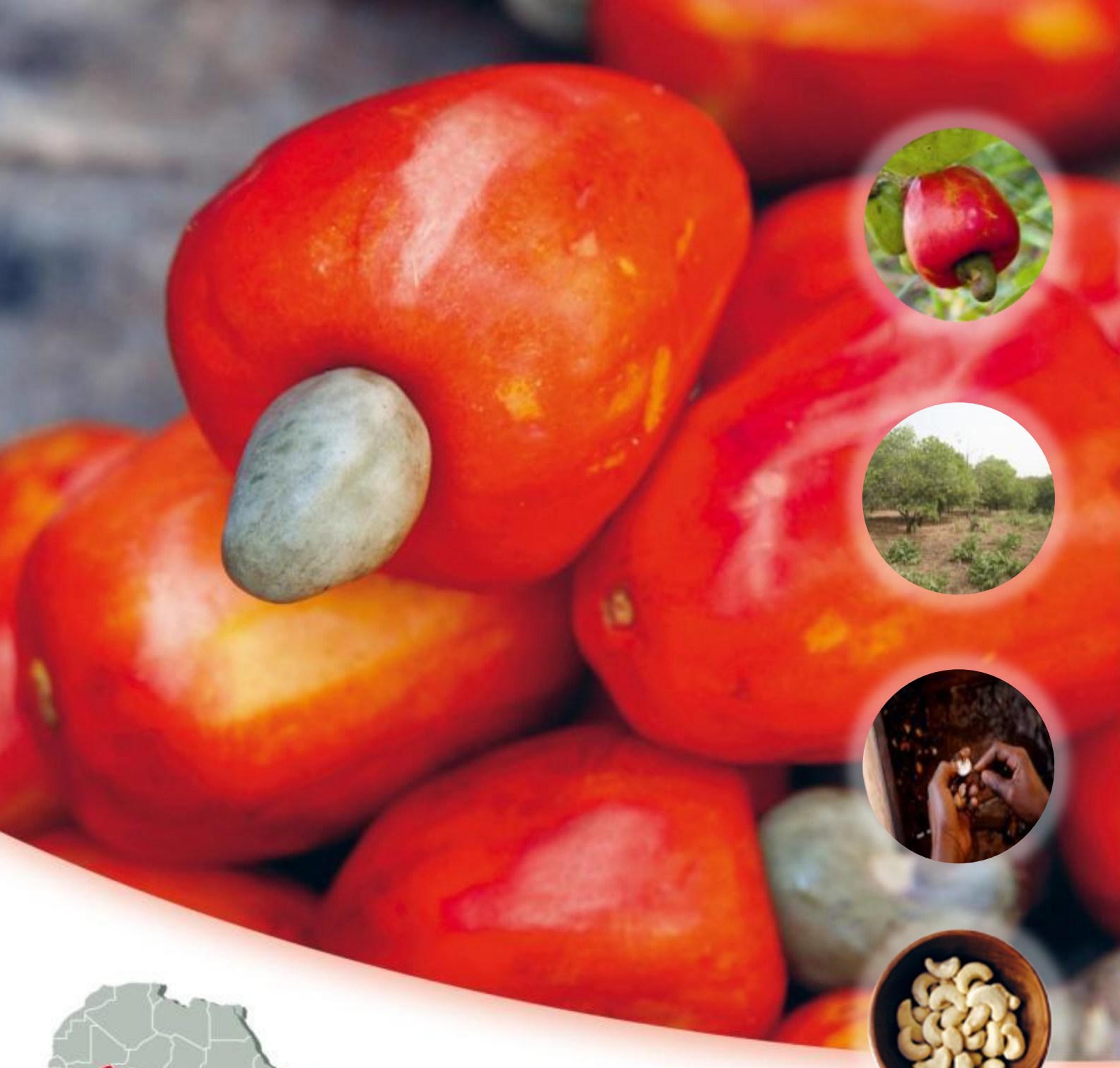

Cashew Nut Processing Equipment Study – Summary

African Cashew initiative

African Cashew Initiative is funded by:

Federal Ministry
for Economic Cooperation
and Development

and private sector partners

Implemented by:

In cooperation with:

Published by:
Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH
International Foundations
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Place and date of publication:
Germany, September 2011

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Acknowledgement:
This study has been implemented as part of the African Cashew initiative (ACi), a project jointly financed by various private companies, the Federal German Ministry for Economic Cooperation and Development and the Bill & Melinda Gates Foundation.

