

## Flour Milling and Blending Systems

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### Summary

Farmers and traders can add value by grinding wheat into flour that can be stored for several months and used to make a variety of processed food products such as bread, biscuits, cakes, porridges and pasta. Manual techniques for producing wheat flour are employed by many communities in Sub-Saharan Africa which do not provide large market opportunities because the quality doesn't meet standards and preferences of consumers. Small to large sized milling and blending systems are available from local and international manufacturers that allow production of premium wheat flour close to production areas. The advantages of processing wheat into flour are the reduction in transport costs from farms to factories and the longer shelf life that result in better access and supply to markets, food processors and manufacturers at local and national scales. Building capacity in rural communities for milling and blending of wheat flour will boost the output, value addition and competitiveness of local producers, and will allow African wheat farmers to better rival with imported products.

### Technical Description

Producing wheat flour is an art which begins with selecting the right factory location, followed by procuring the right variety at the right price, and is concluded with cleaning, annealing and milling in the right manner. Locations for processing should be close to major growing areas that can provide reliable supply of quality biofortified grains, and have convenient transportation routes for easy delivery of raw grains and shipping of final product. In selecting the wheat varieties for blending it is important to take the hardness into consideration because it strongly affects the annealing time and may require using different silos for that step. Blending procedures must also be carried out in accordance with the gluten, sedimentation and index values that determine flour quality, and are closely monitored by food manufacturers. The purpose of annealing wheat is to ensure the optimum level of water for milling and enhancing the nutritional value, and the temperature and resting periods are crucial to wetting the wheat and distributing the water across the grain. Modern milling machines allow to obtain a very high proportion of flour out of wheat grains by sequential crushing of the grain, size reduction of particles and compression of flour carried out with a set of high pressure cast steel rollers that are specifically designed.

### Uses

Flour milling and blending technologies for wheat allow to improve food self-sufficiency and promote business development in rural communities across major growing areas of Sub-Saharan Africa. Equipment setups with a small to large capacity are simple to install and can be supplied with electricity from the national grid, diesel generator and solar panels, making widespread deployment possible. The technology is particularly advantageous where there is limited access to storage facilities, poor road infrastructure and weak links with consumer markets and food processors. Milled wheat flour presents opportunities to improve existing supply chains and open up trade in new areas since it renders large savings on transport costs.

### **Composition**

There is a wide range of equipment for cleaning wheat that perform specific processes based on size, shape and density of grains. A typical air-screen cleaner is made up of four screens that are located beneath a hopper. Grader machines that sort out impurities based on width and thickness are comprised of cylindrical screens that are horizontally positioned and have round perforations. Separators that select grains by length, density or gravity use angular sieves and forced air which can be adjusted according to specific needs. Annealing of wheat grains is done in resting basins or silos that are heated electrically or with natural gas. An abrasive grain mill has a feed-in hopper, roller table for grinding, rotary sieve for bran separation, and a compact engine and conveyor belt.

### **Means of application**

Before setting up a flour milling enterprise there is need for conducting deep market research to understand the needs and identify viable business models. If you are not sure about the location, it is advisable to consult a few experts so investments are not made at the wrong place. Next you need to make a comprehensive analysis of the investment needs for capital equipment, staff wages and other fixed and variable costs. Based upon this you can identify ways to finance the businesses, including loans and personal cash, and approach investors. Once funding is secured you can purchase the machines for cleaning, annealing and milling, and build the flour processing line based on professional advisory about optimal installation. Electricity is a very important spend in operation, and reducing its cost is key to making the investment profitable and maximize net margins. There is need for continuous quality assurance at the flour mill to make sure the product complies with market standards on gluten content, sedimentation and index values.

<b>Agroecologies</b>	Dryland area, Highlands, Moist savanna.
<b>Regions</b>	Africa South of Sahara.
<b>Developed in Countries</b>	Ethiopia, Kenya, Nigeria, Senegal, Sudan, Uganda, Zambia, Zimbabwe.

<b>Available in</b>	Ethiopia, Kenya, Nigeria, Senegal, Sudan, Uganda, Zambia, Zimbabwe.
<b>Solution Forms</b>	Equipment.
<b>Solution Applications</b>	Value addition.
<b>Agricultural Commodities</b>	Wheat.
<b>Target Beneficiaries</b>	Small-scale farmers, Commercial farmers, Agro-manufacturers.

## Commercialization

### Commercialization Category

Commercially available

### Startup Requirements

The following steps are needed for enterprise development around wheat flour milling and blending, and widespread replication thereof: 1) Raise awareness with farmers, agri-food companies and investors on the economic benefits of the technology, 2) Formulate appropriate product standards, packaging sizes and prices based on consumer demand, 3) Identify profitable, durable and equitable strategies for taking wheat flour products to local, regional and international markets, 4) Establish reliable supply of high quality grain to processing plants through nucleus farming or sub-contracting, 5) Set up equipment and production lines that make efficient use of energy and labor, and 6) Train operators and workers on safety and quality adherence throughout the process.

### Production Costs

The delivered prices of wheat grain at the factory gate, including transportation, are a major determinant of the economic viability of a milling enterprise. Exact costs of a flour milling plant depend on the geographic location, size of operation and equipment selection. In general, 60% of the capital investment that is required to set up a processing plant goes to machinery and equipment, while the rest to construction. A small flour mill machine that is manually refilled and with an output capacity of 300 - 500 kg flour per hour costs around US \$ 3,500 without shipment and installation. The base price for a fully automatic wheat flour mill machine with a capacity of 30 ton flour per day is US \$37,500. A flour mill needs skilled labor and unskilled workers for general support to ensure that production runs smoothly, and an accountant/manager to keep track of expenses, supply and sales.

