces for easy movement and working around the equipments and machineries was kept in mind. Parkings for staff, workers and customers have been provided, there is space for raw milk

reception, cleaning in place, initial milk treatment, main production, packing and final cold or normal storage for the products at the Production Facility area. At the ancilliary facility section chilled water tank, compression, boiler, electrical control, fuel, generator, water pumping, fire fighting, workshop, laboratory, ingredients store and packing material storage spaces.have been provided.

For the workers and welfare facilities area, changing room with toilets and baths, medical area with provision for a doctor, a nursing sister, treatment and dispensary spaces. A cafeteria with cooking facilities have also been provided, and a relaxation area with indoor games activities such as ludo, chess, Draft, Ayo, cards, table tennis and others have been provided apart from the snack/bar area.

A farm area with facilities for cow milking, calving cows, and calves (new born cows) would be provided, about 200 cows would be on the farm.

The administrative facilities would see to the day to day smooth and officient running of the industry: the personnel staffs would determine the number and level of experience required of its employees who would help man the industry; sales and marketing staffs would be concerned with purchases of starting material, sales of the factory products, purchase of spare parts and machineries and also cater for reaching a wider market; technical staffs would see to the proper functioning of the production activities and maintenance.

The managerial staff will be involved in the co-ordination of all activities under the section which they occupy, for instance, the technical manager or production manager would be responsible for all technical requirements of the industry.

He does this best by co-ordinating and planning the activities of technicians who are in direct contact with the workers. From this, it can be seen that the administrative facility is very essential. It provides for skilled manpower, modern technology, embarks on research, development and stimulates the provision of suitable market environment.

The production area is the back bone of the industry. It is here that all production and manufacturing process from preparation of raw milk to the packing of the finished products occur. Its easy and smooth running is enhanced by the ancilliary facilities which provides services such as compression to produce cooling effects needed for storage and other activities. The boiler produces steam and hot water for the processing.

The laboratories would perform experiments for attaining and improving upon standard and quality of the products. This would boost sales. The level of production and even the quality depends, to some extent, on the workers who are to operate the various machineries and equipment. They should be given incentives which would make them put more effort at work; training programmes would be given and in order to retain and attract employees incentives, apart from monetary consideration to be given include social, welfare, health and recreational facilities.

Because of the complexity and the number of units and facilities provided in modern industries, the site organization should be given due consideration in order to ensure and enhance proper functioning.

A good site organization would reveal the need for proximity of certain facilities, their interdependence and relationship to each other would be potrayed in the final site layout. For instance, the starting material storage might be located near the main gate or near the main production area. For the purpose of this work, the storage is in direct contact with the production hall, this ensures efficient flow of goods and workers and thus contribute to effective productivity. Must the workers enter their changing room before reaching their working place or vice versa? What would be the correct location of storage facilities for the industry's product: near the gate, the sales department or the production hall? These are some of the vital questions which must be taken care of by the organization of the site.

In this work, the overall layout has been done with two main consideratiions: the ease and efficiency with which the unit is to be run and the relationship of the industrial unit to its neighbours. The site is well away from the main road to avoid any problems of traffic bottleneck during times of resumption and closure of work. Entrance and exit patterns are done in such a way as to ensure that employees and visitors could drive with reasonable aese. The roads proper, are designed to take heavy loads without high maintainance cost.

From the car park, one approaches the building either through the workers entrance or the main door meant for visitors, staffs and customers, a lobby with reception facilities is provided for visitors and customers.

The workers passes through the health, social and welfare facilities respectively before reaching the main production hall. The administrative building, the health, social and welfare and the main production hall are well-oriented on the site bearing in mind their natural lighting and ventilation needs.
Since constant maintainenace and alterations to main supply lines is almost inevitable, accessible ducts would be provided. This would avoid accidents which might have occured were the roads dug cut; this often leads to depressions and later transforms into pot-holes. Excavation can be a recurring nuisance, untidy and expensive.
Space for delivery of raw milk and their movement from storage to the production area and of finished products to packing storages, and the despatch of products have been provided in the design.

The treatment plant for water supply is located well away from the industrial waste and effluent treatment plants.

CHAPTER SEVEN

DESIGN PROBLEMS AND CONSIDERATIONS

In designing the dairy factory, certain problems are inevitable if economic and technical success were to be achieved. Choice of the proper location is the first and perhaps the paramount problem that confront the industrialist. From here the problem of the design starts in earnest, with the site planning and then the building components, circulation, design expression, structure design, building service, material finishes, landscaping and layout.

Apart from accessibility, the site has been chosen after careful consideration of the availability of raw milk within the vicinity of the site. Cost to be incurred from the acquisition of infrastructure like road, electricity, water supply among others have been greatly reduced due to the existence of some industrial concerns within the location which have already made provisions for these infrastructures. The chosen site also can accommodate all pre and post-planned structures. There is therefore room for expansion and extensions whenever and wherever the need arises.

One may like to recall here that since land is a very sensitive issue in this area, its acquisition assumes some paramount stance if the industry were to operate without undue embarrasement and harassment from land perpetuators. This is why the reasonable choice of site and location has been made at the industrial zone of the Offa Town Development Plan.

After acquisition of site, the next issue is the organization of the site in such a way that easy and effective production process would be guaranteed. The various units making up the whole complex should each be given due consideration and placed at locations where maximum utility could be made of it, thus enhancing rather than inhibiting productivity. Site planning commences with tapping of the main road to make access on to the site. To avoid the problems of traffic bottleneck and consequent losses, the site is well off the road, † at its junction to the main road, the factory road is widened, clear of obstructions and vehicles approaching the main road could only join it slowly. This effectively reduces the risk of accidents.

To ensure traffic orderliness, separate parking spaces have been provided for visitors, staffs and wokers of the industry. Traffic on the site is reduced, supply vehicles and the factory's vehicles follow routes which are channelled to avoid any occurence of accident; there are no sharp corners and walkways are provided on the road shoulders.

After the preliminary investigations have been completed; the building design is the next problem to be considered. This perhaps is one of the most demanding aspects of the whole Scheme to an architect faced with the design of this type. Any fault in design would affect the overall production; effecting a correction after the design would not only involve the removal of a single item but all related items of design, this would definitely result into a colossal lost of money.

This is why voices of business efficiency cosultants have been listened to, advice of experts on all components of the building have been sought and together with surveys, forecast of present and future space requirement, the Scheme of this design has been drawn. An essential pre-requisite for the design of the building is the exact planning of the manufacturing process, the process takes place in a wet medium pass through a dry area for the packing before finally being stored in the cold facilities, the design recognises this stages.

Necessary components of the building which are indispensable to the easy and smooth running of the unit, components which would ensure qualitative and high productivity were all identified and each located at situations where functionality would be most obtained.

In the production hall minimum columns are most desirable if efficient flow of work is to be ensured.

Approximate calculation of space required was based on annual production or number of employees from the Dairy Industries visited. For each employee there would be at least $2m^2$ of space. In the production area standard size of plants, machineries and equipment were used in conjuction with circulation space. The layout and width of circulation routes depended on arrangement and space requirement of machine, working space, storage space and means of transport used. Office corridors are not less than 1.5metres while corridors linking one facility to another is usually about 2 metres.

The expression of the design is a culmination of the client's aesthetic notions, structural technique employed and the materials utilized; these were done in such a way that it needs no telling any eye that the building is an industrial unit. Although the building module must be regarded as one of the most important designed factors, one would be guilty of a rather narrow concept of design work if the determination of a suitable module and of the appropriate multiple is given a pride of place. Famous architectural designs derive their fascination from the open or concealed reign of the module and the ensuing harmony of relations, and this is taken advantage of in this design.

In order to cover building spans with least obstruction to flow or circulation of people and the industrial activities, and in order to achieve an effective height to floor area ratio and to attain a judicious use of material the structure design chosen is very crucial; however the use of a certain design might be predetermined, for instance, if the client wishes to make a couspicious display of a material produced, processed or sold, which is not much applicable here.

The framed building gives greater strength and stability; besides, it allows freer arrangment of units within the enclosing walls, the external walls become mere curtain designed to keep out wind and weather. This is applied in the design.

The choice of a building material is a limitation of the structural technique adopted in the design of the building, both therefore should be considered simultaneously.

The use of unsuitable material would mean increase in maintenance costs and may sometimes require being totally scrapped off. Some of the possible materials that could be utilized include steel, concrete, reinforced concrete, prestressed concrete, light weight materials and others.

Because this design is an industrial one, loads to be carried are special in that the roof would require a peculiarity and so are the loads due to the plants, machineries and equipments to be used in the manufacturing process. This calls for an independent structural support separate from the structure of the building, and these supports should have economical span. Steels frames have advantages of being altered and extended whenever occasion demands but it has a high maintenance costs. This is why steel in concrete are being proposed. Thus the resultant structure would be flexible, highly resitant to fire and corrosion. Of worthy for notice is the fact that the production processes involves the use of crrosive materials which may attack steel if used, besides, cleanliness which is required of the Dairy Industry would not be achieved were steel to be used for the structure.

Certain services are very essential to the proper functioning of an industry. Of these, electricity and water supplies are indispensable yet in Nigeria they are inadequately supplied.

Approximate estimate would be made of the industries peak load together with the duration of the peak, electrical consultants would be approach for expert advice to ensure that malfunctioning due to electrical installation is non-existent. Moreover, a private generating plant capable of supply electricity for and over the use of the industry would be acquired.

Since the industry would be using a large amount of water for its productinn processes, a careful analysis to ensure the suitability and adequacy of available water for production would be made. To ensure constant water supply artesian well, an elevated tank, an underground tank and a water treatment plant have been recommended.

Details of size, location and depth of surface water would be determined and soil sewers are well considered in the design of a functional drainage system; expert advice would be sought for.

Surface drains are provided to take rain water from roofs to surface water sewer. It is laid in stoneware and the pipes are laid in cement mortar on concrete bed, usually, it is sorrounded with concrete where it runs under building. Soil drains were also provided to take waste from perpendicular basins, sinks, water-closet and other domestic sewage to soil sewer. It is laid in tested stoneware, and pipes are laid in cement mortar on concrete bed as for surface water drains.

Trade effluent drains takes effluent from plant to a trade effluent sewer or the treatment tank and thence, to the soil drain. It is laid in acid resisting stoneware pipes laid in acid resisting cement bedded as for soil drains.

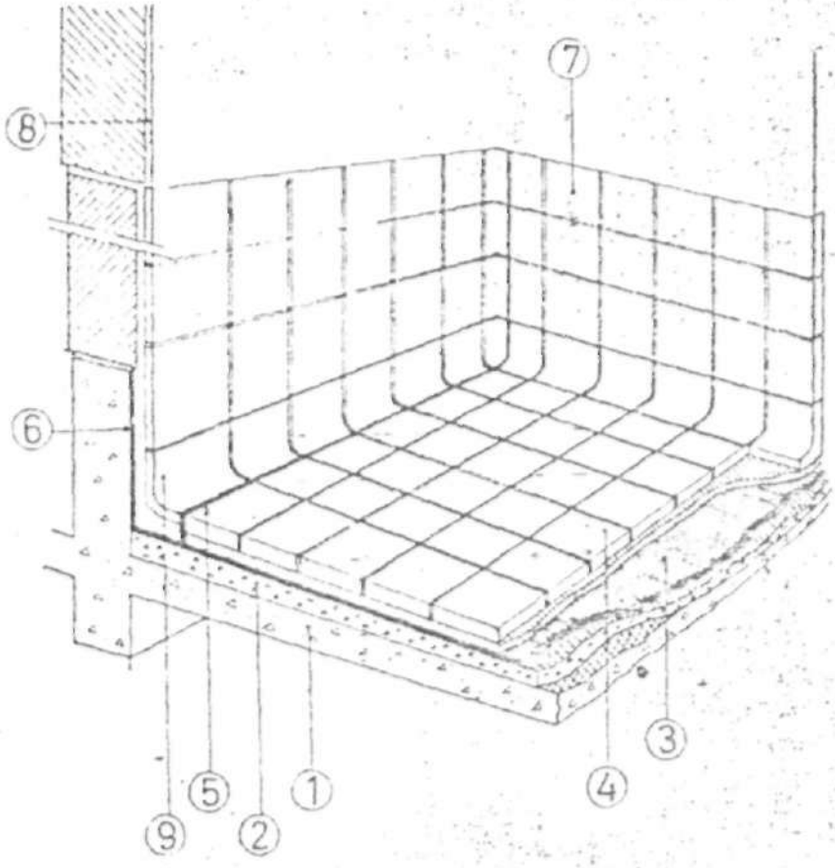
The available fire brigade is about 56 kilometre away. For fire outbreak, reliance would be heavily on local provision of fire fighting equipments; apart from this preventive measures that would be introduce into the design. In this connection, the size and pressure of the local water mains would be checked in relation to spinkler systems and fire hydrants which would be installed round the production facilities, warehouse, packing material store, laboratory, electrical controls any other places where risk of fire outbreak is high; fire stops designs have been incorporated into the design of doors to reduce effect of fire when they may occur.