ACi is implemented by the African Cashew Alliance (ACA), the German Development Cooperation GIZ, as a lead agency as well as FairMatchSupport and Technoserve.

This report is based on research funded by the Bill & Melinda Gates Foundation. The findings and conclusions contained within are those of the authors and do not necessarily reflect positions or policies of the Bill & Melinda Gates Foundation.

Design:
© creative republic // Thomas Maxeiner Visual Communication, Frankfurt am Main/Germany
T 4969-915085-60
I www.creativerepublic.net

Photos:
© GIZ/Rüdiger Behrens, Julia Renault, Raja Fuegner-Patel, James Fitzpatrick, Thorben Kruse & creative republic, iStock, Shutterstock

Cashew Nut Processing Equipment Study – Summary

September 2011

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1 Introduction to the Cashew Equipment Study

1.1 Purpose of the Study

In November 2010 The African Cashew Initiative (ACi) commissioned a study on Cashew nut Processing Equipment. This document is a summary of that study which was undertaken between December 2010 and March 2011.

About the African Cashew Initiative (ACi)

ACi was established in April 2009 to improve the profitability and competitiveness of the cashew value chain in Benin, Burkina Faso, Cote D'Ivoire, Ghana and Mozambique by providing technical support to cashew farmers and local processors and linking them to national and international markets. The German development corporation, GIZ, has the lead role in the project, which it is implementing together with three other partners – the African Cashew Alliance, an international platform of public and private partners involved in the cashew value chain, FairMatch Support, a Dutch non-profit organization and TechnoServe, a US-based not-for-profit organization.

The purpose of this study is to develop an objective fact database on cashew nut processing and processing equipment to assist purchasing decisions for smaller, medium to larger African cashew nut processors. The study is in the form of a report and a database which has been passed to the ACi. Note: The Terms of Reference were for "small and medium". We did not look at any large factories (15,000 tonnes per annum upwards.) That's why for example we did not consider the fully automated systems or the large scale offered by Oltremare for example.
The study aims to improve the competitiveness of the African cashew processing sector by developing an information resource and establishing a structure which will allow that resource to develop. It is hoped that this study will mark the beginning of an active strategy to develop the ability of African cashew processors to make good decisions on cashew processing equipment.

The study has analyzed and reported on:

- Processing trends, processing equipment and process flow in Vietnam, India, Brazil, and Africa.
- Challenges faced by African processors in purchasing processing equipment.
- The processing equipment market and trends
- Procurement strategy for small and medium processors in Africa
- The available Cashew processing equipment
- Cashew processing equipment suppliers

The study has prepared:

- Cashew Processing Equipment Evaluation Cards – 50
- Equipment Supplier Evaluation Cards – 22 selected from 86
- Database of cashew equipment suppliers and equipment - 86 suppliers
- Studies of processing in Brazil , India , Vietnam and six Africa countries (Tanzania, Mozambique, Benin, Togo, Ghana, Burkina Faso)

1.2 Study Method

Fieldwork

The field work for the study was carried out during January and February 2011. It is based on the interviews and findings of the national studies mentioned above, factory and manufacturer interviews, a review of the literature on processing and a review of websites of a wide range of providers of processing equipment.

The study interviewed ninety five stakeholders in eighteen countries as follows:

Table 1.1 Functions of interviewed stakeholders

Cashew processors	37 (of which 32 were visited)
Equipment Manufacturers	48
Agencies & other stakeholders	10
Total	95

The study started with the equipment manufacturers. Data was collected on approximately 150 pieces of equipment. From these fifty pieces of equipment were selected, analyzed and evaluated by the study team on Equipment Evaluation Cards which are included on the database.

Twenty two key suppliers or potential suppliers of equipment to African processors were assessed on Supplier Evaluation Cards again to give an idea of the strengths, weaknesses and potential in the equipment supply chain. Suppliers were evaluated in terms of their terms of sale, equipment, after sales service and reliability.

