AN ENTREPRENEUR'S GUIDE TO BREAD-MAKING CASSAVA FLOUR PROCESSING AND COMPOSITE FLOUR BREAD PRODUCTION

Adebayo Abass, Abdul-Rasaq Adebowale, Gregory Nwaoliwe,
Adeniyi Ogunkoya, and Simon Lukombo

IITA Transforming African Agriculture
CGIAR SCIENCE FOR A FOOD-SECURE FUTURE
AFRICAN DEVELOPMENT BANK GROUP
GROUPE DE LA BANQUE AFRICAINE DE DÉVELOPPEMENT
TAAT Technologies for African Agricultural Transformation
ATA-RDC Agenda de la Transformation Agricole
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About IITA. The International Institute of Tropical Agriculture (IITA) is a non-profit institution that generates agricultural innovations to meet Africa's most pressing challenges of hunger, malnutrition, poverty, and natural resource degradation. Since 1967, IITA has worked with international and national partners to improve livelihoods, enhance food and nutrition security, increase employment, and preserve natural resource integrity. As one of 15 research centers in CGIAR, a global partnership for a food secure future, IITA is engaged in several CGIAR Research Programs (CRPs). IITA has delivered more than 70% of the CGIAR's impact in sub-Saharan Africa and remains committed to the science-driven improvement of agriculture and related food value chains. To help address poverty and the high number of unemployed young men and women in sub-Saharan Africa, IITA has initiated a Youth Agripreneurs program to create jobs by making agriculture and agribusiness appealing to the youth. The program is integrated into the Business Incubation Platform (BIP), the technology delivery arm of IITA, which serves as a model to stimulate product development and to provide opportunities for market expansion.

About TAAT. The Technologies for African Agricultural Transformation (TAAT) Program is the African Development Bank (AfDB) flagship program and a major component of the Feed Africa Strategy. The program is being implemented by a consortium of international agricultural research and development institutions led by the International Institute of Tropical Agriculture (IITA). TAAT is deploying proven agricultural technologies and innovations to African farmers in more than 35 countries with a focus on African priority commodities: cassava, maize, rice, fish, high-iron bean, wheat, orange-fleshed sweet potato, sorghum and millet, soybean, aquaculture, and small livestock. These value chains have high potential for helping Africa achieve food security and participate in global agricultural trade while reducing food importation. The consortium of national and international organizations is organized as a Compact around each commodity, design interventions, and national strategies to introduce the technologies and innovations to help nations transform their agriculture. The TAAT ecosystem of experts assists countries in designing, planning, and executing their agricultural loan projects as a vital element of the approach to attaining the desired agricultural transformation.

About the DR Congo Agricultural Transformation Agenda. ATA-RDC is a program of the Government of the Democratic Republic of the Congo designed to modernize the agricultural sector as part of the government's agenda to develop the 145 territories of the country. It focuses on the key value chains of cassava, rice, maize, soybeans, banana, beans, and aquaculture. IITA provides technical assistance to the nationwide program. It aims to double agricultural yields using improved crop varieties, fish breeds, and production inputs. Its goal is to create wealth and jobs through modernized agriculture by consolidating and building on several ongoing agricultural projects financed by development partners and banks. The program works closely with and provides technical assistance to a range of private sector entities, chiefly the Bio AgroBusiness (BAB) that operates on behalf of the Ministry of Agriculture. An essential priority of ATA-RDC is to develop the infrastructure and human competencies for the production of bread-making cassava flour (BCF) or high-quality cassava flour (HQCF) and its use in the bakery industry to reduce dependency on imported wheat.

About the CVCD Project. Cassava Value Chain Development to Support Food Security and the Bread Industry in DRC (CVCD) is an American government–funded project. It builds on American government bilateral interventions in deploying improved cassava production technologies to enhance the economic potential of the crop. The project aims to improve the livelihoods of small-scale producers and women while creating jobs for youth. The value chain approach seeks to strengthen cassava processing activities to produce high-quality food products, which can replace imported food items such as wheat flour. This will boost cassava agro-industrial and agribusiness activities, thereby attracting private sector participation. The goal of the project is to assist DRC in ameliorating food shortages resulting from the impact of Russian Federation's war on Ukraine. The project collaborates with other ongoing projects with similar objectives, such as the TAAT Program and ATA-DRC, to contribute to the cassava value chain development efforts of the DRC Government aimed at reducing the importation of wheat by at least 10% through substitution with bread-making cassava flour.

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PREFACE

As many African governments and industry leaders seek alternatives to imported wheat, cassava—a crop well adapted to African agriculture—offers both a practical solution and a powerful opportunity. By adopting bread-making cassava flour as a partial substitute for wheat in bread production, entrepreneurs can reduce costs, support local farmers, and create businesses that are both profitable and resilient.

An entrepreneur's guide to bread-making cassava flour processing and composite flour bread production is published as a practical, business-focused resource for individuals who want to start or improve a bakery enterprise using high-quality cassava–wheat composite flour. Drawing on tested techniques, market insights, and hands-on knowledge, the guide translates technical baking concepts into actionable business strategies.

The guide is written in clear, straightforward language tailored to early stage and aspiring entrepreneurs. It avoids complex technical jargon, while still providing technical accuracy and depth. Its content is organized into logical, easy-to-follow sections:

1. **Introduction**—Introduces bread-making cassava flour (BCF), explains who the guide is for, and sets out the business opportunity, benefits, and return on investment of substituting cassava flour for wheat.
2. **Context**—Places BCF in its policy setting, outlining the African governments' mandates on wheat substitution and the cost-saving and profitability case for bakeries.
3. **Business planning and financial management**—Walks through the practicalities of starting up, from choosing premises and costing equipment and depreciation to operational costs, pricing, break-even analysis, and working capital.
4. **BCF processing and quality control**—Describes the quality characteristics of BCF, the critical control points in its production, and the equipment needed to process it.
5. **Bread-making with composite flour**—Covers recipe formulation and scaling, water-absorption adjustments, mixing, kneading, fermentation, and timing to produce good-quality composite-flour bread.
6. **Overview of food safety and hygiene management**—Sets out the essentials of personnel and workplace hygiene, ingredient and equipment handling, pest control, cleaning protocols, and record-keeping.
7. **Quality standards and regulatory compliance**—Explains the national, regional, and international standards for BCF and composite flour, alongside labeling, packaging, and certification requirements.
8. **Marketing and value chain integration**—Addresses customer identification, supplier relationships, distribution, competitive advantage, and strategies for scaling the business.
9. **Documentation and record-keeping**—Explains why keeping records matters and what documentation a bakery or processing enterprise should maintain.
10. **Essential reference materials**—Provides supporting reference resources for use in day-to-day operations.

Each section combines practical knowledge with illustrative examples, checklists, and real-world applications. Readers can use the guide both as a training tool and as a reference manual in daily business operations. It is intended for: aspiring bakery entrepreneurs, particularly youth and women seeking income opportunities; small- and medium-scale bakery owners looking to transition to or integrate cassava-based products; agroprocessing startups interested in value addition to local crops; development practitioners, nongovernmental organizations (NGOs), and government programs supporting food enterprise development; and business trainers and incubation hubs offering mentorship in the agrifood sector. It is specifically suited for contexts where cassava is abundant, wheat prices are volatile, and there is a strong push for local sourcing and job creation.

This publication is part of a wider toolkit—including a *Trainer's manual*, *Learner's handbook*, and *Practitioner's workbook*—designed to support a complete ecosystem for cassava-based bakery development. As you turn these pages, we hope you will be inspired not just to bake, but to build enterprises that feed families, empower communities, and sustain local economies.

1: INTRODUCTION

WHO THE GUIDE IS FOR

This guide is for entrepreneurs looking at business investment opportunities in the cassava flour processing and bakery sectors.

BUSINESS OPPORTUNITIES IN A NEW OR EXPANDING SECTOR

Bread-making cassava flour (BCF) or high-quality cassava flour (HQCF) is a commodity with a growing future.

BCF is unfermented cassava flour prepared from freshly harvested cassava roots by peeling, washing, and grating the fresh cassava roots, then dewatering, drying, and milling. Processing, up to the drying stage, must occur within 24 hours of harvesting the cassava roots.

Already established in several countries, where the sector is expected to grow, it is also likely to play a vital role in local economic development in other countries where cassava is grown or where cassava or cassava flour can be easily imported from neighboring countries. Growth and opportunities are expected throughout the value chain from farms, through processing plants and flour mills, to bakeries and confectionaries. This guide focuses on the two stages likely to see the most growth and achieve the greatest returns on investment: processing raw cassava into high-quality unfermented flour and baking bread and pastry products.