Floor surface is another problem area especially in the dairy industry where most of the process is a wet one. Plain concrete is unsatisfactory as a finish because it tends to be dusty and has little resistance to acids or continuously running water; provided that solvents are not likely to be spilled on the floor and that the use of metal wheeled traffic is confined to specially prepared floors, asphalt would make a hard-wearing and comfortable floor, but for an industry of this nature, flooring should be acid-resistant and since spill-overs are inevitable during processing, Blue-brick pavers, plain or chequered, laid in acid-resisting cement care used. Because of the problem of water, the flooring has been sloped to avoid stagnant waters, drains are also provided. Again because of the wet process nature, the bases of the equipments and machineries used in the production process have to be protected. This problem is overcome by rais ng the bases of these equipments by mountings.

dismantling equipment for cleaning. Any milk residues which remain will become acid and therefore corrosive. It is usual, therefore, to surface the floor of a process room with hard-burned ceramic tiles or bricks not less than 2.5 centimeters thick. Various colors and sizes are obtainable: tiles are usually 15 to 22.5 centimeters square, and bricks 22.5 by 7.5 centimeters. They should be impervious to water and precise in size, the top surface being absolutely flat (Figure 59).

The success of a tile or brick floor, however, lies to a great extent in the material used for bedding and jointing and in the techniques employed. High alumina cement and sand is fairly good if the joints are kept thin.

FIGURE 4. TYPICAL FLOOR AND WALL CONSTRUCTION



(1) Concrete structure. (2) Screed laid to falls. (3) Waterproof asphalt membrane. (4) Floor tiles and acid-resisting cement. (5) Expansion joint. (6) Vertical waterproofing. (7) Glazed wall tiles. (8) Plaster flush with tiles. (9) Coved tiles.

DESIGN CONSIDERATIONS

Design considerations aims at meeting the process requirements as obtained in the dairy industry, it also allow for the greatest scope for good architectural design and sound building techniques. These, it is able to achieve through the analysis of various problems encountered in the production processes. Generally, the consideration aims at creating a pleasant environ, healthy and free of contamination, easy accessibility, efficient and effective production flow. Adequate lighting and ventilation less interrupted and sufficient space for production process, quality and hygienic standards.

With a thorough put of 200,000 litres per day, the industry could be described as a large scale one and the products are various; varying considerations is therefore required for the various production process.

Starting with the milk reception, road tankers which would be bringing milk to the site require a concrete area of adequate strength on which they can be parked during discharge and subsequent cleaning. The tanker bay would be situated such that connecting hose may be taken for connection to the raw milk pumps to be pumped to the silo storages. A cantilevered canopy is provided to shelter over the working area. Trucks arriving before their milk can be unloaded must have a parking area, preferably in the shade. The reception dock is about 15 metres wide outside the building.

Storage tanks for raw or processed milk are normally cylindrical with domed ends. Tanks for processed milk are arranged vertically and free standing on four legs.

It can therefore empty by gravity. Other equipments such as the separator, Evaporator and Butter shums take advantage of same.

Equipments used in milk processing include pasteurizer, ckrifier, separator, standardizer, preheater and homogenizer, ancilliary equipments such as milk pumps, hot water sets, detergent tanks for in-place cleaning are generally grouped in one room. Each of these equipments rquire little space-just about 2 metres but space for easy all-round access for cleaning, handling and repairs should be provided.

The products of the industry would be packed in non-returnable containers. There is therefore a considerble saving in space and cost. Space is provided for daily and reserved storage of cartons and carton materials. The cartons would be made from flat sheets which could be later performed to shape.

An effective means of storage which eliminates loss of value and quality is aimed at. Cold storage at $2^{o}C$ and $4^{o}C$ is therefore provided for pasteurized milk, cream and yoghurt. Butter would be stored at $0^{o}C$ for short time storage and - $10^{o}C$ for long term butter storage. Ice cream storage requires temperatures as low as - $15^{o}C$. Powdered milk would be stored at normal temperatures.

Services are usually provided in the ancilliary facilities area and are provided with exits at Opposite ends while the floor level is made to be the same.

Boiler room is located near the plants (evaporator and milk drier) where they are most needed and is accessible for repair and maintenance works. The boile room provides accommodation for steam boilers and ancilliary equipments such as the hot well or feed tank, feed water treatment plant, induced draft fans and fuel oil preheater, caloifiers for the production of hot water is also located here. A head room of 2 metres above the boiler (3.5 metres), a 2 metre working space between boiler and other equipments and 3 metres frontage space is allowed for an all round easy access, cleaning and eventual replacement. The provided chimney is so placed that the connecting flue is short. The space required for the base depends on the chimney height which, in turn, is determined by the draft requirement, about 10 m2 is provided. Fuel storage space depends on type of fuel and reliability of supply. Diesel oil would be used and the supply is relatively regular. It would be stored in horizontal, cylindrical tanks housed outside the boiler room. The room is 'tanked' up to a height sufficient to contain the oil, should the tank leak or the drain cock fail. The 50,000 liter tank requires about 15 m^2 of floor space and about 5 metres ceiling height.

Refrigeration machinery is grouped close to rooms where they are to cool. Long referigerant lines and pressure drops are therefore obviated.

Foundations provided for the compressors and condensers are built on a cork mat and insulated from the floor by a 5 centimeter air gap bridged at the floor level with timber. Evaporative condensers are placed outside the building adjacent to the compressors room. The chilled water storage is placed near the compressors. The water tank is made of concrete and provision is made for withdrawal of evaporating coils should any fault develops.

Water supply is via the public main, however, provisions have been made for a water supply system on the site. A pump room and water treatment equipments are provided. Below - ground water tanks are sealed against entry of surface water, they are completely covered and ventilated; elevated tanks are also provided.

The plant receives electricity at high voltage from the public supply, the transformer substation is therefore provided in a separate housing and connected by underground cable. Switchroom housing the main incoming circuit breaker and main distribution board is also provided; motor starters and control rooms are also provided. A standby generating plant is also provided to offset power failures by the public authority.

Underground supply and distribution of services is considered. This would allow short, direct connections to the process equipment on the ground floor and eliminate the necessity for housing service pipes in the process rooms; foremen accommodation for the various production process and the 2 floor level height of such equipments as sterilizers, spray driers, butter-churn are considered. The various process sections are grouped around the milk treatment and processing rooms and forms

the center from which the liquid products are distributed.

Office, Administrative and Welfare Facilities:

With a through put of 200,000 litres of milk, the degree of responsibility calls for the establishment of a separate administrative building located near the main entrance to the site. Provisions for boardroom, conference room, tea room, area and specialist offices were also provided apart from the administrative and managerial offices. The administrative block may not be in close proximity to the production area if only to save customers the embarrassment of walking through the whole plant. Workers facilities such as the changing room and toilets are well positioned on the site to minimise lost of time and to discourage truancy, health, canteen and other facilities have all been located very near the production area. An entrace with timing facilities and records would be provided for the workers.

Space, with facilities for repair and maintenance work as well as a workshop for components utilized in the production process are also considered.

Construction Consideration and Maintenance:

Material chosen was done after consideration for; action of acids, alkalis, water vapour, clean and smooth surfaces, bacteria or organism growth.

Foundation:

The foundation is damp proofed and all pipelines or drains were so constructed as to prevent entrance of unwanted pests into the building. The design of the foundation is influenced by

At such areas like pasteurization, where large amounts of liquid is to be released extra floor drains would be provided; drains and gutters in floors should be placed alongside walls. (10-15cm width) Leakage is certain to occur where pipes go through the floor and where there is drains. A water proofing membrane is therefore applied to the top of the base concrete and underneath the topping concrete or tiled surface. This usually consists of two layers of asphalt felt covered with 2 centimetres of fat - resistant asphalt; the base concrete is smoothed off carefully before membrane is laid; pipe sleeves with flanges for pipes and cables are put in, as well as bolts for anchoring the machinery. The asphalt is taken to a safe height of approximately 30 centimetres on the walls and bases to ensure complete sealing. The tiles are finally laid in cement mortar on top of the membrane insulating material. Concrete floors contract or expand with changes in temperature. This results in surface cracking. The top layer of the floor is thefefore laid in panels 3 to 6 metres square, the joints being about 2 centimetres wide and opening down to the waterproof membrane. The joints are filled after the concrete has set with asphalt poured hot. Each floor panel therefore flaots on the membrane and is separated from the wall and the remainder of the floor by a flexible joint, making it free to expand or contract. This is necessary in low temperature storage rooms and where warm water might warm the temperature of the floor.

Services other than drains should be grouped in ducts for distribution through the building, ducts wall below floor level are provided with waterproof membrane; separate ducts are essential for steam, cold water, chilled water, referigeration, electricity and communication.

Wall:

Walls should be easily cleanable, acid resistant and pleasing to look at. The junction of the wall with the floor is coved with special coved tiles. Where concrete flooring is used, the topping is carried up to form a skirting with a generous radius at the floor line. Tiles are placed up to 1.5 metres above the floor level in the processing room. In the reception and distribution sections, where the lower part of the walls is subject to impact, they are protected by unglazed ceramic tiles of the floor type, up to a height of 1.0 metre. Smooth and well sized plastered walls could be covered with coats of enamel paints as soon as it is dry; light coloured points are most preferred but glare should be eliminated. Ceiling of the folded plates roofing is plastered with water-proof material, properly sized and severally coated in bright enamel paints. A highly gloss finish will reflect light and provide surface for easy cleaning.

COLD ROOMS

Cold rooms for milk and butter are kept at a temperature of $4^{\circ}C$ with the referigerated long-term storage rooms at $-15^{\circ}C$. Thermal insulation in the floor, wall and ceiling of these rooms are provided. Cellular forms of vulcanized rubber is used. Mositure penetration through joints is well taken care of by using water proof barriers (asphalt, bitumen) on the warm side, that is,

on the outside of the cold rooms. The internal finish of the room is done such that any moisture present can freely move to the cooling unit. The ceiling and upper part of the wall is therefore plastered while the lower part which is prone to damage is finished in easily replaceable materials. Hard surfaced asbestos cement sheets fixed on battens with protective wooden cover fillets are used.

'Frost heave' is of great concern to low temperature rooms. This is the disruption of the floor and possibly the wall foundations caused by water freezing in the soil underneath the room; thickness of floor insulation and underfllor heating helps.

DOORS AND WINDOWS:

Doors, windows and metal fittings associated with them are subject to ardous conditions in a milk plant. Stainless steel on a steel base are used for the doors; to reduce cost, galvanised steel doors are used on steel jambs. Cold room doors are thermally insulated like other parts of the room, the sealing surface which is on the face of the jamb is provided with rubber seals to prevent the ingress of air and water vapor. All door fittings are rustfree, waterproof, robust and be operatable from the inside for opening. Lighting is most needed in processing room, skylights are therefore provided apart from large factory windows. Windows are set open for fresh air, small mesh woven wire screen designed to allow window to be opened and made of non-rusting material are provided.

Painting:

Painting makes building attractive and creates an enticing working environment; it also extends life of structure. Primers or undercoats are therefore used to check moisture solutions which might wash the paints away. Fungicidal compounds are used on the building to check bacterial growth and phenolic is occassionally applied to check ants, mites and other pests attack.

Roof Inspection:

Roof should be inspected twice a year and every time after a storm. Prompt repairs prevents loss and great damages.