The study also engaged with processors in Africa. By assessing the information and opinion gathered from them and the visits to their factories a description of cashew processing in each country was compiled, the market access challenges were identified and a procurement guide was compiled.

Equipment Evaluation

The evaluation of the individual pieces of equipment was the core of the study. The main factor considered was the overall performance of a piece of equipment combined with its suitability for the small, and medium to larger processor in Africa. Each piece of equipment was assessed in terms of factors such as skills needed, after sales service, environment, reliability, scalability, efficiency and cost. The equipment was also ranked in terms of its suitability for small and medium.

There were no existing benchmark studies of this scale on cashew nut processing equipment. The methods, indicators and reporting cards were specially designed for the study.

1.3 Summary of findings of the Study

Trends in cashew processing

- The sector is beginning to develop into a modern "industry".
- Developments in processing have been driven by costs including labor.
- Investment and working capital needs for processors are rising.
- Food safety, security and traceability driving change in the industry.
- The mechanization trend will continue making new demands on processors.

Cashew processing equipment market

- The market has developed into a large market with a wide range of equipment and prices.
- Vietnam is the leader and most developed market.
- There are no government trade barriers in the sector.
- Suppliers are reluctant to do business in Africa. They see it as a high risk area therefore the African sector is served by a narrow base of suppliers. The market lacks competition.
- Brazilian suppliers can offer equipment solutions for small and medium processors in Africa.

Processing in Africa

- Processing remains a relatively small scale activity.
- The "steam and cut" model was the right choice for African countries. It is used in almost all processing units in Africa.
- Management of new equipment is poor.
- Labor problems are the major concern of processors especially in East Africa.
- Working conditions in cashew factories remain poor.

Challenges for African small and medium processors

- Lack of information on the equipment and suppliers.
- There are very few African equipment manufacturers. Vietnamese and Indian manufacturers are mainly focused on their own fast growing markets.
- Poor financial services are the biggest obstacle for processors.
- As a whole processors lack expertise in processing equipment and lack skills in procurement strategies. They buy machines to solve labor problems but end up with machine problems.

Recommendations

A. Two Purchasing strategies

- "One stop shop" – everything is sourced from one supplier.
- "Do it yourself"- the best price is sought for each piece of equipment from different suppliers.

B. Development of the Information Infrastructure

- Two way communication providing information to processors in Africa and to the equipment suppliers abroad.
- Promote the African sector to suppliers in India and Vietnam and especially in Brazil to stimulate equipment options and competition.
- Maintain an accessible equipment database.

C. Technical support

- Processors need support in machine management techniques.
- Processors need support in procurement strategy and policy.
- Processors need support in developing communications and linkages within the industry.

2 Processing methods in selected countries

2.1 Overview of processing of Cashews

The market for cashew nuts has always been volatile. The rapid changes in the cashew processing equipment market are relatively recent. It could be argued that the cashew business is only beginning to develop the characteristics of an industry in recent years. Previously it was a collection of loosely connected businesses with an interest in cashew nuts each pursuing their own interest.

The expansion in the growing of cashew nuts has not seen a major change in the location of the processing of cashew nuts. Processing of the cashew nut to remove the kernel remains largely confined to three major countries India, Vietnam and Brazil.

In general, cashew processing developed as a low investment activity with minimal use of technology. It relied on low cost labor (relative to the value of the product). The profitability of cashew processing depends largely on the proportion of kernels extracted without being broken or damaged. For many years, technology was unable to provide a commercially viable solution to this problem. As the cost of labor has increased and the quality of other jobs has improved processors have been forced to improve wages and working conditions. This has tipped the balance in favor of some new mechanized or automated technologies.

The Brazilian industry developed on a different course, with a few large mechanized factories. Brazilian processing is characterized by high running costs, with investment levels and wage levels much higher than in other cashew countries.

In African countries cashew processing remains a small scale activity. African factories have tended to embrace the new technology more quickly than their competitors in India. This study concludes that this has been primarily driven by problems associated with managing the labor force rather than any outstanding improvements in outturn achieved by processing equipment.

