

Research Article

Kilishi, a Secular Product with a Strong Identity in the Lake Chad Region: Opportunities for Differentiated Development of a Product with High Economic Potential

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Abstract

Kilishi, a dried meat made from strips of meat seasoned with a cocktail of ingredients, represents one of the forms of meat preservation traditionally practiced in the savannah areas of Africa. This foodstuff, highly prized for its organoleptic qualities, has a market potential estimated at 40 billion FCFA in the Lake Chad region if technological, normative and marketing improvements are made. The present work was initiated with the aim of presenting the market potential of kilishi and its variants (powder, sticks, stuffing, and aroma) in the Lake Chad region, beyond the artisanal nature of their production system and the various associated constraints. With a herd of around 80 million cattle, the Lake Chad region doesn't really benefit from the attractions of this potential in terms of value chains driven by meat and dairy processing, despite the fact that for every 1 FCFA spent on meat, the kilishi producer generates 2.5 FCFA in kilishi sales. There are around 700 kilishi producers in the countries of the Lake Chad region, and a number of scientific studies have focused on the traditional kilishi-making process, with particular emphasis on the relationship between process and product quality. For the most part, these studies are based on the technical and market constraints facing the kilishi production system, and propose directions for the development of the industry, in terms of optimizing process factors and improving product quality for markets. The study revealed that meat unwound ($< 5 \text{ Kg.h}^{-1}$), was the major constraint of the production process and the essential component of the kilishi production know-how, which could be eliminated by laminating and reconstituting lamellae. Implementing and mastering the results of this research will lead to innovative initiatives in the creation of resilient production units and job niches. These globally mechanized, environmentally-friendly units would run entirely on solar energy, with domes and tunnels for drying, coating, grilling and packaging, improving productivity and reducing production time from 3 days to 4 hours at the height of sunshine, for a daily processing capacity of 200 kg of meat. The dome will contribute to the hygienic and organoleptic quality of the kilishi, enhancing its market value. All this justifies concrete action to facilitate the emergence of a new typology of very small enterprises.

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Keywords

Kilishi, Productivity, Job Niches, Quality, Solar Energy

1. Introduction

Food crafts, made up of small-scale food production, processing and distribution structures, are the main nourishing agents of African urban centers [1]. These structures draw on the potential created by the diversity of agricultural resources that can be put to good use, and by fast-growing consumer demand, due to galloping demographics and urbanization [2, 3]. The countries of the Lake Chad region have a fairly varied assortment of cattle breeds inherent to the different agro-ecological zones, ranging from zebu (*Bos indicus*) to bulls (*Bos taurus*) and various crossbreeds¹, estimated at around 80 million head. According to the standards recommended by the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO), the quantity of meat required for each individual is 42 kg/capita/year². In the countries of the Lake Chad region, this average consumption is below 13.3 Kg/Hbt/year, and as part of a drive to capitalize on agropastoral systems as a strategy for sustainable production systems, the objective of the countries of the Lake Chad region is to substantially increase animal protein consumption towards FAO standards. In addition to food security and self-sufficiency, the long-term promotion of medium and large-scale farms should enable the region to play its role as a supplier of livestock and meat products with ease. In this respect, kilisheries³ in the Lake Chad region are in pole position with kilishi, a form of meat preservation and a food highly prized for its organoleptic qualities [4-6]. It has a market potential estimated at around 40 billion FCFA in this region, if technological, normative and marketing improvements are made [7-9]. The above findings point to the need to control kilishi quality by formalizing production units and upgrading production tools in order to overcome production constraints, which are real discriminators of quality and technico-economic performance. All this while benefiting from the attractions of research and market notes and technical and economic feasibility.

2. Materials and Methods

The opportunity of differentiated kilishi valorization in the 04 countries of the Lake Chad region was discriminated through market notes and technical and economic feasibility

through the exploitation of the state of the art, with the effect of densifying the emergence of productive and competitive VSE's (Very Small Enterprises) and SME (Small and Medium Enterprises).

2.1. Dimensional and Gravimetric Measurements of Samples

The weight of the samples taken during each stage of the process was measured using a Camry digital scale model EK5350 with a precision of 0.01 g, their dimensions (length and width) using a graduated ruler and their thickness using a digital caliper, model King Force Professional (Precision: 0.01 mm). The duration of the unit operations was determined by a Hybrid Stopwatch & Timer 3.1.2 digital and the dimensional and mass data collected at each unit operation made it possible to determine the production yields at the various intermediate and final stages.

