CHAPTER ONE

1.0 INTRODUCTION

A modern cassava processing factory can be described as a purpose-built industrial facility that serves as the central space for the efficient transformation, production, and value addition of cassava roots. According to agricultural studies (FAO, 2020), such agro-industrial institutions often form part of the broader food security and economic development center, designed to be focal points within rural and industrial landscapes, housing dominant processing functions. Traditionally, these factories reflect technological authority, but more recently, the concept of industrial design has evolved to encompass not only advanced machinery but also strategic organization, automated systems, and sustainable practices for operational and environmental effectiveness (Smith, 2022). In the context of a modern cassava processing factory, special attention must be paid to the Internal organization of production lines and public spaces, alongside critical design aspects such as processing efficiency and waste management.

Processing efficiency is a branch of industrial engineering that deals with the optimization of production, including its planning, execution, and output. In factory design, it is concerned with the planning, layout, and construction of facilities to achieve desirable processing conditions within and around the operational environment. Proper efficiency design plays a vital role in correcting production-related deficiencies in factory components, improving output quality, controlling spoilage, and minimizing resource waste. Specifically, in a modern cassava processing factory where root transformation, product diversification, and market readiness are central to its function, processing performance becomes an essential design priority. This include both the streamlining of internal production stages as well as the management of

external factors like raw material perishability.

The application of processing optimization In industrial design ensures optimal production conditions in areas such as washing units, drying zones, packaging lines, and storage facilities. As factories become increasingly automated with the use of conveyor systems, temperature controls, and other technological devices, the need for efficiency control intensifies. Without proper process management, these technologies can contribute to a production environment that impairs yield and sustainability.

Cassava (Manihotesculenta) is a staple crop for millions of people, known for its high carbohydrate content and adaptability to varying climates and soil types. However, the post-harvest handling of cassava presents significant challenges. Fresh cassava roots are highly perishable, typically beginning to deteriorate within 24 to 48 hours of harvesting. This short shelf life necessitates rapid and efficient processing to prevent spoilage and economic loss.

Modern cassava processing factories address these challenges through mechanization and innovation. Key stages in the processing line typically include washing, peeling, grating, dewatering, drying, fermenting (for gari or starch), milling, sieving, and packaging. These steps are performed using advanced equipment such as rotary washers, hammer mills, flash dryers, pneumatic conveyors, and automated packaging systems. The use of such equipment increases processing efficiency, reduces labor dependency, ensures consistent quality, and minimizes contamination risks.

Cassava can be processed into a wide variety of value-added products, including:

1 Gari – a fermented and roasted granular flour used as a staple in many West African diets.

2 High Quality Cassava Flour (HQCF) – used in baking, pastries, and as a partial substitute for wheat flour.
3 Starch – utilized in the food industry as a thickener, binder, and stabilizer, and also in non-food industries such as textiles, paper, and adhesives.
4 Cassava Chips and Pellets – used in animal feed and as raw material for ethanol production.
5 Ethanol and Biofuel – derived from cassava fermentation, contributing to the renewable energy sector.
6 Modified Starches and Sweeteners – for industrial and pharmaceutical applications.

In conclusion, modern cassava processing factories represent a fusion of agriculture, technology, and industrialization. They are not only transforming cassava from a subsistence crop to a commercial commodity but also fostering rural development, job creation, and industrial diversification. As global interest in food security, renewable energy, and agro-industrial development continues to grow, cassava's role in these sectors is set to become even more prominent, and modern processing facilities will remain at the heart of this transformation..

1.1 HISTORICAL BACKROUND

The journey from traditional to modern cassava processing began with small-scale manual method where cassava roots where peeled, grated and fermented by hand. By the late 20th century, technological advancement brought mechanized equipment into the picture, significantly increasing efficiency and production capacity. This period marked the birth of modern cassava processing factory characterized by larger, more sophisticated facilities.

Countries such as Nigeria, Vietnam and Thailand led to the change in adopting these new technologies, transforming cassava processing landscape.

The early 21st century saw a surge in the implementation of sustainable practice and innovation making factories more environmental friendly and economically viable. These development not only boost local economies but also enhanced food security and product quality.

The 21st century saw a significant improvement in cassava processing technology. Modern factories embraced automation with processing lines that could peel, grate, mill and dry cassava with minimum human intervention. These innovation drastically reduced labor cost, Increased production and enhanced product consistency. The introduction of continuous processing system also led to more streamlined operations, making it possible to process larger quantities of cassava in shorter timeframe.

As environmental concern became more prominent cassava processor began adopting more sustainable practices, energy efficient systems, waste reduction, technologies and the conversion of cassava by-product into bio-fuel and animal feed became common.

1.2 DEFINITION OF TERMS

- **Modern** :
  Refers to something contemporary, up-to-date, or relevant to the present time.