BENEFITS OF BREAD-MAKING CASSAVA FLOUR INCLUSION IN BREAD PRODUCTION

Substituting up to 10% of wheat flour with BCF creates monetary savings throughout the value chain, as cassava and BCF are typically much cheaper than wheat and wheat flour, most of which is imported. Consumers also receive health benefits from bread made with BCF, as cassava flour shows a lower glycemic response and has a lower fat content than wheat flour. Processors add a new product to their range of commercial offerings in the form of BCF, and millers add composite cassava–wheat flour to their portfolios. Overall, the national economy benefits from a growing economic sector, savings on valuable foreign exchange spent on wheat imports, and improved domestic food security.

RETURN ON INVESTMENT

Data from Nigeria suggest that substitution of 10% of the wheat flour in bread-making with BCF improves the return on investment from 2.09 (i.e., 109% net gain) to 2.31 (i.e., 131% net gain).

2: CONTEXT

POLICY CONTEXT AND GOVERNMENT MANDATES

African nations have long depended on the international market for a primary staple—wheat. In late 2007, those nations faced a food and price crisis as international prices of staple foods reached record highs, and millions suffered. For many years, and especially since the food price crisis of 2007–2008, many African countries have sought to bolster their food security by reducing their reliance on volatile imports.

At the same time, national governments have been keen to improve their balance of payments to relieve the shackles of debt. At least seven African countries have determined that there is enough potential benefit from BCF to initiate projects, strategies, and even mandates. The governments of the Democratic Republic of the Congo (DRC), Ghana, Guinea-Bissau, Kenya, and Nigeria have all enacted either policies or national programs on substitution levels for BCF in bread-making and pastry production. These mandates, strategies, policies, and projects have not met with blanket acceptance across the bread-making value chains, but progress has been made, and these countries continue to promote BCF substitution and encourage local value chain actors to adopt it.

Taking the DRC as an example, the government set mandatory substitution levels at 5% for bread and 10% for pastries in combined efforts to reduce wheat imports, localize food value addition, and improve domestic food security.

FINANCIAL BENEFITS OVERVIEW: COST SAVINGS AND PROFITABILITY (ESPECIALLY FOR BAKERIES)

Wheat millers and bakers in particular gain cost savings simply because cassava root and BCF are usually cheaper in Africa (especially in cassava-producing countries and their neighbors) than (imported) wheat and (consequently) wheat flour. Moreover, composite bread-making cassava–wheat flour produces more loaves of bread (and cartons of biscuits) from the same amount of flour than 100% wheat flour. Since that bread is of similar quality to 100% wheat bread, the increase in product yield translates into increased profit. However, it is prudent for bakers to pass at least some of their savings on to their customers through reduced prices.

3: BUSINESS PLANNING AND FINANCIAL MANAGEMENT

PREMISES

Of all the capital outlays for setting up a business, locating suitable premises is probably one of the most difficult and may be the hardest to predict cost-wise.

BCF factory location selection

If you are considering setting up a cassava processing plant to produce BCF, you probably want somewhere close to the cassava farms. This is because of the need to shorten the transportation time and ensure processing of the freshly harvested cassava root within a strict and short timeframe (24 hours) after harvesting, combined with the fact that the BCF you produce should have a shelf-life to enable distribution to buyers (mills and bakeries) and aided by the likely cheaper cost (kilo for kilo) of transporting BCF compared with fresh cassava root.

Bakery location selection

Siting and selecting premises for a bakery may be a far more detailed process.

When selecting a viable bakery location, consider strong foot traffic regions, accessibility, rental cost, utilities, and proximity to suppliers and target customers, while also analyzing competition and national/local regulations. Choosing a location that is both accessible and visible to potential customers might give you an advantage over the competition.

Remember: A great baker can bake anywhere; the best bakeries choose the right location.

Whether a processing plant or a bakery, the building to be used may be available as owner's equity or rental. In the latter case, premises rental will be a major fixed, ongoing capital commitment. The building can be modest or elaborate in size and cost, depending on the location, resources available, or the wishes of the owner.

Bear in mind that you may have to bring the building up to health-and-safety and food-safety standards from your own funds.

EQUIPMENT INVESTMENT AND DEPRECIATION CALCULATIONS

As an entrepreneur, you are likely to want the latest and best equipment and machinery—and that will come at a cost. For the typical bakery, the oven is the most expensive item, making up at least 40% (often about half) of your fixed investment cost.

Be sure to include all the equipment required in investment calculations. A suggested list for a start-up bakery, with likely proportions of the fixed investment costs, is presented in Table 3.1.

Each piece of equipment has an economic life span, that is, the length of time you are likely to be able to use it before it needs to be replaced due to wear and tear. The expected economic life span is included in Table 3.1. For cost calculations and accounting, equipment cost is spread over its economic life.

Depreciation calculations

Depreciation calculation is a systematic method of allocating the cost of physical assets (mainly equipment and machinery) over their useful life.

Depreciation calculation formula: Depreciation is calculated using the straight-line method with the following formula:

> Daily depreciation cost = Asset value ÷ Economic life span (in days)

For annual calculations, this would be:

> Annual depreciation = Asset value ÷ Economic life span (in years)

Application in bakery operations: Daily depreciation costs are calculated for each item of bakery equipment with an "economic life span". For example:

- A medium-capacity diesel oven valued at US$9630.61 with an economic life span of 20 years has a daily depreciation cost of US$1.605
- A 10 kVA petrol generator valued at US$488.13 with an economic life span of 25 years has a daily depreciation cost of US$0.065.

ESSENTIAL TIPS FOR CHOOSING A BAKERY LOCATION

Target the right customer base

Understanding your ideal customer is the first step in choosing a bakery location. Consider:

- **Young professionals**—Set up near offices and commercial hubs.
- **Families and homemakers**—Look for residential areas with steady foot traffic.
- **Students**—A spot near schools, colleges, or universities ensures daily business.
- **Tourists**—A prime location in a busy market or near attractions works best.

High foot traffic = higher sales

A location with high foot traffic and purchasing power is crucial. Areas that work best for bakeries include:

- **Busy streets and main roads**—More visibility = more walk-ins.
- **Shopping malls and markets**—Customers looking for quick snacks and desserts.
- **Near cafés and restaurants**—People often grab a bakery item after a meal.

Avoid locations that are hidden, hard to access, or have low visibility.

Check competition in the area

Before finalizing your choice of location, analyze existing bakeries and competitors.

- **Too many bakeries?** The market may be oversaturated.
- **No bakeries?** Either a great opportunity or a sign of low demand.

Affordability and operating costs

A viable location comes at a price! Before committing to a spot, consider:

- **Rent and lease costs**—Can your expected revenue cover the rent?
- **Utility costs**—Water, electricity, and gas expenses may vary by area.
- **Taxes and permits**—Check existing tax rates and business regulations.

Accessibility and parking space

Your bakery should be easy for customers to reach. Consider:

- **Is there parking nearby?** Essential for customers who drive.
- **Is the location pedestrian-friendly?** More walk-ins = more sales.
- **Is public transport available?** Ideal for urban areas.

A location that is hard to access will not draw in customers, no matter how good your products

Proximity to suppliers and delivery services

Running out of ingredients during peak hours is every bakery owner's nightmare. Choose a location:

- Close to wholesale markets or ingredient suppliers for easy restocking
- Accessible for delivery services.

Space for kitchen and seating

Your bakery layout depends on whether you:

- **Only sell to retailers**—A big sales and cash collection room.
- **Only sell takeaway items**—A small space works.
- **Offer dine-in options**—Need enough space for tables and customer comfort.
- **Plan to expand**—Choose a location that allows for future growth.

Consider peak hours and seasonal demand

- Is the area busier in the **morning or evening**?
- Are sales higher on **weekends or weekdays**?
- Does foot traffic increase during **festivals or holidays**?

Government business regulations and licensing

Before signing a lease, ensure the location meets:

- Health and safety regulations
- Food licenses and fire safety approvals.

Avoid locations where you might face legal hurdles in the future.

Table 3.1. Example of equipment investment breakdown for bakery start-up.

EQUIPMENT	INVESTMENT (LIKELY %)	ECONOMIC LIFE SPAN (YEARS)
Oven(s) (diesel, electric, gas)	51.0	20
Delivery vehicle(s)	11.0	10
Dough mixers	19.0	25
Baking pans	3.7	5
Storage equipment (freezers)	1.8	5
Bread slicing machines	3.7	8
Dough dividers/cutters	2.8	12
Generator(s) for power backup	2.6	25
Bread cooling trolleys	1.7	12
Baker's table (wood, stainless steel)	0.9	
Plastic basins	0.1	
Wooden trays	0.2	
Pastry brushes	< 0.1	
Long-handled wooden spatulas	0.1	
Manual aluminum sieve	0.1	
Digital scale	0.4	
Weighing scale	1.8	
Dough scrapers	0.1	

For the bakery as a whole, the economic depreciation cost is the sum of the depreciation costs of all equipment (and infrastructure) on a daily or annual basis.