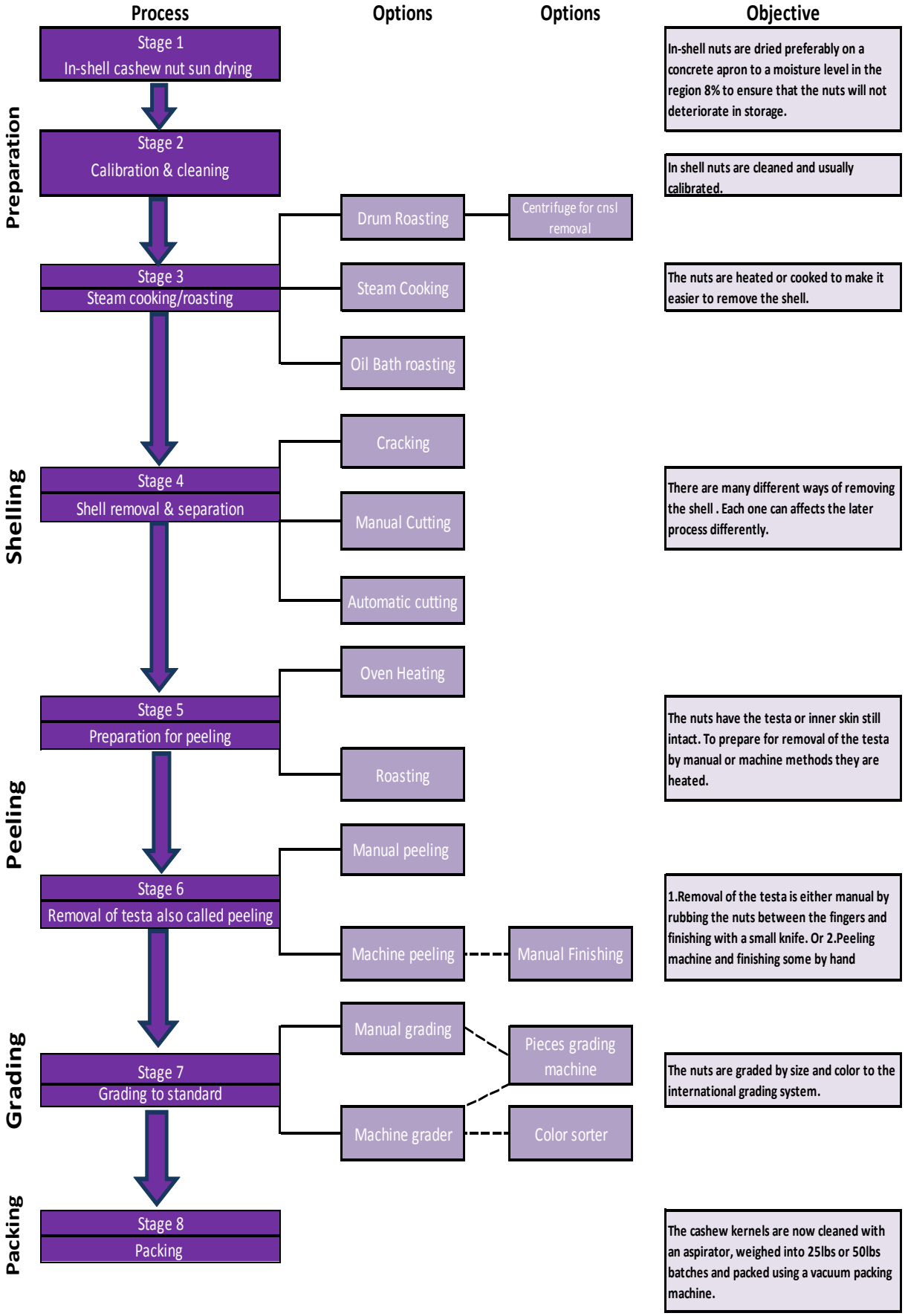
The objective in processing cashew nuts is to remove the highest possible weight of kernels from the nut in-shell, unbroken and with the distinctive light ivory cashew color. It is a food product so the taste should remain as natural as possible and the process should be done in a safe manner. There are a number of different methods of shell removal and testa removal.

The methods found in the different countries are summarized in the following sections:

Figure 2.1 In each case the process consists of five basic elements:

The following graph gives an overview of the processing of cashew nuts.

Figure 2.2: Summary diagram of the overall cashew process



2.2 Processing in Vietnam

"Innovation and ingenuity have characterized the development of the Vietnamese cashew process."