- **Cassava**:
  A tropical root crop (Manihotesculenta) that serves as a major source of carbohydrates. It is widely cultivated for its starchy tuberous roots, which are a staple food in many developing countries.

- **Factory** :

A building or complex where goods are manufactured or assembled, primarily using machinery.

- **Modern Cassava Processing Factory** :
  A contemporary industrial facility designed for the efficient processing of cassava roots into various end-products using advanced machinery and technology. It aims to enhance productivity, ensure product quality, meet food safety regulations, and promote environmental sustainability.

- **Processing Line** :
  An arrangement of machines for sequential cassava processing operations.

- **High Quality Cassava Flour (Hqcf)** :
  Finely processed cassava flour used as a wheat substitute in food and industry.

- **Waste Management System** :
  A facility-integrated system for handling cassava peels and wastewater sustainably.

- **Automation** :
  The use of advanced control systems to operate machines with minimal human input, increasing efficiency.

1.3 STATEMENT OF DESIGN PROBLEM

Kwara State, like many regions in Nigeria, continues to face challenges in cassava processing due to the absence of a modern, well-structured cassava processing facility. The current system relies heavily on outdated, small-scale, and often unhygienic processing methods that not only limit production capacity but also compromise the quality of the final product. These limitations affect food security, reduce potential economic gains for local farmers, and hinder the

expansion of cassava-based industries.

Despite cassava being a staple crop with high industrial value, many communities still lack access to modern processing infrastructure that incorporates efficient layout planning, sanitary workspaces, proper storage conditions, and appropriate waste management systems. In many cases, the absence of integrated design considerations, such as adequate ventilation, efficient circulation, and separation of processing zones, results in overcrowded, poorly ventilated, and environmentally unsafe working environments.

Furthermore, poorly designed processing spaces often lead to cross-contamination, product spoilage, and health hazards for workers. Noise pollution from processing machines, lack of natural lighting, poor drainage, and improper waste disposal are common problems arising from inadequately designed or unplanned processing environments. These issues contribute to the inefficiency and unsustainability of cassava processing operations.

This project proposes the design of a modern cassava processing factory that prioritizes hygiene, functionality, scalability, and environmental responsibility. The factory will be equipped with appropriate acoustic and ventilation systems to ensure user comfort, efficient workflow layouts to enhance productivity, and designated areas for cleaning, processing, packaging, and storage. This facility is intended to serve as a model for sustainable agro-industrial development in the state, thereby improving local economic development, employment opportunities, and food production standards

1.4 AIM AND OBJECTIVES

1.4.1 AIM

The aim of this project is to design a befitting Modern Cassava Processing

Factory that will optimize cassava processing operations, ensuring efficient workflows, minimize waste and incorporate sustainable practice by promoting eco-friendliness

1.4.2 OBJECTIVES

i. Design a fundamental And efficient building/structure layout that accommodate various processing stage.
ii. Incorporate energy- efficient system and technologies.
iii. Design a waste Management System that minimize waste and promote recycling.
iv. Design the factory to be flexible and scalable.
v. Provide amenities and facilities that promotes employees well being.

1.5 JUSTIFICATION

Even though, the people of OWU-ISIN LOCAL GOVERNMENT AREA are mostly farmers. There are no modern cassava processing factory to process Cassava roots in the area. So this compelled me to design a state-of-the-art Modern Cassava Processing Factory that will add value to raw materials, ensuring better market opportunity for the farmers in the area and promoting economic growth through job creation and industrialization in the area

1.6 CLIENTS BACKGROUND

Owu-Isin Local Government Area is one of the sixteen (16) administrative divisions in Kwara State, Nigeria. Located in the southwestern region of the state, it is predominantly occupied by the Yoruba-speaking Isin people. The local government headquarters is situated in Owu-Isin town, with other notable communities including Ijara-Isin, Alla, Iwo, Oke-Onigbin, and Igbesi. The area is largely rural, with agriculture forming the backbone of the local economy. Cassava, being a staple crop, is widely cultivated by smallholder farmers across the LGA due to its resilience and multiple end-uses.

Despite the abundance of cassava production in Owu-Isin, the region suffers from a lack of modern processing infrastructure. The majority of cassava harvested is processed through traditional and inefficient methods, resulting in substantial post-harvest losses, limited value addition, and suppressed income potential for local farmers. Consequently, the community remains economically underdeveloped, with limited opportunities for industrial growth and employment.

The proposal to establish a modern cassava processing factory within Owu-Isin LGA is conceived as a strategic intervention to address these challenges. The facility is intended to serve as a landmark project that reflects the community's aspiration for industrialization, food security, and rural transformation. Architecturally, the project aims to integrate functional design with context-sensitive planning that reflects local identity, enhances efficiency, and encourages sustainability.

The philosophy of the proposal is grounded in the belief that agriculture, when properly harnessed through modern technology and industrial design, can drive local economic development and social progress. By transforming raw cassava into a range of value-added products such as garri, fufu, high-quality cassava flour, industrial starch, ethanol, and animal feed, the proposed facility will act as a processing and distribution hub for the region.