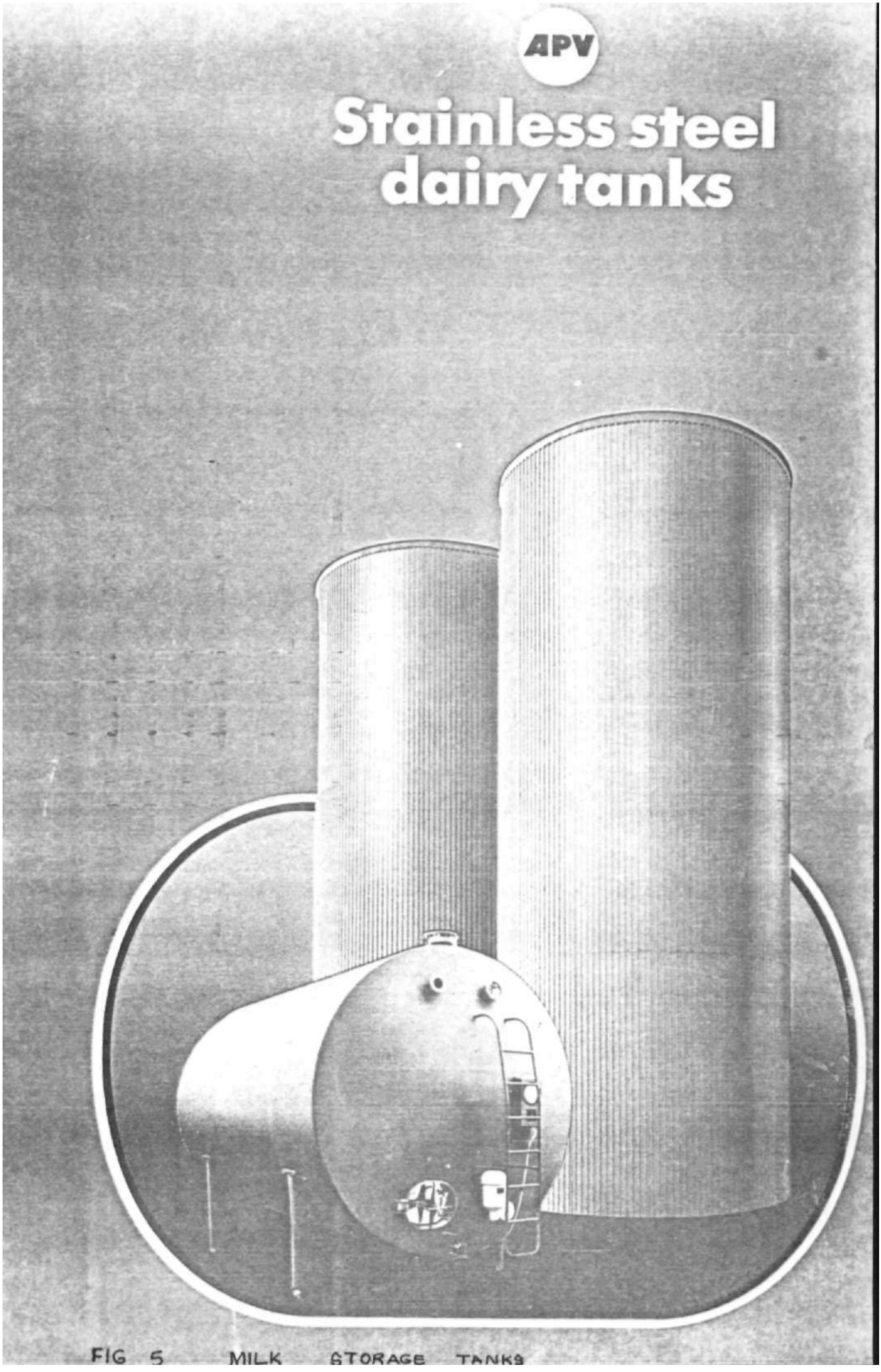


FIG 5 MILK STORAGE TANKS

CHAPTER EIGHT

THE DAIRY FARM: COW BREEDING, FEEDING AND HOUSING.

In order to ensure adequate and constant supply of raw milk for this industry, it has been proposed that a dairy farm be established, this would serve as a model for local cattle rearers who might come to the farm to learn modern techniques of cattle breeding and production. The farm would laise with educational establishments which are agricultrually related like the Institute of Agricultural Research, Samaru; International Institute of Tropical Research, Ibadan; for various researches into ways and means which can improve cattle breeding. Among other things, calf shed, calving pen, milking parlour would be provided. High quality yields from the animals can be ensured by immunization schemes, screening surveys for detection of chronic diseases, identification and correction of actual causes of diseases, quarantine restrictions could be placed on the movement of cattle suspected of being carriers, new stocks should therefore be separated from the already 'clean' ones so that any incubating disease would have developed to a clinical stage.

The modern dairy absorbs a lot of capital tied up in its stock, land and equipment and efficient control and monitoring system. Maximising the use of resources is always crucial and ensuring maximum economic milk production per cow per year must be everyone's main aim.

The University of Reading in England have developed the Dairy Information System (DAISY) which is a recording and reporting system that operates on any of 50 micro computers. By regularly feeding the Daisy with straight forward facts on any cow as they occur such as calvings, services, veterinary treatments, incidence of such problems as mastitis, lameness and milk fever, the operator has a complete and easily accessible record of a cow's life history. Daisy can also keep full records of any simple milk yeild recording taken for the cow on say a weekly or fortnightly basis. Daisy reports could be used by herdsmen, veterinary surgeon and others. The aim of any good information system is to allow records to be easily kept, updated, corrected where necessary and then stored. Analysis should be easy and it be possible to aggregate records in several different ways without the original data being spoilt, a good earding system operated by well trained staff could serve but computerised systems containing features that bring an educated and modern approach to the keeping and display of information, either in printed form or on the computer. is most desired.

This Daisy proposal could be well researched into and be adopted for use in Nigeria. Reports such as these would be obtained from the use of this DAISY:

- Cows due to be dried off
- Cows due to calve
- Cows not yet served after calving
- Cows served and due for pregnancy diagnosis
- Cows pregnancy diagnosis in calf but having an odd event aftermath (for example abortion)
- Cows that the Doctor must see at next visit
- Cows on barren list

Reports could also be obtained on such features of conception rate as:

by different bulls

by day of the week

by grouping of the animal

by service number

If the system is properly applied, calving intervals can usually be shortened by an average of 10-20 days, bringing them closer to the optimum of a calf a cow per year. The advantages over other schemes have been the much deeper level of analysis that can be carried out using the DAISY and the flexibility of the printouts. In herds of 1500 cows, it is a great help to have the lists of cows at the top of the list-rather than simply in cow number order.

Morever, cows can receive timely attention. Users find the reports particularly useful when someone running the system has scanned them and marked them sutably to highlight the problem areas. I therefore intend to have a bureau service using a four-terminal mini-computer operated by a consortium of commcercial and farming interests (as proposed for Zimbabwe). The service would operate on a short turn-round and would be able to cope with village settlement herds as well as large dairy herds in the environ of Offa. The plan is therefore to integrate the advisory services closely with the scheme and to involve the milk collection services in the delivery of print-outs to the farms.

The concept of a local service from a shared machine has a lot to commend it.

A bureau service would be operated by a dedicated specialist whose job it is to ensure that good quality records are entered into DAISY regularly. The specialist needs be an animal production one so that he can recognise information that is wrongly recorded by a herdsman. The bureau operator can also bring to the attention of the farmer areas of his management of the herd that needs urgent attention.

Limitations to the successful implementation of this scheme borders on availability of fund, hardware engineering support and software support. Clearly, these requirements are no minor undertaking but where the scale of the national dairy enterprise warrants it, the improvements brought about in productivity can be quite massive and out weigh the costs of setting up and running the scheme; the engineering problem and software supports could be easily overcome by training staffs at the University of Reading, England, where the system originated, the acquired technology could then be adopted to a Nigerian situation.

On a good managed farm about 90% of the milking cows will bring a calf each year. Of the young calves, a certain percentage will not survive the first months. It is quite reasonable to calculate with 160 cows a year on a farm of 200 cows; of course half of this number is male. The male calves will leave the farm after a few weeks, while the female are retained. In a normal situation, young cattle can be pregnant about 15 months after birth and bring their first calve at an age of two years.

A pregnant milking kow should not be milked during two months before the expected date of birth, this means that an average number of 24 cows is not milked.

So on a 200 cows farm, there will be

1. 168 cows to be milked
2. 24 dry cows
3. 40 calves younger than 6 months
4. 60 calves from 6-15 months
5. 60 pregnant (heifers) cows 15-24 months

In practise, some cows under (4) and (5) would be sold since some would be of lowest quality. Hence, one may expect:

200 x 0.9 = 180 births, milking cows

44 x 0.9 = 40 births, heifers
TOTAL = 220

Birth will take place in a maternity, assuming each birth takes an average time in the maternity for one and a half weeks, number of stables required would be $\frac{220 \times \frac{3}{2}}{52} = 6.0$ stables

In practise, birth would not be so nice linear in time so a reserve factor of say 2, is needed. Looking at the farm layout, I would need:

160 places for milking cows
24 places for dry cows
12 places in maternity
4 places in sickbay
40 places for young calves, 3 months
60 places for calves 3-15 months
44 places for young cattle/heifers 15-24 months.

Breeding:

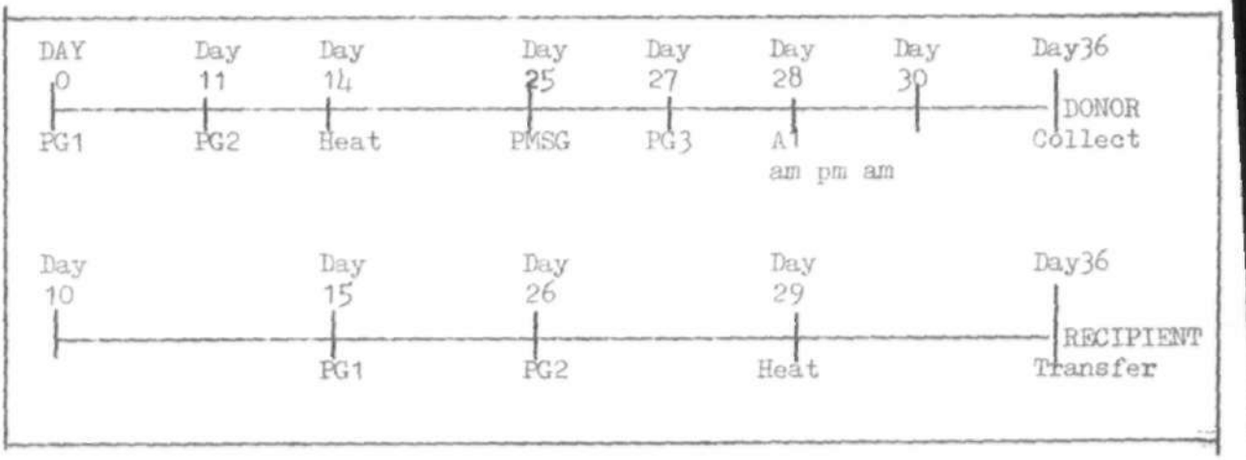
Cows may be bred either naturally or artificially. To ensure high productivity both in animal and milk yields and to encourage healthy, more disease resistant breeds, artificia insemination by embryo transfer technique would be utilized.

It has been observed that with embryo transfer the potential fecundity of a cow has been, on the average increased nearly ten fold, from just under one living calf a year to eight surviving calves. In the dairy herd, this capability can be used in two ways: either to increase selection intensity or to decrease the generation interval; over 500 embryos have been exported to African countries including Kenya and Zimbabwe and the leading organization involved in the transfer of calf embryos from high quality cows to lower quality recipient cows is the British Livestock Embryos. Advantages of this system include disease control, rapidity of genetic progress, lower transportation costs compared to those involved in slipping calves or adult cattle, and for Nigeria, embryo transfer provides for the multiplication of progency from selected cows of indigenous African breeds.

The technique is a combination of five basic steps: observing heats by the donor cow, super ovulation by the donor cow, fertilization of the ova, collection of the embryos, transfer of the embryos to the recipients.

PG: PROSTAGLANDIN INJECTIONS
PMSG: PREGNANT MARE SERUM GONADATROPIN (fertility drug)

PROGRAMME FOR DONORS AND RECIPIENTS FROM THE FIRST DONOR INJECTION TO THE DONOR FLUSHING.



The actual transfer of the embryo to the recipient is via a small flank incision under local anaesthesia. The recipient is first examined per rectum to determine on what side she has ovulated, and the embryo is then transferred to the uterine horn on the side of which she has ovulated. Each operation lasts about five minutes.

The donor will be one heat on average 10 days after the flushing day, but some will be on heat three to four days later - some even up to 14 days. The first heat after flushing is normally a very fertile heat and if the intention is to put the donor back in calf she should be served at this time.

If a cow is receive to a donor again, it is preferable for her to have two heats after flushing before she is programmed again. This means that the interval between flushing is an average 45-60 days. It is possible to flush donors at 30-35 days interval but this is not advisable with all cows.

FEEDING

The Cattle are fed by fresh grass with some concerntrates like corn-meal, guinea corn, groundnut cake, cotton seed and others including dry fish during the rainy season and dry grass (hay) preserved grass.

Three broad feeding methods could be identified: Free Range, semi-intensive and the intensive or zero Grazing. Aftert from this broad classification, each feeding system is characterized by different kinds of actual feeding.

and, because of the large area, the application can be done quickly and evenly.