Key depreciation principles

1. **Asset-specific application:** Different equipment types have different economic life spans according to their durability and usage patterns.
2. **Systematic allocation:** Costs are distributed evenly throughout the asset's useful life.
3. **Business planning integration:** Depreciation must be factored into operational costs and profitability analyses.
4. **Investment proportion assessment:** Percentage calculations show each asset's contribution to total investment costs.

This approach ensures accurate financial analysis, allowing bakery enterprises to properly account for the gradual reduction in asset value when determining actual operational costs and profitability.

OPERATIONAL COST STRUCTURE: FIXED VS. VARIABLE COSTS

Operational costs are divided into fixed and variable costs. Fixed costs apply regardless of the amount of work done, while variable costs change in proportion to the total volume of activity. Thus, connecting to public (or private) utilities, equipment and its installation, repairs and maintenance, administration, and insurance are all fixed costs. Marketing costs (e.g., signage, flyers, labels) are also considered fixed costs. Almost everything else is variable costs.

An example of the costs for the first month (including start-up investment) for a small-scale bakery start-up is presented in Table 3.2.

Table 3.2. Example of costs in a small-scale bakery business start-up, first month (excluding bakery building).

COST TYPE	COMPONENT	VALUE (US$)*	PERCENTAGE (%)*
Fixed	Utility, equipment, and installation cost: *Production infrastructure and networking with public infrastructure, including drainage, septic tank, electricity connection*	8,950	67
	Electricity generator	2,150	16.0
	Administration †	250	1.9
	Repairs and maintenance	560	4.2
	Waste and insurance	35	0.3
	Marketing—flyers, labels, signage, etc.	165	1.2
	Subtotal	12,110	90.4
Variable	Raw material	250	1.9
	Water	15	0.1
	Packaging	35	0.3
	Electricity (and/or other energy sources)	115	0.9
	Communication	30	0.2
	Wages (8 staff)	700	5.2
	Miscellaneous	135	1.0
	Subtotal	1,280	9.6
	Total §	**13,390**	

* Of the total budgeted funds (guide only); † may vary month to month and may include operational oversight, record-keeping, and compliance documentation; § excluding building construction or lease.

REVENUE PROJECTIONS AND PRICING STRATEGIES

An example of daily costs, returns, and profit component analysis is provided in Table 3.3 (A–D).

Production capacity

Production capacity will be determined as the bakery reaches production efficiency and adjusted according to customer demand.

Price points and revenue

Revenue is the price per loaf multiplied by the number of loaves sold (Table 3.3C).

Table 3.3A. Daily cost and return analysis of an example bakery enterprise using BCF–wheat composite flour (at 10% BCF inclusion)—Fixed investment costs.

ITEM	QTY	UNIT PRICE (US$)	VALUE (US$)	ECONOMIC LIFE (YEARS)	DEPREC. (US$/DAY)	% OF INVEST-MENT COST
Diesel oven (medium capacity)	1	9,630.61	9,630.61	20	1.320	51.80
10 kVA petrol generator	1	488.13	488.13	25	0.053	2.62
Bread-cooling trolley shelves, 200-bread capacity	2	158.31	316.62	12	0.072	1.70
Dough mixer (50 kg capacity)	1	3,562.01	3,562.01	25	0.390	19.10
31-blade bread-slicing machine	1	422.16	422.16	8	0.144	2.27
Bread baking pan (3 in 1)	150	4.62	692.61	5	0.379	3.72
Dough scraper (small size, stainless steel)	5	4.62	23.09	5	0.013	0.12
Digital scale	1	72.56	72.56	6	0.033	0.39
Baker's table (stainless steel)	1	171.50	171.50	10	0.047	0.92
Delivery vehicle (tricycle)	1	1,978.89	1,978.89	10	0.542	10.60
Chest freezer (310 liter)	1	329.82	329.82	5	0.181	1.77
Dough divider/dough cutter	1	521.11	521.11	12	0.119	2.80
Plastic basins for bread processing (medium size)	4	3.30	13.19	5	0.007	0.07
Wooden trays	12	2.64	31.66	5	0.017	0.17
Pastry brushes	3	1.32	3.96	2	0.005	0.02
Long-handled wooden spatulas/paddles	3	4.62	13.85	3	0.013	0.07
Manual aluminum sieve	1	9.89	9.89	4	0.007	0.05
Weighing scale	1	329.82	329.82	35	0.026	1.77
Total depreciated cost/day (US$)					3.370	100.00

Table 3.3B. Daily cost and return analysis of an example bakery enterprise using BCF–wheat composite flour (at 10% BCF inclusion)—Operational costs.

ITEM	QUANTITY/VALUE PER DAY	UNIT PRICE (US$)	DAILY VALUE (US$)	% OF OP. COST
Wheat flour	315 kg	0.92	289.80	77.80
High-quality cassava flour	35 kg	0.43	15.05	4.04
Fuel cost (gasoline) for both tricycle and generator	15 liters	0.73	10.95	2.94
Salt at 0.1 kg/50 kg flour	0.7 kg	0.26	0.18	0.05
Baking soda per 350 kg of flour ($0.02/kg flour)	350 kg	0.02	7.00	1.88
Sugar at 1.2 kg per 50 kg bag of flour	8.40 kg	0.86	7.22	1.94
Improver at 0.3 kg per 50 kg flour	2.1 kg	4.40	9.24	2.48
Labor cost at US$92.8/month (1 supervisor at US$40 and 2 attendants at US$26.4 each)	US$3.87	N/A	3.87	1.04
Rent of factory house per day	1 day	2.64	2.64	0.71
Preservative (0.3 kg/50 kg flour)	2.1 kg	0.20	0.42	0.11
Yeast at 0.05 kg per 50 kg wheat flour	0.35 kg	3.96	1.39	0.37
Shortening at 0.5 kg per 50 kg flour	3.50 kg	1.98	6.93	1.86
Repairs and maintenance per day (US$)	1 day	1.32	1.32	0.35
Cost of electricity per day (US$)	1 day	0.82	0.82	0.22
Packaging cost (packs of 100)	12 packs	1.32	15.84	4.25

Table 3.3C. Daily cost and return analysis of an example bakery enterprise using BCF–wheat composite flour (at 10% BCF inclusion)—Revenue.

ITEM	QUANTITY	US$/LOAF	TOTAL REVENUE (US$)
Sales of big bread	528	1.19	628.32
Sales of small-loaf bread	602	0.40	240.80
Total loaves of bread produced per day	1,130		
Total benefit (revenue) per day (US$)			865.17

Table 3.3D. Daily cost and return analysis of an example bakery enterprise using BCF–wheat composite flour (at 10% BCF inclusion)—Analysis.

	AMOUNT IN US$
Total revenue (benefit) per day	869.12
Total investment cost per day	3.37
Total operational cost per day	372.67
Total cost per day	376.04
Net benefit (return to labor and management) per day	493.08
Total benefit per kg of wheat flour and BCF	2.48
Total cost per kg of wheat flour and BCF	1.07
Net benefit per kg of wheat flour and BCF	1.41
Return on investment (ROI)	2.31

Sales volume analysis

Sales volume is the revenue stream for all the bread produced. This is used to calculate profit or net benefit.

Example analysis

Daily production using 10% cassava flour:

- Total output: 1130 loaves
  - Large bread: 528 loaves
  - Small bread: 602 loaves.

Market prices:

- Large bread: US$1.19 per loaf (revenue: US$628.32)
- Small bread: US$0.40 per loaf (revenue: US$240.80)
- Total daily revenue: US$869.12.

Per day:

- Total production cost: US$376.04
- Total revenue: US$869.12
- Net benefit: US$493.08.

Note: The figures and prices used in the analysis are only for explanatory purposes. The unit weights and prices of bakery inputs and output product (bread) vary by location and the specific characteristics of the enterprise or bakery, and they change over time. The prices in this guide may not apply to your location or country.

Pricing strategy

The level at which you set your prices will be dictated by your daily costs, daily production, and desired or feasible profit margin. In setting prices, you need to consider and balance:

- Production costs
- Market rates
- Customer purchasing power
- Competition.

You are unlikely to maximize your sales if you set prices too high in relation to the local market and nearby competitors. Your bread must also be affordable for your target customer base without being so cheap they would worry about the quality of your product.

PROFITABILITY AND BREAK-EVEN ANALYSES (BAKERY EXAMPLE)

We analyze profitability of bread-making with 100% wheat flour and composite cassava–wheat flour by means of a generalized case study based on field surveys of Nigerian bakeries.

Key assumptions made in the calculation of the profitability analysis

The following key assumptions were made in calculating the profitability of bread-making using 100% wheat flour and composite cassava–wheat flour.