2.2. Unwinding Flow Rate (UFR)

Mass of meat unwound into strips per unit of time Eq. (1):

$$UFR = \frac{M}{t} \quad (\text{kg.h}^{-1}) \quad (1)$$

With: M: Mass in kilograms of the meat to be unwound; t: Time taken (h) to unwind the mass M of meat.

2.3. Sales

The sales is given by the formula:

$$\text{Sales} = \text{Selling price} \times \text{Quantities sold} \quad (2)$$

2.4. Working Capital Requirement (WCR)

The WCR of Very Small Enterprises of kilishi is given by the formula:

$$WCR = SC - RMI - FGI - IPC \quad (3)$$

SC: Supplier Credit

RMI: Raw Materials Inventory

FGI: Finished Goods Inventory

IPC: Indirect Production Costs

1 <https://www.fao.org/3/v6950t/v6950t03.pdf>

2 <https://faolex.fao.org/docs/pdf/cmr146473.pdf>

3 Kilisheries is a neologism coined by Ndiha Aimé Christian, Expert in meat products and in food industries to designate a kilishi production and sales unit [10].

2.5. The Internal Rate of Return (IRR)

The internal rate of return is given by the formula:

$$IRR = \frac{\text{Net income}}{\text{Sales}} \quad (4)$$

2.6. Data Analysis

The data were analyzed in the light of the SMART objectives which stands for Specific, Measurable, Achievable, Relevant, and Time-Bound. Specific set of criteria are used to help ensure that objectives are clearly defined and attainable within a certain timeframe.

3. Results and Discussion

3.1. Market Note

3.1.1. Product Description

As part of a trading dynamic, the Hausa peoples probably ensured the spread of the practice of producing dried meats (kilishi) to other peoples in the Lake Chad region. Several types of kilishi exist in Cameroon and in Chad, with the dif-

ference lying mainly in the use or non-use of chilli pepper and the red dye djawa (*Bixa orellana*), whereas in Niger and Nigeria, A part from the use or non-use of hot pepper, the thickness of the kilishi lamella induces a typology of kilishi (Dangana (4-5 mm), Dan kalambé (~ 1 mm), Fari (~ 2 mm and coated with peanut cake), Rumuzu (< 3 mm)). Other forms of kilishi exist, but are little known to kilishi consumers: stuffed kilishi, powdered kilishi and kilishi aroma.

3.1.2. Estimated Market Potential

Kilishi, dried meat strips, is a representative component of the food and cultural heritage of the savannah populations of the Lake Chad region, with a market potential estimated at 40 billion FCFA, an unwinding flow rate of 3.5 to 6.62 (kg.h⁻¹) for a production of 4000 tons by around 700 workshops. According to SMART marketing, the 4,000 tons target can be reached if technological improvements are made to manufacturing processes by mechanizing certain unit operations using modern production equipment. This is sure to boost productivity and competitiveness. This Specific, Measurable, Achievable and Realistic objective is projected over a defined timeframe, with intermediate dates for the modernization of production units. The kilishi system market is summarized in Table 1.

Table 1. Potential market for the kilishi system in the Lake Chad region.

Potential market (FCFA)	Unwinding Flow Rate(kg.h ⁻¹)	Production (Tons)	Workshops	Direct jobs	Formalized companies
40 000 000 000	3.5-6.62	4000	700	5600	< 50

3.1.3. Supply

In the Lake Chad region, the vast majority of kilishi production facilities are artisanal, with beef processing productivity below 40 kg and unwinding through put below 5 Kg.h⁻¹, for a loss in disintegration of the ingredient cocktail of over 22%. All these production constraints, combined with the low technological quality of the meat (suitability for preservation and processing) as shown by [11-15], mean that unwinding the meat is extremely arduous, making it impossible to meet the demand of a potential market that extends far beyond the Lake Chad region. As things stand, producers could only cover the 20%, justifying a loss of 80% of foreign currency for the purchase of other meat products, and thus wiping out job niches in the same proportion.

Producers are keen to upgrade their facilities, but are hampered by the lack of support and facilitation at financing outlets, and by the lack of administrative formalization of their structures to take advantage of tax breaks and exemp-

tions.

3.1.4. Kilishi and Related Products

There are several types of kilishi and derivative products, such as those summarized in Table 2.

Table 2. Summarize of the types of kilishi and derivative products.