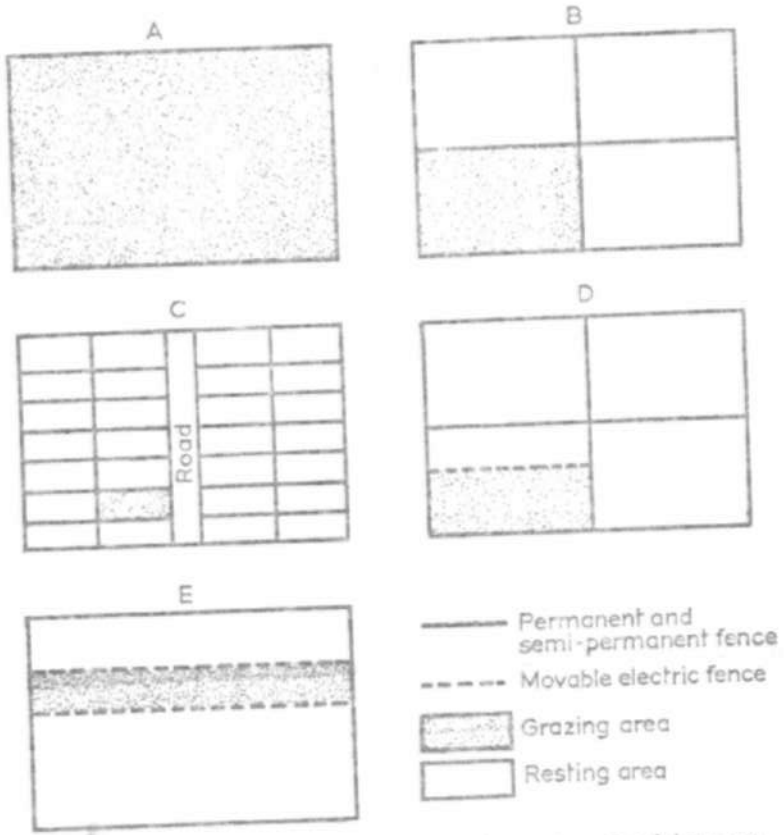


Fig. 4. Diagrammatic layout of five grazing systems for dairy cows
Key: A = continuous grazing or set stocking; B = rotational grazing with 4 7-day paddocks; C = paddock grazing with 28 1-day paddocks; D = rigid rotational grazing system with 4 paddocks each grazed for 7 days with front electric fence; E = strip grazing with a front and a back electric fence

Stocking Rate for Continuous Grazing

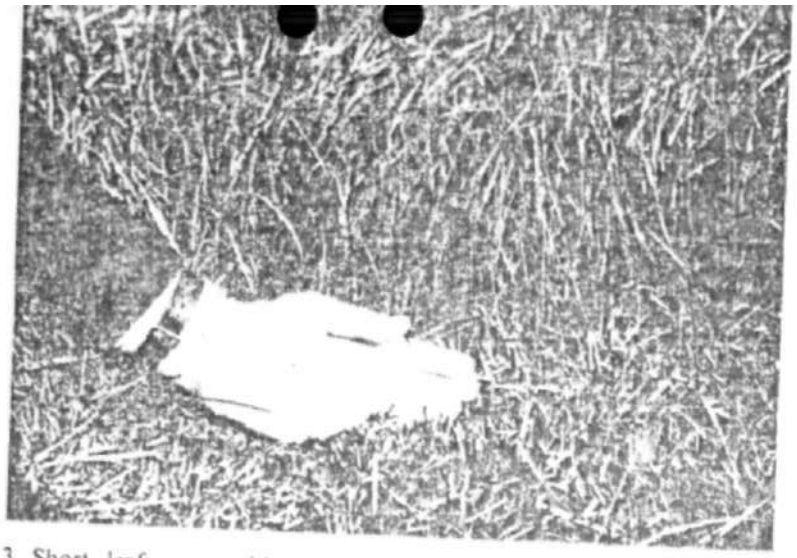
Stocking rate, i.e. the number of cows per ha, is a vital factor in this, and indeed in all grazing systems. Should the sward be overstocked,

the cows will not eat enough herbage and milk yields will fall. On the other hand, with a low rate of stocking the herbage will become mature, and although the cows may select an adequate diet and maintain milk yields, the output of milk per ha will be low. Thus for success, the stocking rate must not be fixed for the entire season, but vary in order to match the needs of the cows with the production of the sward. Over the whole grazing season a stocking rate of 5 cows per ha is desirable.

It is stressed that this is an average rate, and a herd calving in spring may be stocked fully with 4 cows per ha. Conversely, an autumn-calved herd may be stocked at a higher rate. Overall stocking rate depends on the yield of herbage, which is itself a reflection of many factors which include the soil fertility, the fertilizer input, the rainfall and sward quality. Flexibility of stocking rate within the grazing season will generally mean that the area allowed per animal will increase slowly but steadily as the season progresses. In April and May, when the grass is growing rapidly, 6 to 7 cows per ha may be needed; whereas in August and September, 2 to 3 cows per ha may be adequate. As cow numbers in a dairy herd are normally static, the variation in stocking rate is made by increasing the grazing area by bringing in aftermaths from the fields cut for conservation. As in all systems of grazing, the management of the grass must be dictated by the output of milk and the condition of the cows.

Leys containing pasture types of perennial ryegrass such as S23, and permanent pasture with productive grasses, are ideal for continuous grazing. Swards will thicken and improve with continuous grazing if stocking rate is controlled and adequate amounts of balanced fertilizer are applied. Grazing should not be delayed in the spring until too much herbage is available to the cows, and the grass should be allowed to grow to the cows.

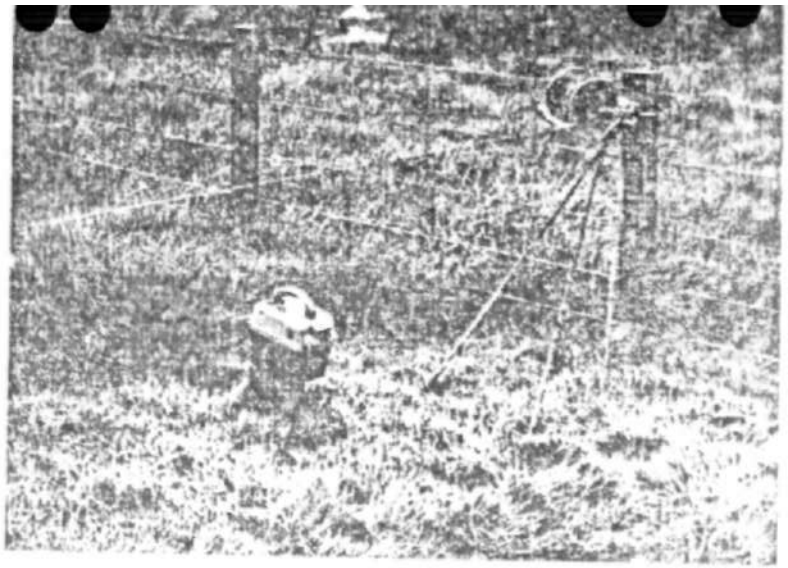
Continuous grazing requires less fencing and labour than other systems, but the cows may be scattered over a wide area, and rounding them up at milking time can be tedious and time-consuming. Probably the biggest disadvantage of the system is that milk production per ha is often 10 to 15 per cent lower than on a rotational system of grazing at the same stocking rate. As the rate of stocking increases, the difference in output between continuous grazing and rotational grazing will increase, and at times of severe grass shortage the continuous grazing system can 'break'. Nevertheless, the system has a definite place for many milk producers. An output of over



3. Short, leafy grass with no seed heads has a D-value of 70 and over (*Chapter 3*).



4. Tall, stemmy grass with the heads fully emerged has a D-value of only 55 (*Chapter 3*).



5. Equipment for electric fencing includes a tripod, reel and battery unit (*Chapter 4*).



6. Strip-grazing with an electric fence enables the correct amount of herbage to be given to the herd each day (*Chapter 4*).

FIG 7 CATTLE FEEDS: ELECTRIC FENCE STRIP GRAZING

FREE RANGE

Practied by the local herdsman and the Fulani, the cattle are taken out to graze on open land during the day and returned back either to a shed or tied down in the open. This exposes the cows to diseases and inclement weather.

SEMI-INTENSIVE

Cattles are taken out occasionally for feeding in the open when the weather permits but feeding is mainly done indoors. This method is used by many ranches.

INTENSIVE OR ZERO-GRAZING

The cattle are kept permanently indoors. Feeding, exercising, breeding, calfing and all other processes take place right inside houses provided for same.

In this work, the semi-intensive system would be adopted, grazing land of high quality fodder would be provided in the ranch and the cattles be allowed a breathe of sunlight and fresh air in the grazing land provided. Silos would be provided for storage of feeds.

Before calculating ration for cows an estimate of the dry matter intake must be made. A general guide is to allow 2.5 to 3.0kg dry matter per day per 100kg liveweight, but factors such as milk yield, stage of lactation, type of ration and method of feeding also affect intake, and allowance must be made for them in determining the ration. At calving, the dry matter intake of cows is normally at a minimum with a progressive increase to a maximum at 4 to 5 months after calving.

After this peak, this intake declines slowly as the lactation advances.

For cows, 600kg liveweight and producing 20kg milk per day in mid and late lactation, dry matter intake is 17kg dry matter per day. This is less, about 15kg, for cows in early lactation. To increase nutrient intake, foods of the highest digestibility should be given.

Grassland can produce high yields of dry matter and digestible nutrients per hectare if it is treated as a crop and well managed. Potential yield of milk from grass is high if sufficient grass is available and an efficient system of grazing is adopted. A friesan cow weighing 600kg and with an intake of 3kg dry matter per 100kg liveweight can eat 18kg of herbage dry matter per day which can supply 218 megajoules (MJ). This energy amount is sufficient to maintain the cow, give a liveweight gain of 0.5kg per day and produce up to 10kg milk per day. Yields of 10,000kg milk per hectare is expected from the ranch on the site using strip grazing system. An electric fence is moved forward either once or twice per day to allow the cows a sufficient ration of fresh grass to maintain a normal pattern of milk yield without any sudden day to day fluctuations. Skillfully operated, this method is the possible best. Planning involve where and how to apply fertilizer, resting area and movement of silage and hay. If a field is to be grazed for more than one week, then an additional back fence to the front one is necessary. Fences are moved when cattle are out of fields. To utilized the herbage efficiently, it is wise to give the herd a long, narrow strip of fresh grass at each grazing.

This avoids the soiling and treading of herbage and decreases wastage. Conventional post and wire (barbed) fencing involving 75mm x 75mm posts at 2m intervals with 3 wires would be utilized. Movable electric fence comprises of metal post with a foot and an insulator, carrying electricity, about 750mm above ground level with the metal posts at 10-20m interval. Wire is strained in order to reduce number of posts and wire used. Wire height is about 1.5 metres.

HOUSING

BARNS OR CATTLE HOUSE: Planning of the cattle house should aim at reducing the time required in caring for a cow and keeping the total equipment expenses to the minimum but at an efficient productivity level. Three main ways of housing cattlex are:

(i) Stanction barn

(ii) Loose housing

(iii) Free-stall

(i) Stanction Barn. This is of two types:

the single and double story barns

In the double storey barn, feeds especially the roughages are stored on the upper fldor while the lower floor is used for housing the cattle. Thus the feeds can be moved down using gravity or system of pulleys. The commonly used single storey barns requires less storage room per ton of feed and has the advantage of less windstorm hazards, fire risk to minimal, it is easier and cheaper to build and easy repair or maintenance required. Length of stalls provided for the cows depend on their sizes and whether or not electric framer is to be used. The cattles are usually kept indoors.

(ii) Loose Housing: This is a flexible design which allows stall sizes to be changed whenever and wherever deemed fit. The cows are free and have access to fresh air and sunlight. It consists of:

(a) Feeding and feed storage - this is a paved area with manger so constructed to prevent cows from pulling out the hay and lying on them. The hay is stored at the rear of the shed with movable feed rack as the manger.

(b) Paved Area - this is an open space where the cattles may 'stretch-out' at, it could also be used as the sillage feeding area, the manure from the feeds could then be easily cleaned and used as fertilizer.

(c) Loafing Area - This is a heavily bedded area, where the cow can rest, the cow's udder shouldn't be allowed to tough the bare ground whenever they are resting.

(iii) Free-Stall: Constructed in wood or steel, the stalls are separate compartments and cows can easily enter them from alleys behind the stalls. Manures in the alley can be easily removed.

For the purpose of this work, the stanchion barn would be preferred. Feeding and fodder would be mechanically brought into the stalls; water buckets would be fixed to stanchion columns and an electric tramer, a coat-hanger device, would be suspended above

MILK PARLOUR:

Milking the cow in Nigeria is done manually especially by the Fulanis. This practise should be discouraged as the milk so collected is contaminated and the exercise itself is laborous. Generally, a modern milking parlour as being proposed, should follow these guidelines:

(a) Walls should be of concrete, block, brick, wood or any other solid material

(b) house should be well ventillated and lighted

(c) window area should be at least 10% of floor area

(d) Insulation to check heat should be provided

(e) Floor made of concrete or other easy to clean flooring material and sloped to drain, with gutters

(f) Size varies with number of cows to be milked at a time; the milk parlour should be located near the milking area but not opening directly into it.