- The investor had already secured the building or structure for the bakery.
- Bread production was captured per day, which involves two production shifts.
- The BCF substitution level was 10%.

- Modern baking machinery was used for the fixed investment cost of bread production by a small- to medium-sized enterprise (SME) bakery.
- An estimated 7 bags of 50 kg wheat flour each were used per day (i.e., 350 kg wheat flour total). This was a mean value derived from interviews of bakers, caterers, and other key stakeholders.
- Bread prices were determined based on the market price at the time of data collection and profitability calculation.
- The quantities of other ingredients (sugar, yeast, shortening, salt, preservative, etc.) per kilogram of flour were also based on mean values obtained from field data collection and experience.
- A tricycle was used for transporting bread to the retailers/market, as this reduces overhead costs, and its use is becoming popular among African SME bakers.

Profitability components and calculations

For accurate determination of profitability, you need detailed cost, production, and sales data, as shown in Tables 3.4 and 3.5.

Table 3.4. Daily cost and return analysis, typical Nigerian bakery using 100% wheat flour.

REVENUE			
Output (production)	**Quantity**	**Price (US$/loaf)**	**Total revenue (US$)**
Big bread	500	1.19	595.00
Small-loaf bread	560	0.40	224.00
Total number of loaves of bread produced per day	1,060		
Total benefit (revenue) per day			**819.00**
COSTS			
Fixed costs (US$)			
Depreciation (machinery and equipment)			3.37
Rent			2.64
Equipment maintenance			1.32
Operating costs (US$)			
Ingredients (including 350 kg wheat flour)			354.38
Fuel (for delivery vehicle and generator)			10.95
Labor (1 supervisor @ US$40/month; 2 laborers @ US$26.40/month)			3.85
Fuel (electricity for operations, ovens, etc.)			0.82
Packaging			14.52
Total cost per day			**391.85**
Net benefit (return to labor and management)			427.15
Total benefit per kg wheat flour used			2.34
Total cost per kg wheat flour used			1.12
Net benefit per kg wheat flour used			1.22
Return on investment (ROI)			**2.09**

Table 3.5. Daily cost and return analysis, typical Nigerian bakery using composite cassava–wheat flour (10% BCF).

REVENUE			
Output (production)	**Quantity**	**Price (US$/loaf)**	**Total revenue (US$)**
"Big bread"	528	1.19	628.32
Small-loaf bread	602	0.40	240.80
Total number of loaves of bread produced per day	1,130		
Total benefit (revenue) per day			869.12
COSTS			
Fixed costs (US$)			
Depreciation (machinery and equipment)			3.37
Rent			2.64
Equipment maintenance			1.32
Operating costs (US$)			
Ingredients (including 315 kg wheat flour, 35 kg BCF)			337.23
Fuel (for delivery vehicle and generator)			10.95
Labor (1 supervisor @ US$40/month; 2 laborers @ US$26.40/month)			3.87
Fuel (electricity for operations, ovens, etc.)			0.82
Packaging			15.84
Total cost per day			**376.04**
Net benefit (return to labor and management)			493.08
Total benefit per kg of wheat flour and BCF used			2.48
Total cost per kg of wheat flour and BCF used			1.07
Net benefit per kg of wheat flour and BCF used			1.41
Return on investment (ROI)			**2.31**

Return on investment

Return on investment (ROI) is calculated using the following standardized formula:

ROI = Total benefit (revenue) ÷ Total cost

This ratio provides a clear metric of financial efficiency, indicating how effectively the invested capital generates profit.

Application in bakery business assessment (example)

Example ROI calculation through comprehensive cost–benefit analyses:

- 100% wheat flour operation (Table 3.4): ROI of 2.09
  - Total benefit: US$819.00 per day
  - Total cost: US$391.85 per day
  - Interpretation: Every US$1.00 invested generates US$1.09 in profit.
- Composite flour operation (10% BCF inclusion) (Table 3.5): ROI of 2.31
  - Total benefit: US$869.12 per day
  - Total cost: US$376.04 per day
  - Interpretation: Every US$1.00 invested generates US$1.31 in profit.

A breakdown of profit components from this example is given in Figure 3.1.

Comparative ROI analysis significance

The differential between these ROI values (2.09 vs. 2.31) demonstrates:

1. Higher financial efficiency with composite flour utilization
2. Reduced operational costs through strategic ingredient substitution
3. Enhanced production output (1060 vs. 1130 loaves per day)

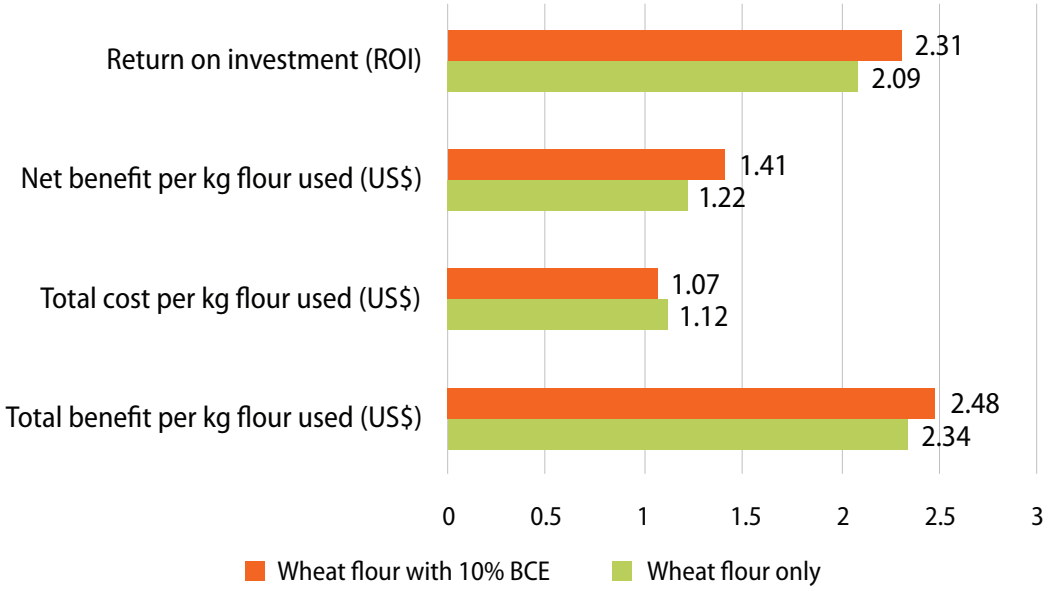

Figure 3.1. Total benefit (revenue), cost, and net benefit per kg of bread produced using 100% wheat flour and composite cassava–wheat flour.

4. Improved net benefit per kg of flour utilized (US$1.22 vs. US$1.41).

Strategic implications

ROI assessment enables:

- Quantitative evaluation of different production methodologies
- Data-driven decision-making for resource allocation
- Evidence-based policy recommendations for stakeholders
- Benchmarking opportunities across production environments.

Production economics

Per-kilogram metrics with composite flour:

- Total benefit: US$2.48
- Total cost: US$1.07
- Net benefit: US$1.41.

Break-even analysis

The break-even point is where your revenue exactly matches your costs—this means selling enough loaves to cover daily costs. In the case of composite bread presented in Table 3.5, with a total daily cost of US$376.04, this means the point at which sales reach exactly US$376.04.

WORKING CAPITAL REQUIREMENTS

Working capital is the "cash in hand" needed for daily, weekly, and monthly expenditure. These funds need to cover all monthly operational costs and be managed with a keen eye on cash flow.

Monthly operational needs

- Raw materials inventory
- Staff wages
- Utility costs
- Packaging materials
- Maintenance reserves.

Cash flow considerations

- Daily sales provide working capital for the next day's production
- Maintain ingredient inventory for 7–14 days of production
- Plan for seasonal variations in demand and ingredient availability.

4: BCF PROCESSING AND QUALITY CONTROL

QUALITY CHARACTERISTICS OF BCF

What makes cassava flour suitable for bread-making?

BCF is unfermented cassava flour prepared from freshly harvested cassava roots by peeling, washing, and grating the fresh cassava roots, then dewatering, drying, and milling. The processing to a dried product must occur within 24 hours after harvest due to the high perishability of cassava roots.

In contrast, several traditional cassava processing methods are applied in different countries to make cassava flour. All traditional processing techniques involve fermentation in various forms (e.g., chipping, soaking of peeled or unpeeled roots, combined with other steps such as sun-drying) before milling. The key difference between traditionally processed cassava flour and BCF is the fermentation of the former. Fermented, traditionally processed cassava products are not suitable for baking and some industrial applications.

BCF must also adhere to strict quality requirements (defined in international, continental, regional, and national standards: see chapter 7). This is achieved in large part by conscious adherence to good manufacturing practices (GMP) and good hygiene practices (GHP).