Processing in Vietnam started based on the oil bath process. There is now a trend towards the introduction of the steam cooking process and the use of more machines as the pressure on labor grows.

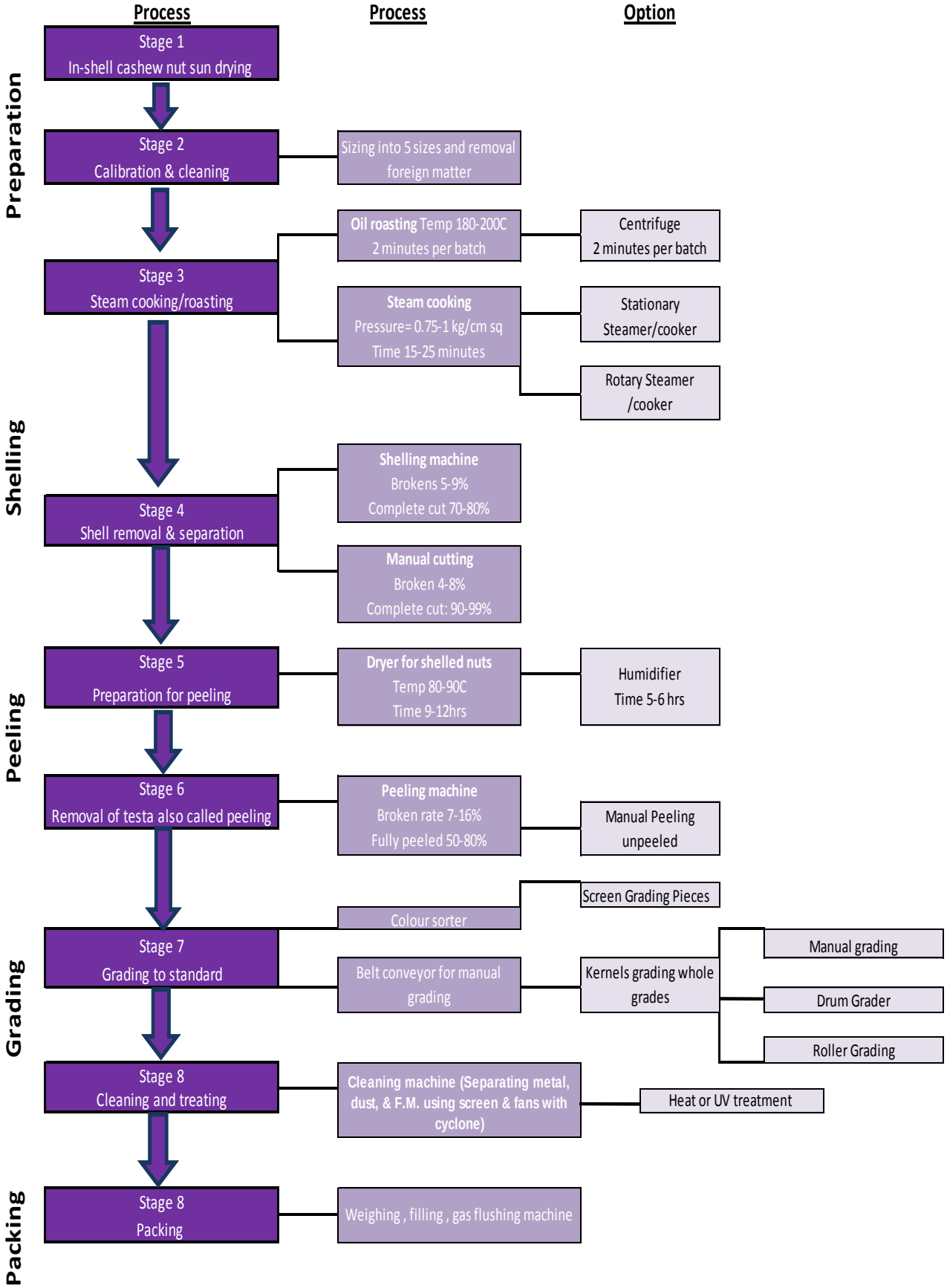
In recent years the growth of commercial equipment manufacturers has led to diversity in the equipment available. The problem of finding workers to work in the conditions of a cashew factory has accelerated the development of processing equipment in Vietnam. In Vietnam today we see both the steam and oil bath process. The steam process has a range of variations from the static "kettle" type cooker which is most common in India. The most common variation is the rotary cooker which is the same process of cooking by steam but the cooker itself rotates. The rotary cooker is faster and usually allows for a larger batch size. Vietnamese factories and equipment manufacturers have also developed a range of grading and sorting machines.