There are three methods of meeting these requirements of milking parlour:

(1) Tandem - the milker works in a pit while the cows are in stalls set in tandem and arranged around a square or in banks with the milker working in the centre. This parlour is expensive to construct, requires greater washing and cleansing, each stall should be provided with a separate milking stall and is bedevilled by the constraint of feeding by hand.

(2) Floor level abreast type: This is of two types - the single level and the double level abreast walk - through. The single is most common and allows one milker to milk 60 cows at a time. It is arranged in such a way that while a milking machine unit at a bail is being used for milking a cow, the other side could be used to wash another cow. Concerntrates are given manually or mechanically, and the floor slopes away from the bails either in front or behind the cows. The double level abreast differs in that the milkder works at a lower level than the cow stand.

(3) Herringbone type: the cows are milked in batches with the cows placed side by side at a suitable angel in 2 rows. Concertrates are distributed by machine and the milker works at a lower level than the cow stands.

Rotary Milking

Designed by an Italian company, this allows the milking of about 1500 cows in 3 days - about 20 cows per hour. The parlour is circular in plan with two concerntric platforms. The outer one is made of concrete while the inner one, made of metal grating and free to rotate, houses the cow bails and milking machines. Cows to be milked are first passed unto the first platform where their udders are sprayed, washed and dried with sterilized cloth and then inspected before being released for milking. By the time of half revolution of the platform, a cow could be milked out and ready to be released finally. This system would be adopted in this work.

HOLDING PEN/WAITING SPACE

This is an area where the cow can relax before and after milking. Each cow is allowed an area of 2 square metres. The shed should be rectangular in shape, must be clean and the cows udder always prevented from touching the ground.

Milk House

This is a referigerated storage tank for milk pending its collection by factory trucks. The size is determined by the number of herds; 18-20 cows require 12-18 square metres area; wash vats, water heater, can and cover rack (unless bulk storage is used), work counter and pipes, cleaning and storage areas should be provided. The house could be constructed of concrete, cement or concrete block, or brick and should be well ventilated and lighted. The window area should be well ventilated and lighted. The window area should be 10 per cent of the floor area and the floor be made of concrete or any easy to clean flooring material laid to slope into a gutter provided. The milk house should be near the milking area but must not open directly into it. Bacteria grows rapidly on warm milk, collected milk should therefore be stored at temperatures not exceeding $50^{\circ}F$ electric coolers are recommended otherwise very cold running water might be used.

There are two methods by which the coolers may be used: the can and bulk type of storages.

In the can type, the milk is stored in cans of say 50 litres and these are then placed in the cooler while in the bulk type, the milk is pumped into a referigerated tank, this eliminates the use

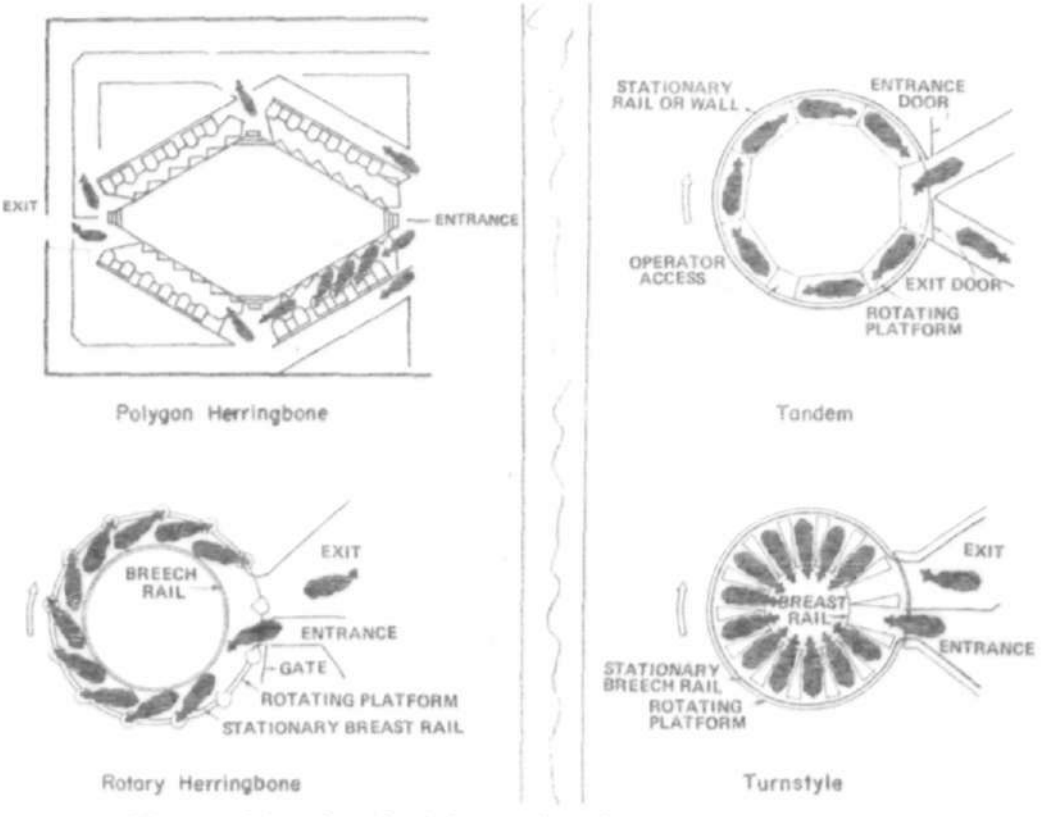


FIG. 22.19 Diagrams of the polygon herringbone parlor and 3 different types of rotary parlors.

of cans and the milk is immediately cooled, large referigerated trucks would be required to transport milk so collected to the industry.

CHAPTER NINE

MILK - PRODUCTION, COLLECTION AND PROCESSING.

Officially there are about one million cattle in Kwara State but the real figure might be more than this because the veterinary department may not be aware of small cattle holdings, moreover, herdsmen usually dont give accurate figures of the number of cattle they have due to the jangali tax to be paid on them. There are six types of cattle in Kwara State:

White Fulani	46%
Khaji	33%
Muturu	50%
Keteku	4%
Adama	2%
Gudali	10%

Their milk production varies -

(1) White Fulani: usually are white big cows with black patches. A five year old one yields about 50-55% milk and weighs 1,100-1,200lbs in 8 months, milk yield may increase to 2,200lbs with a fat content of 5.75%.. First calving (giving birth first calf) occurs at the age of 42-43 months and after calving lactation (secrelion of milk from the mammary glands) takes place. The period between successive calving is nearly 13 months and lactation period ends approximately 8 months during which period about 1,900 lbs of milk may be produced.

With a specific gravity of 1.0313 volume of milk produced could be calculated:

(2) Rahaji - a cattle with long limbs, it has a spotted red coat. The male may waigh 11001b while the female 10001b.

(3) Gudali - This is a cattle type with a long and narrow head with an average height. Its red coat has white patches on the head and under the part of the body. The male weighs 9001b and 8991bs for the female. Calving is mainly higher, April 11.3%, July 13%, September to October, 33.8%

Tropical breeds are generally considered poor milk producers hence the essence of cross breeding of local and foreign cattles to produce new breeds which are more adaptable and productive. Mostly, the foreign breed used in Nigeria for this purpose is the Friezan.

TABLE A:

CROSS-BREEDING WHITE FULANI AND FRIEZAN

TYPE	NUMBER OF ANIMALS	AVERAGE AGE (MONTHS)
WHITE FULANI (W.F.	65	45.4
½ FRIEZAN/W.F.	71	30.9
¾ FRIEZAN/W.F.	26	30.0
FRIEZAN	46	28.7

Table shows the average of each breed at instance of first delivery. Neglecting the difference between the ½ and ¾ breeds, one can clearly see the somatic and sussable preciousness of this exercise.

TABLE B:

WEGHT (KG) AT DIFFERENT AGES

TYPE	6 MONTHS	12MONTHS	24MONTHS	36MONTHS
WHITE FULANI(W.F.)	95	138	241	312
½ Friezan/W.F.	153	230	314	-
¾ Friezan/W.F.	165	251	456	-
Friezan	-	323	473	-

It would be noticed that the ½ breeds reached the ideal weight for the first mating 12 months earlier than pure breed white fulani (W.F.) The difference between the ½ breeds and ¾ breeds are considerable here and is to the advantage of the ¾ breed.

TABLE C:

MILK YIELD AT FIRS LACTATION

TYPE	DAYS OF LACTATION	MILK(KG)	% (W.F.=100)
White Fulani(WF)	251	775±54	100
½ Friezan(W.F.	300	1638±70	212
¾ Friezan/W.F.	263	1690±162	218
Friezen	297	2261±118	292

TABLE D:

MILK YIELD AT OTHER LACTATION

TYPE	DAYS OF LACTATION	MILK(KG)	%(W.F.=100)
White Friezan (W.F.)	246	837±17	100
½ Friezan/W.F.	271	1690±34	202
¾ Friezan/W.F.	262	1898±93	227
Friezan	281	2434±72	291

These data indicate that cross breeding with Friesan breeds has contributed almost double the yields at the half breeds.

TABLE E:

INTERVAL BETWEEN DELIVERIES, DURATION OF LACTATION AND LACTATION PERCENTAGE IN PERIOD BETWEEN DELIVERIES.

TYPE	INTERVAL BETWEEN DELIVERIES (DAYS)	DURATION OF LACTATION (DAYS)	% LACTATION IN PERIOD BETWEEN DELIVERIES
WHITE FULANI (W.F.)	367	246	67.1
½ Friezan/W.F.	358	271	75.7
¾ Friezan/W.F.	348	262	75.4
Friezan	368	281	76.4

This shows that the delivery intervals is shorter in half and three - quarters (½ and ¾) breeds and there is a reduction in the productive period of the cows.

TABLE F:

WEIGHT OF CATTLES AT BIRTH IN KILOGRAM

TYPE	MALE	FEMALE
WHITE FULANI	24.2	23.5
½ Friezan/W.F.	28.9	27.8
¾ Friezan/W.F.	31.9	30.7
Friezan	35.8	34.1

TABLE G:

PRODUCTION RECORD AT FIRST CALVING

TYPE	AGE (MONGH
Pure Gudali	48
Gudali/Rehaji	47

At peak of calving, usually in March-April, about 29% yield is obtainable. Among Among Gudali/Rehaji cross breeds, majority calving fall within a 47% yield. The average interval between calving is 557 days (18 months) for the Gudali, 404 days (13-14months) for the Rahaji while for the Gudali/ Rahaji cross breeds, it is 518 days (17 months)

LACTATION PERIOD:

TYPE	LACTATION PERIOD (DAYS)
Rahaji	250
Gudali	300
White Fulani	241
Gudali/Rahaji	290

It is pertinent to note here that not all the milk produced by the cows are used by the plant, certainly some parts are consumed by the offsprings - calves.

MILK CONSUMED BY CALVES

TYPE	WEIGHT CONSUMED (LBS)
Rahaji	1511 LBS
Rahaji/Gudali	1517
Gudali	1542

The milk consumed by a calf increases as its weight and it can be calculated that average total production for each lactation should be:

Rahaji	2275 LBS
Gudali	2281 LBS
Rahaji/Gudali	2306 LBS
White Fulani	2200 LBS

These figures were calculated from data given by experimental ranches; direct data was obtained from milk consumed by calves while indirect data was obtained from milk provided by animals f at each milking. From these analysis, the various collection centres and that owned by the factory, it is hoped that a constant supply of 200,000 litres production by the factory would be satisfactorily met.

MILK COLLECTION:

A three stage co-operative system backed by the United Nations funds is being operated in Kenya, Poland and India. Collection centres for 150-300 farmers are provided, the milk so collected is then transported by tankers to the dairy industrial plant.

The search for better alternatives to this system involves examining ways of inspecting sources of milk infection at each stage in the chain, working out the best production and collection systems in practise, devising milk classification and alternative quality payment methods and to develop appropriate educational advisory services.

Generally, there are many methods by which milk to be used by a plant could be collected or obtained. Most plants utilize more than one means, the method often adopted is resultant of the production capacity:

(a) Local producers bring milk to plant where they are weighed and then paid. Milk so collected could be easily checked for any contamination, however such supplies are unreliable and often inadequate.

(b) Collection centres may be provided by plant at strategic places where local producers could easily take their milk to for sale. Milk so collected must be stored at a controlled temperature of say, $4^{\circ}C$ until it is collected by a vehicle from the plant. Contamination during milking is inevitable.