Quality specifications

BCF has specific quality requirements that distinguish it from traditional cassava flour.

- BCF must be:
  - White (or cream/yellow if from biofortified varieties)
  - Odorless and tasteless
  - Finely textured
  - Free from foreign matter and fungal contamination
- And have:
  - Low bacterial content
  - Moisture content of no more than 12% (preferably no more than 10%)
  - pH in the range of 5.8–7.0
- And must meet hygiene and safety standards for human consumption.

Key quality specifications for local and export markets are detailed in chapter 7.

PROCESSING AND CRITICAL CONTROL POINTS

The processing of (freshly harvested) cassava roots is critical. Any deviation from the detail and timing of each step will likely lead to a substandard product, which millers or bakers will (or at least should!) reject.

To maximize profit, select (buy) cassava varieties with high dry matter content. The target recovery rate (kg of BCF per kg cassava root) is above 25%.

- Processing timeline: 24-hour requirement from cassava harvest to drying—critical.
- Apply GMP and GHP.
- Processing steps (and *critical control points*):
  - Careful root selection to ensure appropriate quality raw material
  - Thorough peeling within 12 hours of harvest
  - Washing with clean water
  - Appropriate grating
  - Thorough dewatering to remove moisture and cyanide—efficiency
  - Granulation and drying to optimal moisture content—target moisture levels
  - Milling—particle size
  - *Proper packaging and storage conditions*
  - Labeling.
- Monitor and control at each stage to ensure quality.
- Test methods are available for moisture, contamination, and safety of final products, but all these are the results of the processing steps—hence the need for full-process monitoring.

- Hazard control: application of the Hazard Analysis Critical Control Point (HACCP) principles helps identify hazards in the process so that safeguards can be put in place to ensure high-quality BCF suitable for human consumption.
- Documentation is required for (chapter 9):
  - Enterprise management
  - Traceability and quality control
  - Proof of compliance with health-and-safety protocols, GMP, GHP, governmental manufacturing and trade regulations, and appropriate standards.

EQUIPMENT NEEDS FOR BCF PRODUCTION

Graters

Grating is the second mechanical step in the BCF processing line after peeling. It converts peeled cassava roots into a smooth pulp or mash suitable for dewatering. Cassava graters use a combination of impact, shear, and grinding forces to break down peeled cassava roots into a pulp or mash. This is typically achieved with a rotating drum or saw blade and a mesh or sieve that allows the desired size of the mash to pass through, while larger cassava root pieces are re-grated. The necessary force can be applied with an electric, petrol, or diesel-powered motor. The peeled cassava is usually fed into the grating machine through a hopper.

Dewatering press

The pressing machine is used in cassava processing to remove excess water from grated cassava to improve drying efficiency and product quality. Pressing machines use hydraulic pressure to remove water from grated cassava. This process reduces moisture content, preparing the pulp for further processing such as drying. The pressing machine may be a screw or hydraulic type. It includes a pressing chamber, a pressing plate or screw, a motor or hydraulic system, and a collection tray for expelled water.

Dryers

The flash dryer is a critical component in the cassava processing line. It is used to rapidly dry cassava flour or starch to a safe moisture content for storage and further processing. A flash dryer operates on the principle of rapid moisture evaporation by exposing wet material to high-velocity hot air for a very short time, causing near-instantaneous drying. The material is typically suspended within the hot air stream, maximizing heat contact with the cassava particles' surface area and facilitating rapid heat transfer for moisture removal. The dried material is then separated from the air stream using cyclones or bag filters.

The flash dryer system consists of a hot-air generator, blower, drying column, cyclone separator, and product collection system. The system operates by introducing moist cassava grits into a hot air stream, causing instant drying as the material is suspended and conveyed through the drying column.

Mill

Milling is the final mechanized stage in cassava flour processing. A hammer mill is used to mill dried cassava grits into fine flour suitable for baking. A hammer mill primarily relies on impact and friction between the material, the hammers, and the casing of the mill to achieve the desired particle size. In a hammer mill, multiple rotating hammers cause impact and friction to break the cassava grits into fine particles. The mill forces the finest particles to pass through a sieve or screen of predetermined aperture size to produce a fine flour.

Troubleshooting basics

ISSUE	POSSIBLE CAUSE	SOLUTION
Graters		
Low output	Dull blades	Sharpen or replace blades
Machine vibrates excessively	Unbalanced drum or loose fittings	Rebalance drum, tighten parts
Clogged hopper	Feeding too fast or wet tubers	Slow feed rate, drain tubers
Motor overheating	Prolonged use or overload	Allow to cool, reduce load
Dewatering press		
Low pressure	Hydraulic fluid low or leaking	Refill or repair system
Incomplete pressing	Overload or short cycle	Reduce load, extend cycle time
Leaking water tray	Blocked drain or damaged tray	Clear drain or repair tray
Loud operation	Worn mechanical parts	Inspect and replace parts
Flash dryer		
Low drying efficiency	High moisture in input or low heat	Check feedstock, adjust temperature
Blocked pipes	Product build-up	Stop operation and clean pipes
Overheated product	High temperature	Reduce furnace heat setting
No product output	Cyclone clogged	Inspect and clean cyclone
Hammer mill		
Uneven flour size	Damage to the mesh	Repair mesh/use appropriate mesh size
Motor overload	Overfeeding or hard material	Reduce feed rate
Excessive noise	Loose hammers or bearings	Tighten or replace components
Poor output	Blocked screen or blunt hammers	Clean or replace parts

5: BREAD-MAKING WITH COMPOSITE FLOUR

RECIPE FORMULATION AND SCALING

Most experienced bakers have their own preferred bread recipe. If you are starting from scratch, the two example recipes in Table 5.1 have proved successful in DRC.

In any new context—for example, your new bakery—always make a sample batch of bread to verify that the recipe works in the new environment. It may well need some tweaking, usually in processing times (mixing, fermenting, baking, cooling) or the amount of water required to achieve dough with the right texture. If the first batch does not work as planned, experiment until you find a combination of factors that does.

Whatever the recipe, scaling up or down is simply a matter of maintaining the ratio of ingredients, except for water. For correct hydration, a larger or smaller batch may require more or less water than the original recipe.

WATER ABSORPTION ADJUSTMENTS FOR COMPOSITE FLOUR

As a general rule, for composite flour with up to 10% BCF, tried-and-tested bread recipes for 100% wheat flour work perfectly. The only adjustment is likely to be the amount of water required for proper hydration (dough consistency). Again, test batches and a little experimentation are your best friends. With careful monitoring of hydration and dough development, one test batch should be enough.

The issue with hydration is that cassava and wheat have rather different starch properties, and the different types of starch granules must be blended carefully to achieve a good dough structure.

MIXING, KNEADING, AND FERMENTATION

The key point with mixing dough made from composite cassava–wheat flour is the alignment of the different starch granules from the two blended flours. This is achieved by graduated mixing—starting slowly and increasing speed (mechanical) or vigor (hand mixing) as the gluten network develops.

Once the ingredients are mixed and hydrated, continued mixing (known as kneading) gradually develops the gluten network, which is essential to the structure of bread (and pastries).

Mechanical mixers do both stages: mixing and kneading. Separate kneading machines are also available, but unnecessary if you are using a mechanical mixer.

Fermentation—also known as proofing—is the stage after mixing and kneading when the dough is allowed to "rest". The action of yeast enzymes creates alcohol (fermentation) and carbon dioxide. The latter results in the lump of dough increasing in size (if the gluten network is improperly formed, the gas bubbles will not create the desired bread structure).

Some modern proofing cabinets allow dough to be cooled or even frozen, to slow fermentation or even stop it. This enables scheduling, such as preparing the dough the night before for baking first thing in the morning, ready for commuter rush hour or other early morning busy times.

TEMPERATURE AND TIMING MANAGEMENT

Temperature is key for both fermentation and baking. The ideal temperature for fermentation is 20–30 °C, which is easily achieved in tropical climates, where ambient temperatures are high. Lower temperatures will slow the fermentation process, and freezing the dough will stop it altogether. Remember that both chilled and frozen dough will need to reach ambient temperature before normal fermentation speed is regained, and that fermentation will continue slowly even as the dough warms.

Table 5.1. Example recipes from DRC

INGREDIENT	RECIPE 1: BASIC BREAD	RECIPE 2: ENHANCED BREAD
Wheat flour (kg)	45	45
BCF (kg)	5	5
Yeast (g)	300	900
Salt (g)	43.5	60
Water (liters)	25	30
Sugar (g)	0	80
Baking powder (g)	0	50
Colorant (g)	0	25
Vegetable oil (liters)	0	1

When it comes to baking, an oven temperature of 230–273 °C has proved successful in DRC for baguette baking, while 200 °C is appropriate for "Nigerian" or "British" bread. This oven temperature enables the dough to reach an internal temperature of 60–80 °C, at which it transforms into baked bread with the required texture.