### Customer Segmentation

Wheat flour milling and blending systems are applicable to industrial flour processors and food manufacturers, and may be modified to suit the needs of more localized processors and community-based activities. It also requires that consumers accept the products resulting from blended flours.

### **Potential Profitability**

High-performance cleaning systems for wheat ensure very low percentages of non-millable material in the wheat that otherwise bring down milling efficiency and revenues down the line where a 1% reduction in non-millable fraction gives an additional US \$3 per tonne of flour at the bottom line. Modern equipment for annealing and milling wheat grain achieve maximal recovery of flour at 80-82% and 18-20% bran, whereas traditional manual techniques and older milling systems get just 65-70% of flour from wheat. Stable and adjustable engine loadings in modern milling systems benefit energy expenditure since a 5% reduction in output efficiency can raise the cost of processing 1 tonne of flour by about US \$2.50. Better annealing and milling improves flour quality and market price with a 2% increase of water absorption translating into a premium of up to US \$9.20 per ton. The effect of running at higher efficiency versus lower milling efficiency provides an added net profit of US \$30 per ton.

### **Licensing Requirements**

Getting the licence from the government or registering your factory in local administration is important for the success of the flour milling business. It is the basic requirements for a flour milling factory to comply with the local regulation and legislation.

### **Innovation as Public Good**

Techniques for production of wheat flour are a public good, and ICARDA is actively involved in disseminating this information across Sub-Saharan Africa.

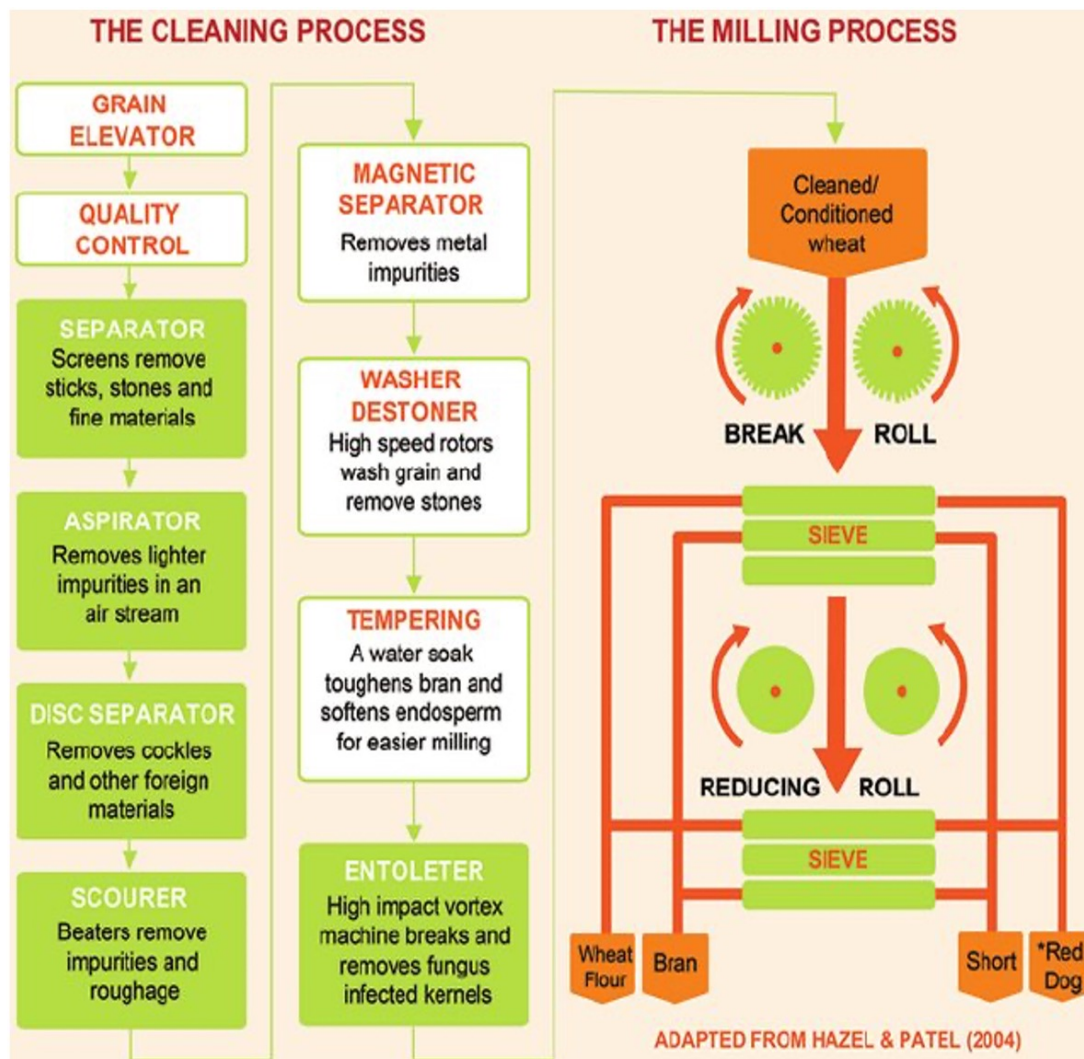
## Solution Images



*A small-sized mill for wheat flour production*

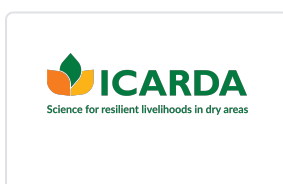


*Flour milling products: whole wheat (left), milled flour (center) and wheat bran (right)*



*Diagram of typical steps in wheat cleaning and milling. Green boxes indicate where reduction of mycotoxins take place (Source: Bianchini et al. 2015)*

## Institutions



## Accompanying Solutions

[Hermetic Bags for Safe Storage of Wheat](#)