Traditionally, there have been links between local technical institutions and Vietnamese cashew factories, which initially led to minor changes in the processing systems. In recent years, growth of the commercial equipment sector and difficulty in finding workers has led to changes in processing systems and an increase in the equipment available in Vietnam.

Innovation and ingenuity have characterized the development of the Vietnamese cashew process. This has been expressed in two ways: copying imported technology for sale as modified machines and developing locally produced technology. Peeling machines, boilers, cookers and other equipment have proven to be successful in Vietnam as in India but the case for shelling and grading machines still remains to be proven.

Overall as the diagram below shows the Vietnam process is more likely to incorporate machines of all sorts than the Indian or African models but has not as yet developed the kind of integrated use of machines and automation seen in Brazil. That is not to say that it is more profitable to process in Vietnam or that the cashew produced are better but simply to say that the Vietnamese industry has adapted to the challenges facing it by developing a wider range of mechanized processing methods than its competitors.

Figure 2.3 Cashew Nut Processing in Vietnam



2.3 Processing in India

India is regarded as the home of cashew processing and for many years was the dominant force in the market with an efficient processing industry based on good availability of skilled labor. In recent years Vietnam has taken over as the premier exporter of kernels but Indian remains the largest processor by far.

The India National Study compiled as part of our global study concluded that the processors could be divided into three groups in terms of their equipment and processing organization:

1. Old style processors utilizing the manual processing and semi-automatic machines not linked together into a process system.
2. New style processors who have upgraded using the new machines in a semi- automated process.
3. Advanced processors who have introduced fully automated plants.

There has been reluctance in the past to invest in capital intensive cashew processing in India. The trend has been for many years to continue with manual processing introducing some upgrades of machines as they become available. Building of new fully automated plants is unlikely in the short term given the attitude toward investment and investment from outside is not likely. It seems likely however, that processors will invest in machines to upgrade their process and reduce their reliance on labor.

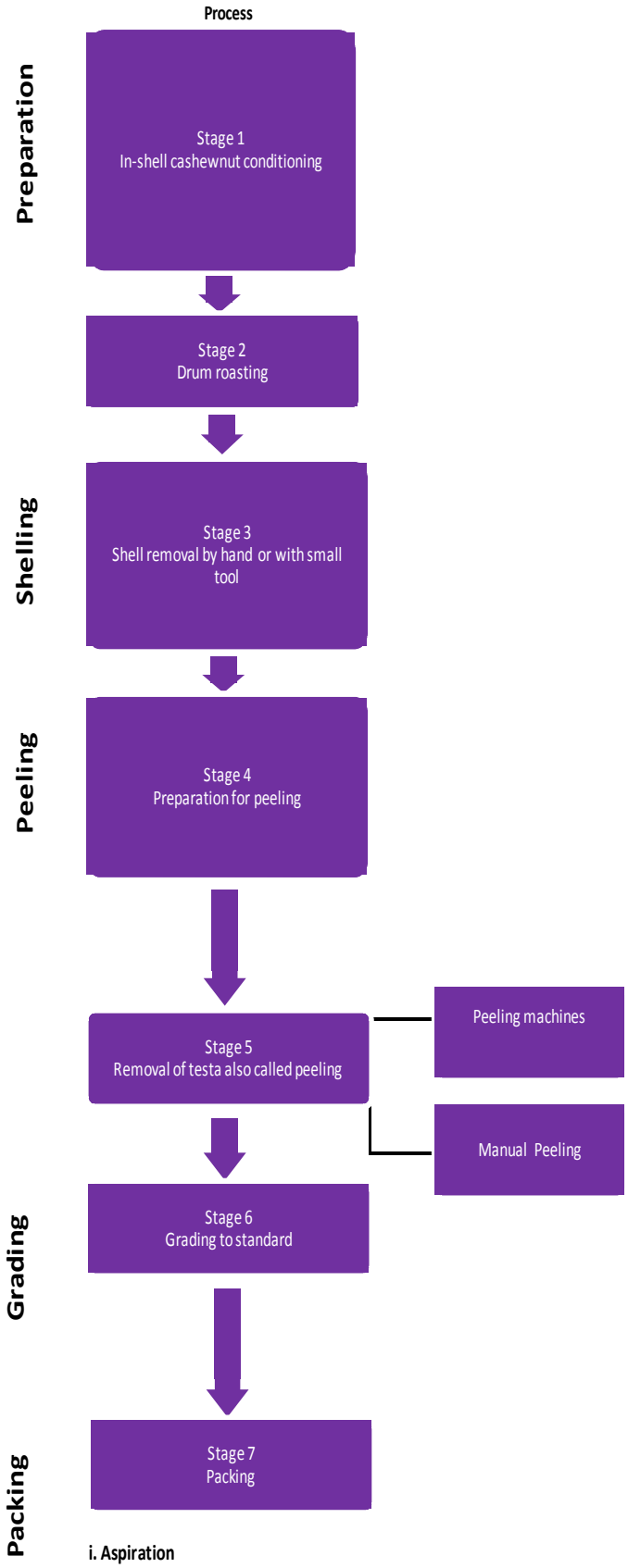
A long term trend in India has been the separation of the process into units. From the mid 1990's on some processors started to separate the packing and grading from the rest of the process. This had the impact of spreading the labor requirement. It also had the impact of making it possible to have a packing center audited and approved without having to have the full processing unit approved.