When starting in a new context or conducting a trial, approximate timing for fermentation is determined in the trial bakes and experiments. Fermentation should be monitored carefully during these trials to determine when the fermentation process has done its job and the dough is ready for the next step (shaping or baking). Once the approximate timing is known and the fermentation environment is consistent and stable, the dough can be left to ferment and then checked at intervals from, say, half an hour before the expected completion time.

Studies have shown that fermentation may take between 1.5 and 3 hours at ambient temperature in DRC and most sub-Saharan African bakeries.

QUALITY CHARACTERISTICS OF COMPOSITE-FLOUR BREAD

Bread made with composite flour containing up to 10% (or even 20%) BCF should differ little from similar bread made from wheat flour alone.

The finished bread should have:

- Golden-brown crust
- Light, airy texture
- Even crumb structure.

However, the details of a bread's appearance and structure will depend on the type of bread you are making and the preferences of your customers.

It is important that your various types of bread are consistent in size and quality (hence the need to maintain records so that any substandard bread can be diagnosed and the process rectified quickly).

6: OVERVIEW OF FOOD SAFETY AND HYGIENE MANAGEMENT

Personal and environmental hygiene are very important in bakeries as bread is highly prone to contamination from the environment, including workers. Yet, local bakeries are generally characterized by poor hygiene.

PERSONNEL HYGIENE

Workers should:

- Not work when unwell.
- Wash their hands thoroughly with soap and water:
  - Including under their fingernails
  - After visiting the toilet
  - Before handling raw materials, flour, or bread
  - After handling eggs and before contact with other food
  - After removing gloves.
- Wear personal protective equipment (supplied by the bakery owner/manager):
  - Apron
  - Hair covering
  - Disposable gloves
  - Covered nonslip shoes.
- Use clean gloves when handling raw materials and bread products.
- Never handle bread products with your bare hands.

WORKPLACE SAFETY

There are a number of hazards in processing plants and bakeries that need to be anticipated and avoided.

- Many **cleaning materials** are hazardous chemicals and should be stored in a lockable room or cupboard well away from working areas and only accessible to cleaners and in case of emergency (e.g., spillage).
- **Machines** present moving parts that can entrap anything that gets too close (e.g., long hair, loose clothing, implements, and fingers!). They may also have sharp edges liable to catch or cut clothing or hands—operators need to be aware of these and be shown how to minimize the risks.
- **Ovens** are hot, posing a risk of burning—oven operators, loaders, and unloaders need to be aware of the risks.
- **All personnel** should:
  - Be aware of machinery hazards
  - Know where the first aid kit is kept, and how to use it
  - Know where the fire extinguisher is kept and how to use it
  - Know where the exits are in case of need for evacuation.

It is probably best if each premises has two staff trained in first aid, to ensure there is always at least one first aider on site.

INGREDIENT HANDLING AND STORAGE

For the most part, the ingredients used in bread-making are harmless. The major exceptions are raw cassava (especially some varieties with high cyanide content) and cracked raw eggs (potential *Salmonella* contamination)—workers should always wash their hands after handling raw cassava or raw eggs. That said, all ingredients must be handled with respect for the finished product, which needs to be free of physical, chemical, and biological (e.g., mycological) contaminants. For that reason, we recommend handling all ingredients (and products) with clean gloves (change gloves between ingredients when handling, sorting, measuring, and before handling finished products). Finished products must not have contact with raw ingredients.

Store ingredients in food-grade closed (for most purposes, airtight) containers and organize storage to enable first-in, first-out (FIFO) protocols to avoid the danger of ingredients sitting on the shelf beyond their best-before dates. Stores should be kept clean, at a suitable temperature, and well ventilated.

Particular care should be taken with eggs:

- Ensure eggshells are not cracked upon receipt and discard cracked eggs.
- Store eggs at a cool temperature until needed (e.g., refrigerated at 4° C).
- If storing eggs at room temperature:
  - Use the current batch daily
  - Replenish stocks daily.

- When pooling eggs:
  - Pool only the quantity required
  - Use all pooled liquid eggs on the same day
  - Do not top up with new eggs.
- Prepare raw eggs away from other food, especially cooked and ready-to-eat food.

EQUIPMENT SANITATION PROCEDURES

Machinery and equipment should be dismantled and cleaned after every batch according to the manufacturer's instructions. Pay particular attention to all surfaces that come into direct contact with ingredients, dough, or bread, as well as to the nooks and crannies where particles and germs can hide. Equipment should be allowed to dry thoroughly before reassembling.

PRODUCT SAFETY

As with ingredients, finished products should be handled carefully with gloved hands. Ensure that both flour and bread are cooled in a clean and dry environment to avoid contamination or moisture uptake. Package both flour and bread as soon as they are cool enough. Label packages with manufacturing date and lot number, your company name and contact details, and best-before date. Sell and transport products on a first-made, first-out basis.

FACILITY CLEANING PROTOCOLS

Essential daily cleaning tasks

- Clean processing area, make-up room, and display areas
- Clean all equipment, utensils, and work surfaces after each use (i.e., per batch)
- Sweep and mop all floors thoroughly
- Clean walls
- Check storage areas for cleanliness and organization.

General facility cleaning

- Plan and follow a systematic cleaning schedule
- Clean floors, walls, drains, and work surfaces daily
- Maintain proper ventilation
- Ensure adequate lighting for cleaning visibility.

Waste management and cleaning

- Practice good waste management with regular (daily) removal
- Clean waste containers regularly (daily)
- Maintain adequate drainage systems.

PEST CONTROL MEASURES

- Implement effective pest control programs
- Conduct regular facility inspections
- Maintain equipment properly to prevent damage that attracts pests
- Promptly repair or replace damaged equipment to prevent contamination
- Keep ingredients, food, and flour stored in sealed containers
- Remove food debris and standing water
- Document all pest control activities
- Remember that exclusion is better than management, and remember the types of pests you are likely to encounter:
  - Rodents (rats and mice)
  - Insects and other arthropods:
    - Beetles (including lesser grain borer, a known major pest of wheat flour)
    - Weevils
    - Moths
    - Mites
    - Cockroaches
    - Flies
    - Book lice (psocids)
    - Ants
  - Birds
  - Bats (roosting bats may contaminate work surfaces, ingredients, and products through their saliva, urine, and feces—when combined with proper storage of ingredients and products, thorough cleaning at the start of the working day should remove this threat)
- If chemical pesticides are used, ensure that they are kept well away from all foodstuffs—ingredients and finished products—both when being stored and when being used.

DOCUMENTATION AND RECORD-KEEPING

Proper documentation of hygiene, food safety, and health and safety actions confirms compliance with regulations and legal requirements. It also provides a record for cross-checking when something goes wrong.

See chapter 9 for details of what should be recorded and documented.

7: QUALITY STANDARDS AND REGULATORY COMPLIANCE

Quality standards are vital for public health. At the regional, continental, and international levels, they also greatly simplify and facilitate international trade (export and import). Adherence to the applicable standards is essential if you are to sell your products on the market.

Well-packaged, good-quality BCF is a potential export product; however, bread and pastries are unlikely to be exported, unless your bakery is in a border town.

KEY COMPONENTS OF NATIONAL STANDARDS FOR BCF AND COMPOSITE FLOUR (LOCAL REQUIREMENTS)

It is important that processors, wheat flour millers, and bakers all understand the standards and specifications for BCF and composite cassava–wheat flour in their countries of operation. Processors need to produce BCF that is of the quality required by local standards; millers need to know the required quality standards, be able to assess the quality of incoming BCF, and ensure output of wheat and composite flours to local standards; bakers need to know the quality standards and be able to assess the quality of the flour they purchase, be it composite flour or a combination of wheat flour and BCF for in-bakery blending.

National standards typically cover the following important aspects:

- Particle size
- Moisture content
- pH
- Biological contamination (e.g., bacteria, mycotoxins)
- Cyanide
- Minimum BCF inclusion levels in composite cassava–wheat flour (e.g., 5% for bread, 10% for pastries, in DRC by regulation).

Other relevant standards and recommendations:

- African standards for BCF set maximum contamination levels for total aflatoxins (≤ 10 µg/kg) and for aflatoxin B1 (≤ 5 µg/kg).

EXPORT READINESS: KEY COMPONENTS OF REGIONAL AND INTERNATIONAL STANDARDS (ESPECIALLY FOR BCF AND COMPOSITE FLOUR)

If you plan to export your product (particularly BCF), it needs to meet several sets of standards:

- Country of production (exporting country)
- Importing country
- Any overarching standards:
  - Regional standards for trade within the specified region (trade bloc)
  - Continental standards for trade within Africa but outside the regional trading bloc(s) of which the exporting country is a member
  - International standards (Codex Alimentarius) for trade on the international market.