(c) Milking trucks might be sent to cattle ranches where milk collected per cow is recorded by a scale fixed to the vehicle. This modern method is effective and could be arrived out at a rate of 1 cow per minute. Usually, milking can be done twice: once in morning and later at evening.

(d) The plant may breed its own cattles under scientific, hygienic and modern techniques. This would ensure constant and adequate supply of starting material for the plant. The cattles would be properly looked after, cross-breeding and embryo transfer could be practise.

For the purpose of (b) and (d) would be adopted because of the need to avoid contamination and insufficiency of supplies emancipating from inadequate and irregular milk procurement methods.

The milk would be collected by trucks with capacity of about 20000 litres and with a total milk capacity of 200,000 litres, the plant would require:

$$\frac{200,000}{20,000} = 10 \text{ collecting trucks.}$$

This number could be reduced bearing in mind the other method of procurement. There will be ten collecting centres each with a capacity of supplying 20,000 litres of milk from 2 shifts per day.

MILK PROCESSING

Milk has a breakdown composition of

Water 87%

Protein 3.4%

Fat 3.66%

Ash 0.71%

Lactose 4.72%

From this, milk can be seen to consist in $\frac{2}{3}$ of its solid part, fat and sugar which are major source of body energy, moreover, the milk casein and lactose bumin are of superior quality than the proten obtainable from vegetable.

The projected capacity of the plant takes into cognisance the market situation, milk availability, milk importation level, attitude of consumers, cost in terms of milk equivalent, nutritional needs of the average Nigerian; the 200,000 litres capacity would be used in producing.

Yoghurt	20%
Ice Cream	20%
Milk Powder	35%
Pasteurized Milk	20%
Butter	5%

MILK

The collected milk is pumped by a pumping machine to the storage tank from where the milk is passed on to the clarifier which removes foreign materials from the milk and checks disease producing bacterial growth. These processes take place at temperatures below $32^{\circ}C$ and this does not affect the milks creaming character; contamination is therefore reduced to the barest minimum. Each of the clarifier has a capacity of 7,500 litres per hour. The clarified milk from the clarifier is passed to the Pre-Coolers at a temperature of $4^{\circ}C$. Milk souring bacteria which converts lactose of the milk to lactic acid is made inactive. With a capacity of 15000 litres per hour, each pre-cooler would require two clarifiers.

From the pre-cooler, the milk is transferred to the Pasteurizer where the milk is heated to destroy any living organism that might have remained in the milk, without changing the milk's property; this process is followed by cooling to check growth of bacteria which is catalysed by warm and moist environment.

Pasteurization can be achieved either by rapid boiling of the milk to a temperature slightly above its boiling point and keeping the temperature constant for a period of 15-20 minutes or by boiling the milk to a temperature one-and-a-half times its boiling point and keeping the temperature constant for a period of 5-7.5 minutes. Because of high risk of over-heating involved in the latter, the former method is preferred. The pasteurized milk is bacteria-free, consumable and can be kept for a long period without danger ot spoilt. It is this milk that is used in the production of all the dairy products.

Pasteurized Standard Milk: This is obtained by passing the pasteurized milk into separators designed to produce milk of required percentage of fat. From the separator, the milk is transferred into storage tanks where it is made available for consumption through bottles or paper jackets. Paper jackets are to be used here.

2. YOGHURT: Pasteurized milk is pumped to the homogenizer which breaks the large particles in the milk into smaller ones and eliminates fat agglomeration. In effect, it produces a uniform milk with fat and other solids evenly dispersed throughout the milk. It is then passed into the separator where the cream of the milk is separated and skimmed milk left. This is essential because the milk used for yoghurt must not contain any or if it should contain at all, 0.05% only. The cream separated from the whole milk can be used for making cheese or butter. The skimmed milk is passed through incubation tanks at a temperature under 42.$^{\circ}$C. Quality control test is carried on the mil at this stage by either a PH test (4.1-4.5 acidity) or titrable test. About 1-2% starter is added on to the milk.

This starter, obtained by adding yoghurt to a certain catalyst, catalyses the exeretion of a bacteria which acts on the milk to form yoghurt. This process is referred to as innoculation. The agitator is stopped for 3-4 hours before cooling to improve upon the viscosity of the yoghurt being produced. The yoghurt is then passed through plate lockers where it is cooled to 2°C before being pumped into storage tanks at the same temperature. Paper packets are filled by Aseptic fillers and packages are finally packed into boxes of 48 packets and kept at cold storage using the conveyor.

3. BUTTER: This is a fatty product derived from milk fat, water and salt (if salted butter) and solid fat (curd). The standard percentage is as follows:

Not less than 80% by weight of milk fat	-	81.31%
Not more than 2% by weight of curd	-	1.03%
Not more than 16% by weight of water	-	15.35%
Not more than 2.5% by weight of salt	-	2.31%

Lactic acid cultures and vegetables colouring matter are aded as flavours. The pasteurized milk is passed into cream balance tank. Cream obtained during the process of producing yoghurt can also be added into the tank. The cream is passed into a pasteurizer, so as to improve upon its quality which must be consistent even at long storage periods, from where it goes into the Ripening vats. Here souring occurs by fermentation and the cream is held for few hours after when it is transferred to butter churns, butter is finally produced by agitating the cream at very high centrifugal forces.

The butter is moulded into required shapes by the moulder and hardened in the hardening room from where it is passed to the wrapper and finally the cold store.

4. ICE CREAM: This consists of milk, fat, solid serum, sugar (as a stabilizer or binder to prevent formation of water arystals) flavouring and colouring materials which differs from industry to industry. It is the last two items that gives ice-cream its different final character or quality to the consumers; research is therefore always carried on means of improving the quality through this channel. The ingredients are put into a mixing tank and then into a patch pasteurizer. The mixture is homogenized and finally cooled. The mixture is then transferred into Ageing Vats for a period of 4-24 hours depending on the milk's determined acidic content (the higher the acidity the shorter the period). Ageing improves the ice-cream's viscosity and gives it a smooth appearance. From the ageing vats the mixture is transferred to the feezer where it is frozen and mixed in a special mixer. After being mixed and frozen, the ice-cream is cut and wrapped and taken to the Hardening section where it is hardened before being placed at the cold storage.

5. DRY OR POWDERED MILK: This is pure, fresh and standardized milk in the powdery form and therefore has the same constituents as in fresh liquid milk. It is produced by heating the pasteurized milk to the vapourising temperature of water ($100^{o}C$) and maintained at this temperature for as long as desired depending upon the quantity of the milk being evaporated. Samples are taken from time to time during this process to check if the required composition has been attained.

Condensed milk is produced at this stage and the milk is passed on to the Roller Drier, an evaporator which removes all the remaining water. The powder is sifted through sieves before the powdered milk is finally packed into cans by means of a weighing filler which ensures that equal amount is packed into all cans. Powdered milk can be stored at normal room temperature in the solid department of the storage facilities.

HANDLING:

Materials have to be moved from incoming freight vehicle to the reception dock then on to starting material storage. From here, it goes on to the milk treatment and process area and then to other process sections before being taken to the final storage and then out again for despatch. During their trip through the plant, the material is picked up and put down many times and since these do not change the form of the product, they constitute a waste. Handling may be wasteful but there is no way one can totally eliminate it in the production of a product but one should cut it down whenever and wherever possible both within and between operations. Materials handling costs within operations is high and attempt should always be made at curbing it; moving materials between operations is also recognised as costly and so are delays to production workers from materials not being on hand, loading and unloading by hand, handling part loads and returning empties. It is hard nailing down every possible saving when the work is so varied, as in the production process of dairy factory, but companies which have really tried to handle materials more efficiently have been able to cut costs considerably.

Handling costs can be reduced by consulting foremen and supervisors as to which and what areas could be eliminated. However, the best way to handle materials is not to handle them but then at certain areas this is impossible, what then could be done is to hands-off handling-handling without the hand. Material handling costs can be cut by eliminating the handling itself whenever possible or using conveyors and power driven trucks whatever handling still remains or making the necessary handling more efficient.

Men and machines combine to make products out of some starting materials. The three have to be brought together. In the dairy industry, the products move away but the machines and men remain. Therefore handling method to be employed should take cognisance of this and make provision for.by applying automation.

Automation is the automatic handling of materials and parts between process operations. Most automation at this time comprises the automatic handling of quantities of material over series of single-purpose production machines or equipments. Automation is used where production is high, processes are simple and straight forward and the product easy to move; self regulating machines do correct themselves when they err. Power and gravity coveyors are widely used in the milk plant for milk cans, bottles, crates, pallets and packaged products of many kinds. They may be independent units transporting the commodity concerned from one machine to the next or from one room to another. In certain cases the conveyor may in addition, form part of the machine concerned, as in case of fillers.

The working surface of the conveyor must be at a height to facilitate any operations.

Since the medium being used in this industry is fluid in nature, pipes are mainly going to be used to carry milk from one stage of production to the other. It is only at the final stage of production, that is the packing area where conveyors are used, for instance from fillers to wrappers to stackers and packing to cartons before being finally carried to storage.

CHAPTER TEN

DESIGN OF INTERNAL AND EXTERNAL SPACE TO THE REQUIREMENT OF PRODUCTION PROCESSES.

THE disposition of the various parts of a plant along with equipments and machineries used therein must be to the requirements of production process. This, in the food industry, calls for understanding of biological process in the production, basic problems of storage, handling of starting and finished materials as well as an appreciation of public health.

Milk and milk products however, impose special requirements which do not occur elsewhere. These requirements affect the structure and the layout of the buildings, the provision and distribution of services. The provision of external and internal space should aim at efficiency and effectiveness by meeting the requirements of capacity and quality in the most economic way. In the main, one might be tempted to overlook the production requirements on external space but when one recalls that the processes are to be manned, then the need for comfortable and suitable external space requires no stressing if boredom, mental and physical fatique and consequent wastage of corporate time were to be avoided. This is why recreational, social and welfare and acilliary spaces have been provided apart from the production space. These have salutory impact on the workers and employees and serves as an enticement. They help in acquisition and retainment of trained and skillful employees. Provision of external space also create a sense of well being among the staff and command the approval of the community.

The overall sizes of these spaces are determined by the number of workers while the individual spaces within any of the facilities provided would be affected by the function that takes place in it. Each of these facilities is housed in a different building and are linked to each other by covered walkways. The office accommodation is located near the main entrance and provides accommodation for administration, technical, managerial and auxilliary staffs needed to fulfil the requirements of the dairy production processes. Separating the offices from the production space costs more than placing them on an upper floor but such an arrangement is unhealthy, ventilation and lighting as required by the production process would be inadequately catered for, and disturbances from machinery and transport would be high. Furthermore, callers to the offices would have to pass through the milk plants where there may be activity and thereby be exposed to risks. The social and welfare facilities are placed at reasonable distance away from the production hall with the changing rooms and toilets being closest to the production space. This ensures that less time is wasted and truancy is discouraged.

Although external space is essential to productivity, internal space is of paramount importance to an industrialist. No wonder then that most of the existing industries make space provision mainly for the machineries, equipments and the auxilliaries. To arrive at the most economic solution to space requirement, a process schedule must be planned and items of equipments and machineries with their capacity and number chosen after a provisional estimate of the daily milk intake must have been made.

The process schedule spells out the various stages through which the production process of each product has to follow.

To involve even one operative in walking a short distance unnecessarily every time he performs a routine operation amounts to time wastage, inadequate working space round an equipment is a great blunder and so is the wrong location of any control which may lead to obstructions, accidents and inefficiency. It is therefore important to plan the layout and arrangement of equipments and machineries to be used in accordance with the production process requirements.

The floor area, the headroom and the shape of space provided is influenced by the type of equipments involved in the production processes and so is the ancilliary services to be provided. Generally, the arrangement and space design of the internal space is done by considering that the space between individual machines is sufficient for the operator to have easy access and for cleaning or maintainance staff to dismantle component parts.

2. Subject to the above requirement, the interconnecting pipes or conveyors must be kept as short as practicable
3. The inflow and delivery of the products must conform to the general flow line for the production process.
4. The arrangement of machinery and equipments must facilitate movement to and from others
5. Arrangement should not create undue difficulties in the supply of services or the disposal of waste.
6. Arrangement and placing of machines should take account of possible future expansion.

It is perhaps pertinent to state here that the innumerable combinations of space available and the requirement of the equipment for a given throughput make it impossible to specify rigid ideal arrangements. The dimensions and other data would not necessarilly apply to other makes of equipment for the same function, and what is more, on different sites even the same machines may be arranged differently.

Requirement of Production Process on the Design:

The main areas of production activity are the starting material storage, the treatment and processing area, packing and the finished material storage.