In India there are two main methods of processing. The "steam and cut" process was invented in Mangalore and is known to give whiter kernels and fewer scorched kernels. This has spread with many of the Kerala manufacturers adopting the "steam and cut method". The traditional "drum roast" method is still often seen. The roasted nuts are cracked by striking the nut.

Modern Packaging Section/Libra Packaging

Traditional shelling in Kerala/ Fitzpatrick 2008

Figure 2.4 Cashew Processing in India - Drum Roasting



i. Aspiration
ii. Weighting
iii. Filling
iv. Vacuum/gas back flush/sealing

Objective

In-shell nuts are dried preferably on a concrete apron to a moisture level in the region 8% to ensure that the nuts will not deteriorate in storage. The nuts are then stored in a dry secure warehouse until needed for processing.

In-shell nuts are fed continously into a cylinder slowly rotating over a fire, with a slight slope on the cylinder to ensure the movement of the nuts along with it. Usually cashew shells are used as fuel.

The nuts have been heated to fix the cnsl and to make the nuts brittle so they will crack along the seam when struck with a small wooden tool.

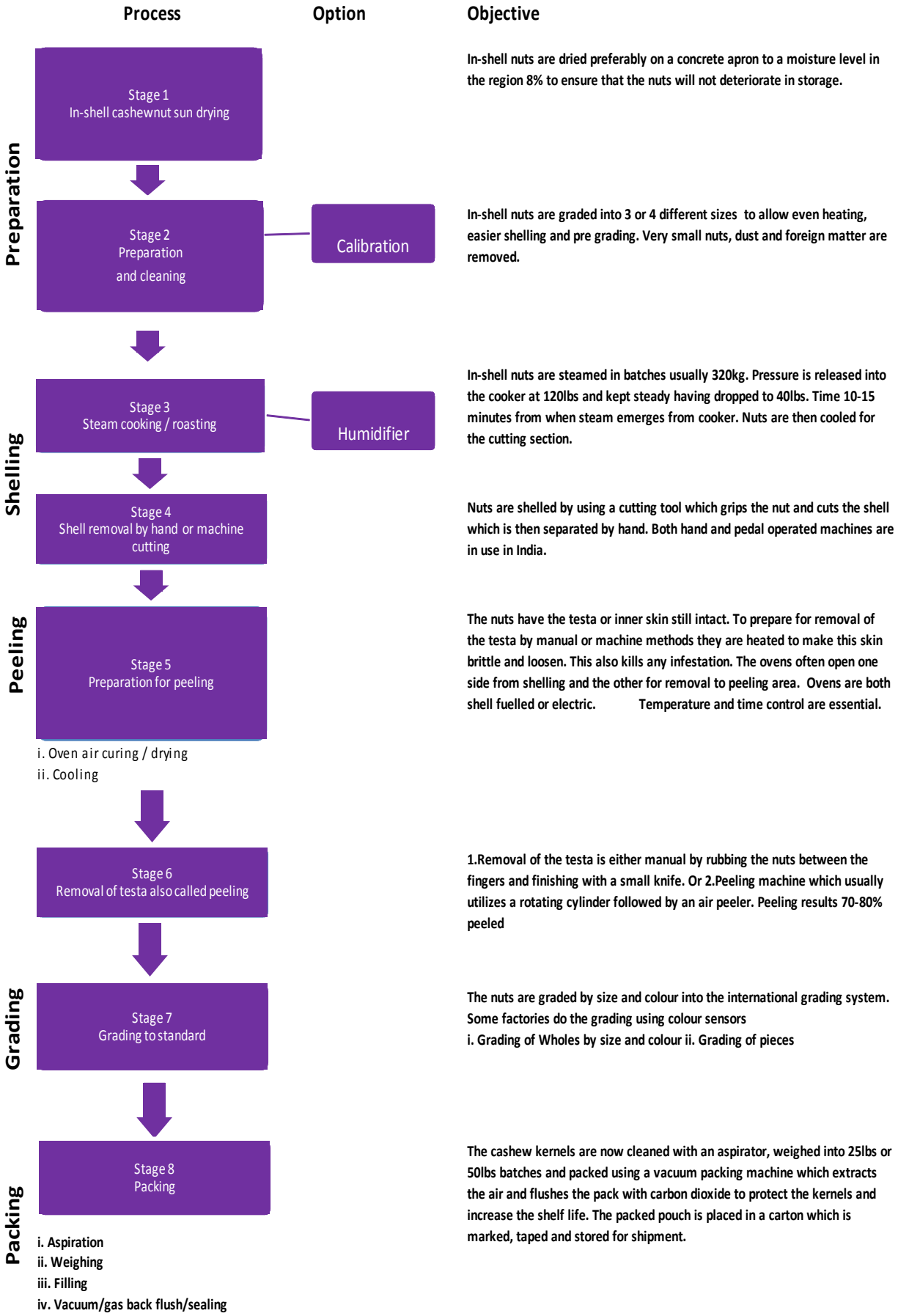
Drying of kernels to loosen testa to allow for peeling of the nuts. This is a critical area where breakage can occur reducing the value of the kernels. The nuts are placed in an oven on trays on trolleys and heating to a moderate temperature for a long period causing the testa to become brittle and separate from the kernel.

Removal of the testa : At this stage the shell has been separated from the nut and the nut has been dried and cooled to make the testa (skin) easier to remove. Good quality properly dried nuts will allow the testa to be removed by rolling between the fingers. However not all nuts will allow that and some break in the process. In India manual peeling is still very common although many of the factories have brought in machine peelers