In our "case study" geographic scope, only the regional (East African) and continental (African) standards include specifications for composite flour.

Key areas where standards overlap

All levels of standards agree on fundamental requirements:

- **Food safety basics**—No harmful bacteria, acceptable contaminant levels
- **Basic quality**—Product must be suitable for its intended use
- **Hygiene principles**—Good manufacturing and hygiene practices required
- **Labeling fundamentals**—Products must be properly identified and dated.

Where standards differ significantly

Particle size requirements

- African: 95% through 250 µm (0.25 mm) (BCF); 90% through 250 µm (composite)
- East African: 90% through 250 µm (0.25 mm) (both).

Practical application: If you are processing BCF for regional export, you need to meet the strictest requirements to access all markets.

pH requirements (BCF only)

- African: Not specified
- East African: 5.5–7.0.

Cyanide limits (BCF only)

- African: Not specified
- East African: ≤10 mg/kg.

Moisture content

- African: Not specified in BCF standard
- East African: ≤ 12%.

Note: IITA recommends ≤ 10% moisture content for optimal bread-making performance and shelf stability, which is stricter than all the official standards.

Composite flour inclusion requirements

This is where national policies create the biggest differences.

Minimum BCF inclusion levels:

- African: No specified levels
- East African: Minimum 10% for any composite flour.

Practical impact: DRC allows lower inclusion levels than regional standards, giving DRC bakers more flexibility for gradual adoption.

Microbiological limits (detailed specifications)

- Specified in African and East African standards
- Both set specific limits for *E. coli*, *Salmonella*, yeasts and molds
- African standards also set limits on total plate count, *Vibrio cholera* (both for BCF only), *Staphylococcus aureus*, and coliform bacteria
- The Codex standard refers to the Codex *General Standard for Contaminants and Toxins*.

Starch content minimum

- Only specified in East African standards (≥ 60%)
- Ensures adequate functional properties for bread-making.

Aflatoxin limits

- African: ≤ 10 µg/kg total, ≤ 5 µg/kg for aflatoxin B1
- East African: Not specifically addressed.

Crude fiber

- East African (maximum): 5%.

OVERVIEW OF LABELING AND PACKAGING REQUIREMENTS FOR FLOUR

The four levels of standards pretty much agree on standardized labeling.

All standards require:

- **Product name:** Must accurately describe the product
- **Ingredient list:** In descending order by weight
- **Net weight:** In metric units
- **Manufacturer information:** Name and address
- **Date information:** Manufacturing date and/or best before date.

BCF labeling requirements

African requirements

- Product name: "High-quality cassava flour"
- Storage instructions: "Store in a cool, dry place, away from contaminants"
- Lot/batch identification for traceability
- Country of origin
- Instructions for disposal of used packaging.

East African requirements

- Product name: "High-quality cassava flour"
- "Human food" statement must appear on the package
- Storage instructions
- More detailed manufacturer information is required.

DRC—follows Codex requirements

- Product name: Must be accurate and not misleading
- Comprehensive ingredients and nutritional information if claims are made.

Composite flour labeling

East African specific requirements

- Product name: "Cassava–wheat composite flour"
- Percentage substitution: Must declare the percentage of wheat substituted with cassava
- Ingredient list: all ingredients must be listed in descending order
- Storage instructions
- Instructions for safe packaging disposal.

KEY COMPONENTS OF NATIONAL STANDARDS FOR BREADS AND PASTRIES (INCLUDING LABELING)

This section relates to the DRC national standard for bakery and pastry products as a case study. You should refer to the national standards for your country of bakery operation.

The standard:

- Mandates that bread and pastry products made in the DRC contain BCF at least 5% and 10% of total flour, respectively
- Covers nine types of bread and five types of pastry products
- Lists basic ingredients for bread and pastry products, and indicates that only authorized food additives may be used
- Stipulates the use of locally produced cassava flour and that BCF must be processed within 24 hours of cassava harvest
- Stipulates that the use of any genetically modified organism (GMO) ingredients must be authorized by the Ministry of Health
- Specifies adherence to (published) national hygiene principles and GHP
- Products must be packaged and labeled in accordance with the relevant Codex Alimentarius standard:
  - Name of the food [product]
  - List of ingredients (in descending order by weight)
  - Net weight (in metric units)
  - Name and address of manufacturer, packer, distributor, importer, exporter, or vendor
  - Country of origin
  - Lot identification
  - Best before date and storage instructions
- Specify physical quality characteristics
- Weight must comply with national regulations
- Requires testing and verification of:
  - Weight
  - Microbiological contaminants
  - Heavy metals
  - Sugar content
  - Product/dough rheology
  - Testing using Codex Alimentarius vol. 13 methods.

QUALITY DOCUMENTATION AND CERTIFICATION PROCESSES

For details on documentation and record-keeping, see chapter 9.

The national food control and administration body of each country enforces and provides product certification and quality marks.

In many contexts, it should be possible (if not mandatory) to obtain certification for premises hygiene. Contact the relevant national certification body to obtain instructions for gaining certification, which will include mandatory on-site inspections.

8: MARKETING AND VALUE CHAIN INTEGRATION

CUSTOMER IDENTIFICATION AND MARKET POSITIONING

Identifying your target customer base is part of business planning (see chapter 3). For processors, do you want to sell your BCF to local mills and/or bakeries, or export it? For bakeries, the first decision is whether to sell directly to the public or to intermediaries (traders, caterers, etc.).

The next decision for bakeries is which segment of these two broad categories. For example, if you wish to sell to the public, do you want to target local workers, shoppers, schoolchildren, or tourists? If you wish to sell to intermediaries, will you sell to traders, corporations, hotels, caterers? Each decision will affect your preferred location and work hours (see chapter 3). Conversely, the availability of property may impact your choice of target customer.

As a (prospective) cassava processor, you should conduct market research on your preferred customer base. Who will buy your product? Who might buy your product if you can make it competitive and make the case for BCF? Remember to talk to exporters and traders as well as local millers and bakeries. You are going to need a buyer for your flour, otherwise the enterprise will simply flop and land you with debt to service.

Positioning a bakery in the market may also involve market research—possibly surveying people in the street or in your targeted customer base, or supplying products for potential customers to evaluate and give feedback on. It will also involve checking out what competitor bakeries are offering in terms of products and quality. Armed with this information, you can make the crucial business decision about which products to make and how to promote them.

SUPPLIER RELATIONSHIP MANAGEMENT

Whether you choose to process cassava into BCF or to use BCF in bread-making, you will need reliable supplies and, therefore, reliable suppliers.

Potential processors may consider dealing with farmers directly or sourcing via marketers/traders. If the latter, it should be very clear to the supplier that there is a very small window for processing and that they should come straight to your factory after harvesting and immediately loading up at the farmers' fields; they also need to be clear with farmers that they require freshly harvested cassava roots when they collect. An advantage of contracting directly with farmers is that you can have your own truck beside the field while they harvest, and you know exactly when the 24-hour countdown starts.

Bakers, on the other hand, may have to deal with several suppliers, such as millers and wholesale or retail traders (for ingredients required in smaller quantities, such as salt, sugar, yeast, and additives). Eggs are a critical ingredient in terms of stock management; hence, you need a reliable daily source of fresh eggs or a reliable refrigerator.

Suppliers will have less conscience about letting you down if you do not have a relationship with them. It is therefore beneficial to develop good working relationships with those suppliers you have tried and tested and who have met your expectations.

Another key to supply reliability (in terms of both quality and availability) is documentation: keep records, keep a file (or file folder on your computer) for each supplier, and monitor reliability. This is especially important in the early days of the business, when you are setting up and working out which suppliers you can rely on and want to build long-term relationships with.

Once you have a good working relationship with your suppliers, you will not only be able to rely on them, but you will also be in a position to discuss any problems with them directly, knowing that you both have a vested interest in solving the issues.

DISTRIBUTION CHANNEL DEVELOPMENT

Whether you choose to sell your products to intermediaries or direct to your primary customers, you are building a distribution channel. Are you going to sell from a shopfront or a market stall? If not, are you going to deliver or are your customers going to collect?

For example, as a cassava processor targeting local flour mills and bakeries, you may have a member of staff dedicated to delivery via van or tricycle. Your customers need to know when to expect deliveries so they are ready.

COMPETITIVE ADVANTAGE THROUGH QUALITY AND CONSISTENCY

In these still relatively early days of BCF adoption in bread-making, it is easy to stand out from the crowd by adopting a cassava-processing strategy that is very different from traditional fermentation-based processing or by adopting BCF in your bakery workflow.