The operational structure of the factory is envisioned as a hybrid model involving partnerships between the local government, private investors, farmer cooperatives, and relevant development agencies. The facility will comprise processing units, administrative offices, storage and packaging areas, quality control laboratories, and training spaces. The design will incorporate modular and scalable components to accommodate future expansion, and will prioritize energy-efficient systems and waste recycling methods.

The primary goal of the project is to validate the need for a modern cassava processing factory within Owu-Isin LGA, and to articulate the design, spatial, and functional requirements necessary for its realization. Through this project, the community seeks not only to reduce cassava wastage and improve agricultural income but also to establish Owu-Isin as a model for agro-industrial development in Kwara State and Nigeria at large

1.7 SCOPE OF THE STUDY

The modern cassava processing factory will be designed to provide adequate and purpose-built facilities for its intended users, structured into three (2) primary sections : Production Section and Administrative & Support Section. Each section will be thoughtfully planned to support efficient workflow, user comfort, and sustainability in line with contemporary agro-industrial design standards.

- The Production Section : will house core processing activities, including raw material intake bays, washing and peeling units, grating and pressing lines, drying areas, fermentation chambers, packaging units, and storage silos. It will also include specialized units for the production of value-added cassava products such as garri, high-quality cassava flour (HQCF), starch, ethanol, and animal feed from cassava by-products.

- The Administrative & Support Section :will comprise the operational and management offices, control rooms, staff changing rooms, maintenance workshops, security posts, and utility areas (e.g. water treatment and power generation rooms). It will also include a staff cafeteria, restrooms, and a logistics management area to support internal operations and external distribution activities.

The design of the factory will incorporate green spaces, internal courtyards for ventilation and relaxation, vehicular circulation routes, and clearly defined

zoning to promote hygiene, safety, and operational efficiency. This integrated approach will ensure that the facility not only serves as a processing hub but also as a center for learning, community development, and agro-industrial

1.8 LIMITATION TO DESIGN

This study will be limited to the architectural design aspects of a modern cassava processing factory, with emphasis on spatial planning, workflow efficiency, hygiene, and environmental considerations. The focus will be on providing functional spaces necessary for the processing stages—such as washing, peeling, grating, fermenting, drying, packaging, and storage—while ensuring adequate ventilation, lighting, and circulation.

However, the study will not delve deeply into the technical engineering details of the processing machinery, biochemical processes involved in cassava transformation, or large-scale industrial automation systems. The scope will also not cover in-depth economic feasibility studies or nationwide agricultural policy implementation. Instead, the design proposal will be limited to satisfactorily providing architectural solutions that enhance productivity, promote hygiene, and support the efficient movement of both people and materials within the factory.

1.9 RESEARCH METHODOLOGY

The methodology adopted for this study includes a combination of both qualitative and observational research techniques. These methods were selected to ensure a comprehensive understanding of modern cassava processing factories in the Nigerian context. The methodologies employed are as follows:

- **Internet Research**: Online resources were utilized to access up-to-date information, technological advancements, and global best practices in cassava processing. This included academic articles, industrial reports, and

architectural design references.

- **Case Studies**: Existing cassava processing factories in different parts of the country were examined to understand their spatial organization, functional requirements, and technological integration. These case studies provided valuable insights into practical applications and design strategies.
- **Oral Interviews**: Interviews were conducted with factory workers, operators, agricultural extension officers, and other stakeholders. This method provided firsthand information on user needs, challenges faced, and opportunities for improvement in cassava processing facilities.
- **Photography**: Photographic documentation was carried out during site visits to record architectural features, machinery layout, and environmental context. These visual references aided in the analysis and design process.
- **Literature Review**: Relevant textbooks, journals, and publications were reviewed to establish a theoretical foundation for the study. The literature helped in identifying key issues, design considerations, and innovations in cassava processing.

DEDUCTION

Based on the analysis of the proposed design and operations of the modern cassava processing factory, the following deductions were made:

1. Efficient Workflow:

The layout of the factory, incorporating sequential placement of machinery—from washing and peeling to drying and packaging—promotes smooth workflow and reduces production time.

2. Product Quality Assurance:

The inclusion of quality control measures and modern equipment ensures that the final cassava products (gari, flour, starch) meet food safety and industrial standards.

3. Safety and Hygiene:

The use of stainless-steel food-grade equipment and proper drainage systems minimizes contamination risks, ensuring hygienic processing conditions.

4. Environmental Sustainability:

The implementation of an effluent treatment system and reuse of cassava waste (e.g., for animal feed or biogas) supports eco-friendly and sustainable operations.

5. Economic Viability:

The mechanized approach increases productivity and reduces manual labor, making the factory economically viable and scalable for commercial purposes.