Although, flexibility and continuous working is allowed in the design (of space and arrangement for equipment, machines and operatives) this must in no way hinder the elementary principles of product flow. This requirement means that the arrangement of the processing and storage accommodation must be firmly based on movement of the product from one stage to the next in the most direct manner. This process requirement ensures economy in building, equipment and a saving in plant cleaning procedure which figures so largely in the dairy industry.

Milk is a most suitable medium for the growth of organism, every possible measure must therefore be taken to reduce the possibility of contamination, especially after processing. The result of failing to maintain adequate control of kygiene may be that the product does not keep or is so altered in flavor that it cannot be sold. It is therefore a production process requirement to design on washable space. Floors and wall must be designed in such a way that they can be maintained clean.

Three major factors which make milk highly perishable are: substantial contamination with bacteria, warm temperature and prolonged time before colling or processing. The design of space at the collection centre, at the reception and the production and despatch should be such as to reduce the chances of these factors occuring. The process requires that milk at the collection centre be cooled as soon as collected.

The recepti n arrangement must be designed to handle milk quickly, so that the subsequent processing can be completed and the plant cleaned within normal working hours. A quick, efficient and hygienic reception method is the tanker discharging system where reception bays are provided with milk pump.

If pathogenic contamination were to occur after processing and before packaging a large number of people could be affected and a serious epidemic could quickly follow. Prevention of contamination is therefore a great requirement of the production process so the design of equipment, effectiveness of cleaning and steriling, method of handling, layout of building and particularly, internal finishes must aim at preventing contamination.

Facilities must be available to find the cause of any pre and post-treatment contamination and prescribe remedy. This is why a highly equipped laboratory has been provided.

The production processes culminates into production of various items such as yoghurt, milk, butter and ice cream. Since each method of production aims at conserving the raw milk, it is a production requirement that the starting material be separated from the finished material.

This is why the raw milk enters at one end but goes out through the other end.

Similarly, pipelines for raw milk must be completely separate from those carrying processed milk. Each section of the plant must be as self contained as possible for most dairy products quickly acquire flavors, not only from one another but from any strong smelling contaminants such as oil, amononia or paint.

The height of the startihg and finished material storages is low while the production hall is high. This is a requirement of production because equipments used in the storage are not high, the requirement of referigerant loads by the products calls for a smaller space so that coolling load could be economically maintained. An effective referigerant is one which ensures that every part of the room is cooled but with a largor volume and height this would have been very high. And to the production hall, the size of equipments and the space requirements of the production processes calls for a higher building. This allows more light and ventilation into the working area through the side glazings.

In planning the service requirements, full consideration to future expansion of process work, the layout is therefore planned to allow for eventual extension.

The space alloted for any function depends on type, capacity and number of equipment. With a boiler of 5000kg per hour capacity requirement of 3 metre by 4 metre by 4 metre is required. 3 of such boilers would be needed with one as a standby; a headroom of 2 metre above the boiler is required, and so is a working space of 2 metre is allowed between the boilers, between the boiler and other machines or the wall. About 4 metre space is provided in the front of the boiler.

BOILER:

Capacity	5000kg/hr
Space	3mx3mx4m
Headroom	2m
Distance from other equipment	2m
Allowance at the front	4m
Number of boilers	3

COMPRESSOR

Capacity	20000kcal/hr
Space required	$5m^2$
Distance from other equipments	1m
Space occupied by ancilliary equipments	$50m^2$
Number of compressors	3

FUEL

Capacity	50,000 litres per tank
space required	$15m^2$
Ceiling height	5m

ELECTRICITY

Space required for transformer and other electrical equipments	$10m^2$
Switchroom or control room	$20m^2$

WATER

Pump and other equipments	$3m^2$
Volume of water required = twice volume of raw milk used	2x200,000 litres = 400,000 litres provided
2underground water tanks and 1 tank would be provided	

MILK COLLECTING CENTRE

Milk reception	6m x 4m
Treatment Area	6m x 8m
Boiler House	3.5m x 5m
Detergent Store	1m x 2.5m
Washroom	2.5m x 2.5m
Laboratory	2m x 2m
Office	2m x 2m
Dock	6m x 1m

AT THE PLANT -

Raw milk storage tank:	
Capacity	20,000 litres
Space required by each	3.5mx7m
Number of tanks	10
Distance from other equipments	1m

Initial processing and treatment

Space required by	
1 pasteurizer	$2m^2 \times 1 = 2m^2$
2 clarifiers	$2m^2 \times 2 = 4m^2$
1 separation	$2m^2 \times 1 = 2m^2$

ancilliary equipment $2m^2$

Detergent tank $2m^2$

High Temperature, Short Time Tank $48m^2$

Space required to accommodate equipments, allowing for all round easy access is:

5 times the area occupied by each

TOTAL AREA $5(2+4+2+2+48) = 300m^2$

BUTTER (10,000l)

2 cream balance	$2m^2 \times 2 = 4m^2$
2 Ripening Vats	$2m^2 \times 2 = 4m^2$
1 Butter churn	$4m^2 \times 1 = 4m^2$
1 Moulder	$4m^2 \times 1 = 4m^2$
Hardening	$20m^2$
Cutting and wrapping	$20m^2$
Packing	$20m^2$

To allow for access, area of cream balance, Ripening vats, Butter chru and moulder is multiplied by 5

$5(4+4+4+4) = 80m^2$

TOTAL space required $(60+80)m^2 = 140m^2$

Ice Cream (40,000 litres)

Mixing Tanks	$20m^2$
Batch Pasteurizer	$40m^2$
Homogenizer	$20m^2$
Cooler	$20m^2$
Ageing Vats	$20m^2$
Freezer	$20m^2$

YOGHURT (40,000 litres)

Homogenizer	$2m^2 \times 2 \times 5 = 20m^2$
Separator	$2m^2 \times 2 \times 5 = 20m^2$
Storage Tank(20,000 litres)	$(3.5x7)m^2 x2 = 50m^2$
Culture Tank	$(3.5x7)m^2 x2 = 50m^2$
Innoculation Tank	$(3.5x7)m^2 x2 = 50m^2$
Incubation	$(3.5x7)m^2 x2 = 50m^2$
Cooling	$= 20m^2$
Filling	$20m^2 = 20m^2$
Packing	$= 20m^2$
TOTAL SPACE REQUIRED	$= 300m^2$

CHAPTER ELEVEN

ENVIRONMENTAL REQUIREMENT & ACCOMMODATION SCHEME

The surrounding conditions of an industry has an impact on employees through its effect on their motivation, involvement and satisfaction at achieving the organizational goals, that is the drive to achieve great strides in productivity. The enviroment is made up of internal and external elements and these can either threaten or reinforce the employees involvement and when one considers the fact that in any field of acitivity, man is the most valuable resource one cannot help but reiterate the point that enviroment of the factory should be pleasant and conducive.

INTERNAL AND EXTERNAL FACTORS

External factors which affect an industrial environment and have a bearing on the workers include provision of facilities and their inter-relationship, and location of industry among others, while internal factors include noise, heat, light, ventilation and colour. The disposition of various parts of a plant along with equipments used therein constitute a facility. It should be such as to enable the factory to function efficiently and effectively by meeting the requirements in the most economical manner.

WORKING ENVIROMENT:

Wrok group is also important, where there is lack of co-operation pace at work is tremendously reduced. The nature of the job which the employee performs is an important determinant of his time use. An interesting and challenging job would, all things being equal, be inviting.

To achieve higher productivity from workers the traditional management style which regards people as replaceable components of production and often authoritarian in style can have undesirable consequences for productivity. Provision of canteen facilities which ensures at least standard meal once a day at subsidised rate for the employees, medical facilities to cater for health, subsidised transport facilities to take workers to and away from work, housing allowances and installation of safety gadgets to prevent accidents and risks of fire are all important in making a good working environment.

should be noted to have

The physical environment of work has a direct impact on the behaviour of employees. General working conditions such as heat, noise, light, colour and technology affects comfort at work and may compel employees to seek more congenial conditions elsewhere or reduce their abilities and capabilities to work. These internal factors to which a worker is exposed for about eight hours in a day brings about boredom, physical and mental fatique if they are inadequately or poorly provided. If well planned, internal conditions of environment can improve efficiency and work out-put and of course risk of accident would be greatly minimised or be obliterated. The consideration is for how to make use of the abudant natural tropic light and natural ventilation but ensuring that glare and heat penetration are reduced to the barest minimum. Such a design approach calls for the use of roof lights. The total internal illumination as a percentage of that available outside should be about 5-10 per cent. This calls for design of openings which are approximately 20 to 30 per cent of floor area.

Wall openings like windows are not sufficient especially when the production hall has a large span. Light received through side-window is highest (about 20 per cent) jus for those areas near the windows and for areas farther away from the window light received is just about 3 per cent. This is why roof lighting is essential to large span production areas if the space were to be effectively illuminated. In order to reduce glare and discomfort, orientation of the building, solar movements and area of glass to be exposed to direct sunlight should all be carefully considered. Light roofing, with 30 per cent glazed area, gives 6 per cent maximum and 5 per cent minimum dalight distribution and is found to be the suitable as it gives more uniform light and less glare, however folded glaxing in folded plates are found to be particularly suitable to the Dairy Industry.

Apart from natural light, artificial light is also required in order to meet the average light requirment of 400 lux. No machine or equipments involved in the production process in a dairy factory requires special lighting, except in the ancilliary facility section where the instrumental dials inspection are might require special lighting. In any case, reflections of light from machines and/or polished surfaces are discouraged and light-fittings which are accessible for maintainance are used.

The following are lighting requirements(in a milk plant)

Offices, laboratories, workshops and most process rooms =	250 lux
Instrumental dials	300 lux
Inspection areas	500 lux
Loading docks, cold stores	100 lux

(Source - Milk Plant, FAO publications)

It is important to design the lighting system to give the required illumination at the working plane. In offices and laboratories, this will be at desk or bench level; in the process rooms, it will be at various levels depending on the height of the machines. Filament lamps produce less illumination for a given amount of electricity while fluoresent tubes may emit a small amount of ultra-violet light, particularly if the tube ends are not effectively screened, as care should be taken in their use where milk, cream or butter are exposed for any length of time. Lighting of the roads and outside areas of the milk plant must be considered

Milk plant operations cause humid conditions as cleaning of floors, walls, and equipment involve large use of water and steam. If provided ventilation is insufficient, water condenses, mildew forms on the walls and ceilings, painting is ruined, woodwork of windows and doors rots and machines rust. This involves great maintainance and repair costs and a shorter life for buildings and machines, Humidity and heat are also very trying for those who have to work in such premises.

Air requirements is expresed in terms of floor area as it mainly depend on the amount of moisture produced and not so much on the height of the ceiling.

Pressing Room:	20	cubic	meters	per	square	meter	floor	surface/hour
Milk treatment:	30	"	"	"	"	"	"	"
Reception:	35	"	"	"	"	"	"	"
Washroom:	30	"	"	"	"	"	"	"
Drying room:	30	"	"	"	"	"	"	"
Butter making:	50	"	"	"	"	"	"	"

Garages:	20	cubic	meters	per	square	meter	surface/hours
Machineryroom:	25	"	"	"	"	"	"
Shops:	12	"	"	"	"	"	"
Offices:	10	"	"	"	"	"	"
Canteen:	25	"	"	"	"	"	"
Changingroom:	25	"	"	"	"	"	"

The removal of Vitiated air from a room involves the admission of an equivalent quantity of air-normally fresh air from outside - to replace it. This may provide a considerable problem in milk plants because the incoming air will inevitably contain dust, mold spores and bacteria. Filtration of incoming air is therefore essential if contamination were to be avoided in the milk plant. Natural ventilation depends on the differences of temperature which normally occur between the air within a room and outside, and on differences of pressure caused by wind. Heated air rises and if allowed to escape at high level, draws in fresh air from the outside. Wind causes a higher pressure on the windward side of a building than on the lee side. Hence, strategically placed air inlets and outlets can give considerable air movements. The design of ventilation system is best left to specialists however, air fitters plenum ventilation and air conditioning could all be used to improve the working conditions for employees. Air curtains may be installed to prevent the ingress of air through external doorways or openings. This prevents antry of dust and insects.

Apart from the internal heat produced, heat comes from outside in the form of solar heat penetration through openings and the building fabric. Workers oftem have to work in an environment which is unsuitable for their own physical andPsychological needs in a factory environment; in the milk plant, cold rooms for milk and butter are kept at a temperature of $4^{\circ}C$ while referigerated rooms for long-term storage of butter, as well as the hardening rooms for ince-ream generally, must be kept at temperatures in the range of $-15^{\circ}C$ to $-40^{\circ}C$. Since human comfort zone is between 31.1^{oc} and $33.9^{\circ}C$ human beings working in the milk plant needs to have some protection against this condition. However, workers do not stay for any considerable length of time in these cold rooms. For those working in the cold areas, protective clothes would be provided. The fabric of the factory building is designed as a first defence against heat by providing thermal insulations on walls, floors and roofings. The idea of providing large openings to drive out heat may not be so workable as they would in the first place allow in more heat, if openings are smaller, on the other hand, insufficient lightening and ventilation reulsts. Wall claddings and roof thermal insulations which are used, are therefore the most successive means of preventing heat penetration. Ventilation methods, already discussed would take care of comfort inside the working factory.