Type of product	Derivative products (New innovative products)
Kilishi	Kilishi powder
	Kilishi aroma
	Stuffed kilishi
	Gut kilishi

3.2. Technical and Economic Feasibility Report

3.2.1. Production Process

The kilishi production process follows the diagram in [figure 1](#), although variations exist in the countries of the Lake Chad region.

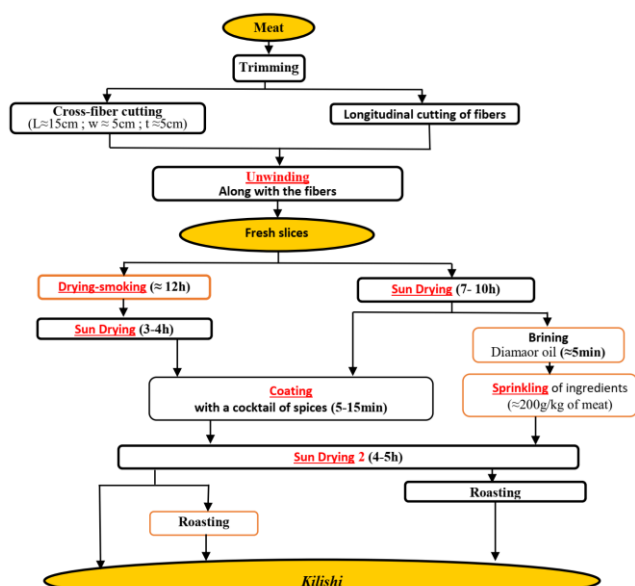


Figure 1. Kilishi product flow chart in Chad region.

3.2.2. Material Resources

Traditional kilishi production does not require large-scale equipment, due to the simplicity of the process. The equipment consists of sharp knives, an oven, cooking utensils and a wooden table, preferably covered with bamboo mats. In the Lake Chad savannahs, there are two different kilishi-making processes, each with its own drying requirements. Upgrading and scaling up production workshops will require additional

investment in the equipment summarized in [Table 3](#).

Table 3. Minimum equipment for a modern kilishi workshop.

Designation	Quantity
Meat sheeter	01
Grinder	01
Mixer-kneader	01
Solar dryer/ Drying domes	01
Solar drying tunnel	01
Mixed solar smoker	01
Hot air and smoke extractor	01
Solar roasters	02
Double chamber vacuum packing machines	02
Packaging and labelling unit	01
Quality control unit	01

This VSE's need to be supply by an UV-protected polycarbonate solar drying greenhouse, durable and shock-resistant as shown in [Figure 2](#) which will enable improve the yield of production.

The large temperature difference between inside and outside ([Figure 2](#)) is ideal for drying strips of meat, spices, fruit and vegetables using internal heat. This polycarbonate device can be modulated according to specific needs, and allows precise control of the amount of light and heat entering the greenhouse, with UV protection contributing to improved hygienic and organoleptic quality and optimum shelf life. The system is equipped with protection systems against insects and other contaminants, guaranteeing product safety and hygiene.

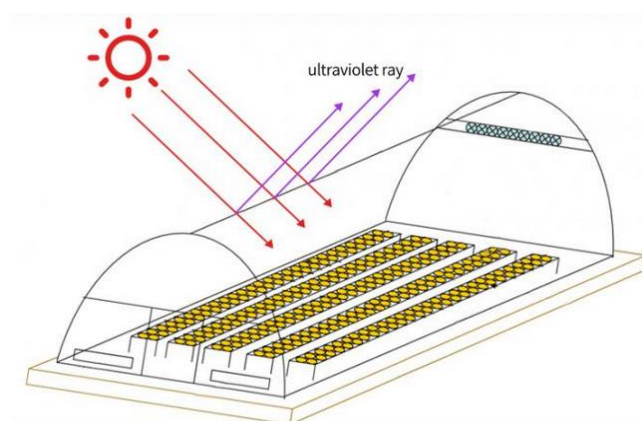


Figure 2. Solar-powered kilishi production unit to be implemented.

3.2.3. Working Capital Requirements

The projected sales of a kilishi workshop are summarized in Table 4.

Table 4. Evaluation of production and sales for a VSE.

Products	Quantity (kg)	Sales (FCFA)
Kilishi	3456	41 472 000
Net income		12 441 600
IRR (%)		30

1 kg of kilishi: 12000FCFA

At a meat purchase price of 1 FCFA, the kilishi producer generates 2.5 FCFA in kilishi sales.

The working capital requirement of the kilishi VSE is based on the assumptions summarized in Table 5.

Table 5. Assessment of the VSE's Working Capital Requirements.