The keys to long-term success, however, are quality, consistency (and price!). It is easy to make bread with 10% BCF that rivals 100% wheat bread in quality and undercuts it on price. What draws long-term customer commitment is quality and consistency. This is where record-keeping fits in: by keeping detailed records, you can ensure that your staff are following best-practice protocols and making high-quality bread all the time. And when something goes wrong, the records are there for you to work out exactly what has gone wrong and where (in the process).

Your customers will likely pay a little bit more for products of consistently high quality.

But always remember: hard-won reputations are easily lost "overnight" by sloppy mistakes. Loyal customers may well forgive you for a one-time slip, but if it is not immediately rectified, they will be gone forever!

SCALING STRATEGIES

As an entrepreneur, you likely have big dreams. You are not going to be satisfied with a small urban bakery serving a few dozen customers. You want the business to grow.

In terms of production output, increasing batch size is as straightforward as increasing most ingredients by the same proportion. So, if you want to double your output, you double your batch size, the amount of flour, the amount of yeast, and the amount of salt. The exception is water: when scaling up, always make at least one test batch at the new volume and monitor dough consistency carefully; you will likely find that the amount of water required for the right consistency of dough is not exactly double that used in the original recipe. But, by doing the test, you will know how much water to use, and production at the new level can continue like business-as-usual.

Other considerations for scaling include preparing the market for the "surplus" product(s) and forewarning your suppliers that you will need greater quantities of ingredients in the future. If they cannot handle the increased volume, you will have to find additional suppliers.

If you still want to grow the business once your factory or bakery has reached capacity, you have at least a couple of options: you can continue to expand the core business by sourcing bigger or additional premises, or you can diversify the business.

Should you choose to expand the core business, you can either look for larger premises and relocate, or you can look for new, similar premises and establish a second shop. With the second option, consider transferring or temporarily "seconding" existing staff to the new premises to maintain continuity, quality, and consistency. The "seconded" staff would then act as on-the-job trainers for new recruits at the new premises. One advantage of choosing a second premises might be access to a new customer base in the new locations, especially if selling to the public.

9: DOCUMENTATION AND RECORD-KEEPING

A vital aspect of business administration is documentation and record-keeping—and there is plenty of both in running a business!

VARIOUS PURPOSES FOR DOCUMENTATION—WHY SHOULD I KEEP RECORDS?

Record-keeping and documentation serve several purposes. For example,

- Ingredient and product traceability
- Quality control
- Business management
- As a basis for troubleshooting and problem-solving when something goes wrong
- Financial management
- As proof of compliance with regulations and standards.

Modern record-keeping is likely to be mainly computer-based, even for receipts, but there will almost always be a case for traditional paper records—at least for some types of records.

Computer-based records need to be backed up off-site. This is most easily done via cloud storage, but if internet connectivity is poor, consider rotating external-drive backups taken home by management each night. You will be sorry if the computer crashes and you have no backup!

Paper-based records should be stored in secure (lockable) fireproof storage. If there is a fire in the factory or bakery, you need to know that the paperwork is safe.

WHAT DOCUMENTATION AND RECORDS TO KEEP

Equipment and machinery

1. All equipment purchase documents (orders, invoices/ receipts, delivery notes) and guarantees.
2. Instruction manuals in a safe, but accessible place; consider having a photocopy or scanned backup copy in safe storage.
3. Operational procedures (effectively the instruction manual translated into local use), including operation by trained staff.
4. Maintenance, servicing, repairs, and replacement of parts.

See also "Hygiene, health, and safety" below.

Inventory

It is vital for the day-to-day running of the business to ensure that you have enough of the right supplies and that those supplies are in date. Inventory may be a smaller and less diverse aspect of a cassava processing factory than a bakery, but there is still a need to ensure there are enough packaging materials, ready-to-print labels, lubricants for machines, spare equipment parts/tools, cleaning agents, and other consumables on site.

Managing inventory is very much a cycle, as the "end" of the process (using things from the store) directly impacts the "start" (ordering and receiving stock).

Keep records and paperwork of:

1. All orders and purchases, including delivery notes
2. Best before dates on delivered ingredients and other consumables (e.g., cleaning agents)—to aid stock rotation
3. All extractions from the store
4. End-of-day stock levels—to trigger reordering.

However, if receipt (fresh deliveries added to the stores) and extraction data are computerized, you should be able to monitor stock levels electronically, with reorder triggers built into the system. Periodic stocktaking would then verify the accuracy of record-keeping.

Quality control

Maintain simple forms (either paper or computerized) to record the results of all quality checks on ingredients and products.

Have simple checklists for the whole process that accompany a whole batch (of cassava or bread) from the extraction of ingredients to storage and packaging of final products. These checklists would include information such as weights, timings, and temperatures to verify adherence to preferred process parameters and record any deviations. Critical control points should be indicated on the checklist, and supervisors should review the completed list for each batch.

Monitor and record environmental factors that may impact storage and product quality. These include storage temperature and humidity (especially for refrigerators and freezers) and ambient temperature and humidity (especially useful if you are proofing or cooling in ambient conditions).

Document quality-control (corrective) interventions made to bring things back to standard after the discovery of a quality drop.

Hygiene, health, and safety

Food safety is vital for the health of your customers and your reputation, with a direct impact on product quality. You are also responsible for the health and safety of everyone on your premises, from staff through traders and delivery persons to customers.

Food safety is maintained in part through quality control of ingredients, products, and the work environment (see previous subsection).

Cleaning is a vital aspect of food hygiene, health, and safety. Have checklists for per-batch, daily, and periodic cleaning schedules, including equipment, work surfaces, shelves, floors, walls, and non-work areas (e.g., toilets, rest area, and outside perimeter). Make sure they are used, completed, and filed.

Maintain records of all staff training, from basic hygiene (e.g., handwashing) to specialist equipment use, cleaning, and maintenance.

Record all pest management activities, from surveys (visual checks) to physical and chemical interventions.

Keep an incident report book to record all accidents, spillages, and near-misses. Include a section for lessons learned and new safeguards implemented. Have reporting and supplies sheets in the first aid kit.

Display premises hygiene certificates prominently (customer-facing) in the building.

Production

Record all production parameters. Alongside all quality-control records (see above), keep production quantity records. These include quantities of ingredients and outputs (BCF, bread loaves) plus sales price per product type. A simple daily production record sheet will aid in maintaining these records.

Quality-control records include ingredient quality tests, ingredient quantities (especially variations), mixing time, dough characteristics, fermentation temperature and timing, baking temperature and timing, and final product assessment. Report any deviations to the supervisor or head baker.

Document sales volumes and customer feedback.

Financial records

Financial recording is vital if the business is to be sustainable and operate at a profit.

- Track all costs associated with the business (see chapter 3).
- Record all revenue.
- Conduct profit and financial sustainability analyses (chapter 3).

Daily recording, consistency in documentation, accuracy in measurements and calculations, and regular review and analysis of records are all important, especially for financial recording. Good record-keeping supports informed decision-making, identifies cost-saving opportunities, enables accurate pricing strategies, and facilitates business growth.

Other business-related documentation

Regulatory compliance

Businesses always face the possibility of review or audit by the relevant authorities. You may also have to demonstrate compliance when applying for a sales license or exporting products.

Many of the records listed above evidence your compliance with regulations (e.g., food hygiene and safety, workplace health and safety), laws, and standards. Record-keeping on its own may well be a business regulation in your context.

Pay particular attention to quality test results, traceability information, and product labeling.

See chapter 7 for details of parameters that need to be confirmed for compliance purposes.

Labeling

Although technically a compliance issue, correct labeling is worthy of mention as a critical aspect of selling, whether to wholesalers, retailers, or the public. See chapter 7 for details on precise labeling requirements, and adhere to them.

In practical terms:

- Design labels for multiple markets
  - Include all possible required information to access the maximum number of markets
  - Use a clear, professional design that builds product credibility
  - Ensure durability—labels must remain legible throughout product's shelf life
- Maintain flexibility
  - Design labels that can be easily updated for different markets
  - Keep digital files for easy modification
  - Plan for seasonal or promotional variations
- Quality control
  - Verify all information is accurate before printing
  - Check that dates, weights, and batch numbers are correctly applied
  - Train staff on proper label application and quality checks.

Training

Keep records of all staff training, including end-of-training results, certifications, and staff feedback on the training activity. Develop personal training logs and plans for individual staff members.

Audits

Commission and document regular audits, and record any action points and their implementation. At the very least, this stands you in good stead should you ever be subjected to an external audit.

Stakeholder consultation

Consult other value-chain stakeholders and engage in any local or regional stakeholder forums. Stakeholders include (other) bakery owners, BCF manufacturers (cassava processors), flour millers, government and industry bodies, and customers. Document what you learn and any changes you implement in light of that.

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