Another problem of a factory working environment on the workers is noise. High noise level impair damages to our hearing and if this continues for a longer time deafness result. For workers comfort, noise level should not exceed 85 decibels or 105 decibles if and only if such exposure last not more than 15 minutes a day.

In the factory, the main source of noise are machine vibrations and this in the milk plant include the noise from boiler, generator, the workshop and vehicular movments. Sound transmission is either direct or of the reflected air-borne type and is reverberant or travels through ducts, flooring and structure. Noise leves in the factory could be reduced by reducing sound output at the source (for instance, use of silencers), reduction of machine vebrations by using spring foundations or resilient neoprene pads, provision of separate structures (this is costly and disturbs production flow), enclosing the mabhines with absorbent covers (this raises problems of ventilation and heat) and the applications of sound absorbent materials to walls, floors and ceilings. Architecturlly, the best and most effective method of noise reduction is the use of absorbent materials and this is applied here; double walls with absorbent material within the cavity can effectively check noise transmission from adjacent structures; for sound transmission through floors, resilient materials for floor finish would be applied while ceiling insulation boards would not only reduce heat coming from the roof but also cause a reduction in the sound level and help in the uniform distribution of light. All ducts and services in walls are to be provided with flexible connections and insulated against noise while landscaping used outside the building to check outside noise sources; the courtyard separating the auxilliary from the production area is particularly useful.

The use of colour as a means of improving internal working conditions of a factory in order to reduce incidence of accidents is also important. Colour combination should be harmonious and pleasing to the eye. Some colurs are warm and others, immediate or aggressive. Red, orange and yellow are not suitable colours in a milk plant because of the humid conditions already prevailing. However, pipings for steam or very hot water may be marked in red to indicate that they are dangerous.

Colour schemes for different units of a factory will vary, the colour scheme for the production hall will be different from that of stores or worker's facilities and should be complimentary to that of working material so as to give a clear differentiation. Green Blue or white could be used for the productinn hall, white is chosen here because it adds to the glamour of cleanliness; for the ceilings, white colours would give more reflected light and gives an impression of security and comfortability which is contrary, were a dull colour be used. Flooorings should give impressions of solidness and provide directions, hence brown is chosen. Separate colours should therefore be applied to gangways and other circulation areas. Accidents could also be reduced by use of change of colours whenever there is a change in floor level or material or surface, and this has been applied in the design.

Machine colours may be different from the working materials which is milk in this case. Switches, operating levers and tool points should be painted in separate colours so that they can be seen easily and clearly from a distance.

Boiler, generator and other hot rooms could have blue colours in order to play down on the heat, as blue would creat an impression of coolness; canteens, games room and the likes would be light and gay coloured in order to relieve work tension, while changing rooms and toilets would be in white to indicate or give impression of sanitory and hygiene.

CHAPTER ELEVEN

ACCOMMODATION SCHEDULE

After a thorough analysis of the process of production in the dairy industry space could be allocated to rooms after a knowledge of number and types of equipments required for the various processes and the minimum space for an all round easy access. The total area to be occupied by the whole complex would be as to the requirement of the following:

- number, capacity and type of facilities
- size, height and style of building
- needs for future expansion
- loading and unloading bays, driveways
- parking areas for employers, customers
- landscaping including courtyard.

The factory consists of office accommodation, welfare, social, health, recreational, production and ancilliary facilities. Others are the water supply and treatment.

Office Accommodation:

Entrance hall	36.0m^2
Receptionist	12.0m^2
Waiting space	48.0m^2
General office	30.0m^2
Retail shop	40.0m^2
Male Toilet	9.0m^2
Female Toilet	9.0m^2
Stationary store	28.0m^2
General Manager	24.0m^2
Sales Manager	24.0m^2
Production Manager	24.0m^2

Personnel Manager	24.0m^2
General Manager Secretary	12.0m^2
Personnel Manager Secretary	12.0m^2
Production Manager Secretary	12.0m^2
Sale Manager Secretary	12.0m^2
Accountant General	24.0m^2
Chief Accountant	16.0m^2
Market Research Analyst	16.0m^2
Mechanician	16.0m^2
Electrician	16.0m^2
Transport Officer	16.0m^2
Welfare Officer	16.0m^2
Supervisor	16.0m^2
Plumbing specialist	16.0m^2
Salary office	16.0m^2
Accountant	16.0m^2
Public Relations Officer	12.0m^2
Sales Officer	12.0m^2
Store keeper	12.0m^2
Cashier	12.0m^2
Cleaner room/store	12.0m^2
Typist	12.0m^2
Clerks	12.0m^2
Board meeting/conference	60.0m^2
Maintainence Officer	16.0m^2
Dairy Officer	
Veterinary Officer	12.0m^2
Cowsmen/Herdsmen	12.0m^2
Milkmen	12.0m^2
Feeder	12.0m^2

Labour Union	24.0m^2
Typing pool	60.0m^2
ANCILLIARY FACILITIES	
Boiler	260m^2
Generator	48m^2
Control Panel	20m^2
Chilled Water Tank	49m^2
Fuel	16m^2
Refrigeration	100m^2
Transformer substation	12m^2
Vehicle Repairs	120m^2
Wrokshop	80m^2
Laboratory	200m^2
PRODUCTION FACILITIES	
Reception	36m^2
Milk Testing lab	20m^2
Milk Treatment	300m^2
Storage Tanks	250m^2
Ingredient storage (Butter)	24m^2
Ingredient Storage (Ice Cream)	30m^2
Ingredient Storage (Yoghurt)	24m^2
Yoghurt Production	300m^2
Ice cream production	320m^2
Pasteurized Milk Production	300m^2
Milk Powder Production	300m^2
Butter Production	140m^2
Packaging	300m^2
Cold Storage	400m^2
Dry Storage	200m^2

OFF-LOADING/TRUCK SPACE

Platform width	$2m^2$
Truck parking	$148m^2$
Turning radius	14m

WELFARE FACILITIES

Male changing room with WC and shower	$120m^2$
Female changing room with WC and shower	$60m^2$
Rest room	$120m^2$
Dining	$200m^2$
Kitchen	$20m^2$
Servery	$12m^2$
Dry store	$12m^2$
Vegetable store	$12m^2$
Fuel store	$12m^2$
Cold store	$12m^2$
Bulk store	$24m^2$
Catering Officer	$16m^2$
Supervisor	$16m^2$
Snacks/Buffet	$60m^2$
Washroom	$12m^2$
Changing with WC and shower	$60m^2$

HEALTH FACILITIES

Waiting Area	$24m^2$
Registration	$16m^2$
Consulting room	$20m^2$
Nursing sister	$20m^2$
Nurse	$16m^2$
Dispensary	$16m^2$

HEALTH CONTD.

Treatment and Dressing	$20m^2$
Store	$16m^2$
Toilet	$12m^2$

RECREATIONAL

Indoor Games	$300m^2$

CONCLUSION

Dairy farming has for long been recognised as one of the most reliable and rewardind methods of farming, repaying both in health improvement and financial gains. The industry takes advantage of what modern science can offer and plans operations with the available technical and economic possibilities such as might be available for the satisfaction of the required production level and milk products in an area.

Technical, economic, social and biological requirements of the industry have been carefully analysed and practical way of tackling them have been propounded.

Because of its nature, milk imposes special requirements on the materials and techniques that is applied in the design; coupled to this is the need for high standard of hygiene and sanitation. These explain for why building materials and techniques used are those which ensure longest possible practicable life with minimum of maintainence and also allow for the possibility of carrying on alterations or extensions with little or no disturbance to production process. This is no mean architectural achievement in any industrial design and the design of Internal and External space to the requirement of production process would be of paramount importance as adequate space required for cleaning, operating and maintainence work are effectively catered for. Also, the external, internal and working environment of the industry which have been given due attention would go a long way in contributing to and ensuring efficient productivity.

Labour has been cheaply and easily available and no less consideration has been given to the requirement of the factory worker but with increasing literacy level, the Nigerian worker of the future would demand more than the starvation wage which is presently his lot at the end of the month. In order to avoid the crisis that may ensue, today's factory must provide for an industrial environment

which is conducive and enticing to the skilled labourer. This is why workers and welfare facilities have been provided in this design.

This project presents a modern and scientific modern way of cattle breeding, housing, feeding and milking. These would help encourage greater food production and distribution and improve on nutritional standards. The dairy industry, as an example of agro-based industries offers a practical way of how to diversify the nation's economy, provide employment apportunities, provide foreign exchange, promote wider and more effective linkages between different sectors of the economy, develop a prudent management of natural and human resources, provides abundant, sufficient and reliable food and raw materials, stimulate a technological take-off and create wealth to improve standard of living. Nigeria cannot afford to miss these advantages, her priorities should therefore be geared towards rigorous and vigorous pursuance of agricultural based industrialization.

This project is therefore highly feasible and because of its contribution to untritional improvement, finarcial assistance from the World Health Organization, The food and Agricultural Orgaization, the Federal, state and local government of Nigeria would be easily secured.

Like you the researcher of this work wants the verdict of history to be that of acquittal because, posterity will not fail to ask if those who had the opportunity to contribute to the survival of this nation did so through a sustained development programme by establishing the economic basis for that survival. It is my fervent hope that this work would inform students, stimulate farmers/ producers and encourage all to put more effort into the laborious but lucrative, prosperous and fascinating dairy industry.

Certainly, milk is and would continue to reman a part of the diet which is indispensable to health, its relative cheapness and high nutritional value would make it to continue to maintain its position as an extremely vital food article. With great endeavour at achieving possible highest quality and standard, the dairy industry in Nigeria, cannot but view the future with confidence.

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the shoulder of each cow at about 45-60cm back of the stanchion line. Whenever a cow arches its back to urinate or pass stool, it receives a mild shock from the framer which is connected to an electronic control. This forces the cow to urinate or pass faeces directly into washable gutters provided. This is the most efficient way of keeping the house and the cattle clean, it saves time and labour and it requires less bedding. The feeds would (fall on to) a large coveyor belt covered with polythene sheet, the reminants could then be easily washed or run off after feeding.

CALVING PEN: At a few days to put to birth, the cows are kept in a well cushioned stalls with ample room for observation and adequate care. The stalls which are located away from areas of disturbances are cleaned after every birth by removing all wet beddings, the cow's udder is also washed with chlorine solution so as to avoid infection to the calf when it starts sucking.

CALF PEN: The calf is transferred here for close observation for a period of a week or ten days after which the calf is transferred to an individual pen for another period of 8-10 weeks. To prevent the calves from sucking each other and from the wrath of preumonia, each stall is separated from the other by solid walls. When they are put in group-pen, each calf should be tied down for 10-20 minutes after feeding from a feed box (20x25x15cm) in order to prevent accumulation of hairs in their stomach which occurs if they were allowed to suck indiscriminately.

TABLE 21.3 *Other Infectious Diseases*

Disease	*Causative agent*	*Source of infection*	*Signs*	*Prevention and comments*
Anaplasmosis[18]	*Anaplasma marginale*	Transmitted by blood from affected animals. Vectors are ticks, biting insects, man (during dehorning, vaccinating, etc.)	1. Anemia; pale nonpigmented skin areas 2. Jaundice; yellow color of nonpigmented skin areas	1. All ages susceptible, clinical signs in animals over 18 months 2. Vaccine available
Blackleg	*Clostridium feseri (chauvoei)*	Contaminated soil and feed; ingested	1. Sudden death 2. Lameness 3. Swelling on hip, shoulder, neck, chest or back; gas in tissues	1. All animals on pasture should be vaccinated by 6 months of age; lifelong immunity 2. Vaccination may not be necessary in dry lot 3. Most common in cattle 4 months to 2 years of age.
Cancer eye (squamous cell carcinoma)	Probably a virus	Infected animals	1. Cauliflower-like growth on third eyelid, cornea on eyelid	1. Lack of pigment around the eye increases incidence 2. Have growth removed as soon as noticed; surgery or cryosurgery 3. Seldom seen in cattle less than 3 years old.
Johne's disease[19]	*Mycobacterium paratuberculosis*	Contamination of environment by infected animal feces	1. Diarrhea 2. Progressive loss of weight	1. Current diagnostic tests are inadequate for eradication[20] 2. Use fecal culture to identify infected cows 3. Animals become infected during first 6 months of life; don't show symptoms until several years later 4. Remove calves at birth and raise in an area away from

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