Supplier Credit (SC)	: 05 days' sales
Raw Materials Inventory (RMI)	: 03 days' sales
Finished Goods Inventory (FGI)	: 05 days' sales
Indirect Production Costs (IPC)	: 7 days' sales

The components of the working capital requirement are summarized in Table 5.

Table 5 shows that working capital requirements for the very small kilishi company are estimated at 1 440 000 FCFA, compare for others enterprises it is very low and this could facilitate the opening of VSE's in the countries of the Lake Chad region.

3.2.4. Intangible Investments

(i). Human Resources

The company's staff is made up of one (01) body with the promoter (main unwinder) as head of the production workshop, assisted by 02 unwinders, 01 roaster and 01 salesman. The skill required is know-how in the technical aspects of kilishi production, with a focus on quality assurance.

(ii). Personalized Technical Assistance

One of the innovations most frequently requested by producers is the improvement of unwinding techniques, to make continuous production easier and ensure the availability of technologically high quality meats. In the same vein, the

acquisition of modern production and packaging equipment suited to the product's marketing system are among the innovations most requested by producers. The emergence of kilishi on the market justifies the need to master these factors in local production systems, in terms of:

- 1) Technological, socio-economic and even cultural analysis of the technical practices of kilishi industry players, including identification of the constraints associated with these practices;
- 2) Assessment of the perception of product quality and management by all actors in the technical system. The aim here is to identify the attributes of quality as perceived by the actors, and their management methods in relation to the constraints identified;
- 3) Technological characterization of kilishi product quality, involving analysis of the physico-chemical, microbiological quality and shelf life of marketed kilishi;
- 4) Identification of directions for improvement or innovation, based on the correlation between the perception and management of quality by actors-consumers and the technological quality of products.

The project requires technical assistance in packaging, mechanization of unit operations and quality assurance, valued at 2,073,600 FCFA, or 0.05% of sales.

3.3. Project Profitability and Solvency

The operating forecasts for a kilishiery indicate good profitability with an internal rate of return (IRR) of 30% relative to turnover from the sixth month of production, resulting in a payback period of three years for equipment with a lifespan of more than seven years. This is significant.

Considering a sensitivity of 10% in relation to direct material prices (Assumption 1) and a sensitivity of 10% in relation to turnover (Assumption 2), the profitability of the project is not compromised, but solvency deteriorates in the last two assumptions. These two assumptions show that fluctuations in the purchase price of raw materials and declines in sales are important factors on which the kilishierie fundamentally depends.

4. Conclusion

The stakes of this study were two-fold:

- 1) To show the economic potential of the kilishi technical production system in the Lake Chad region, in order to encourage the creation of VSE's and SME's to densify the economic fabric and improve the differentiated supply of animal proteins, and the employability of young people and people with special needs.
- 2) Enable the kilishi to benefit from the commercial appeal of Penja pepper and Dijon mustard.

This study shows that kilishi production is an activity with very high economic potential, and puts research support for

the development of decentralized local authorities in pole position, with a view to overcoming production constraints by implementing mechanization and structuring the technical production system in a way that favors the industrialization of the kilishi sector and the creation of job niches.

This pioneering work is part of a drive to modernize kilishi production and embrace a regional vision, in order to benefit from the economic attractions of a standardized, label-certified product that complies with international standards.

Therefore, mastering the construction of the kilishi system means defining:

- 1) Firstly, what are the technological indicators of kilishi quality in the Lake Chad region, in relation to the perception and management of quality by actors and markets?
- 2) Secondly, how to effectively integrate the mechanization of unit operations into a quality assurance approach to boost productivity and competitiveness of innovative VSE.

Abbreviations

FAO	Food and Agriculture Organization
FGI	Finished Goods Inventory
IPC	Indirect Production Costs
IRR	Internal Rate of Return
RMI	Raw Materials Inventory
SC	Supplier Credit
SME	Small and Medium Enterprises
SMART	Specific, Measurable, Achievable, Relevant, and Time-Bound
VSE	Very Small Enterprises
WCR	Working Capital Requirement
WHO	World Health Organization

Author Contributions

Aime Christian Ndihi: Conceptualization, Data curation, Investigation, Methodology, Project administration, Validation, Writing - original draft

Germaine Yadang: Formal Analysis, Investigation, Methodology, Writing - original draft

Robert Ndjouenkeu: Conceptualization, Investigation, Methodology, Project administration, Validation

Conflicts of Interest

The authors declare no conflicts of interest.

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