The nuts are graded by size and colour into the international grading system. Wholes are graded by size and colour. Pieces are grades by type of breakage (split,butt) and then by size of the pieces . Pieces may be graded within the Indian domestic market system.

The cashew kernels are now cleaned with an aspirator, weighed into 25lbs or 50lbs batches and packed using a vacuum packing machine which extracts the air and flushes the pack with carbon dioxide to protect the kernels and increase the shelf life. The packed pouch is placed in a carton which is marked, taped and stored for shipment. Tin packing is still preferred over flexi packs in most of Gulf countries

Figure 2.5 Cashew Processing in India – Steam & Cut



2.4 Processing in Africa

Processing across the continent Africa is very similar in method.[1] In the 1970's East Africa was the leading global processor but the industry collapsed in the 1980's for a variety of reasons. The revival of the East African industry dates back about ten years. It was largely initiated by the intervention of Technoserve and foreign entrepreneurs who brought the Mangalore style of processing to Mozambique. This process has spread and is now utilized in most of the factories of Africa. The system is suitable for small scale operations that have relatively large or medium sized nuts to shell.

All of the sixteen factories visited in six countries use the steam and cut system. In many cases equipment was originally supplied by one main supplier that continues to have a large share of the market. The options that are open for the supply of equipment now are far more extensive than when the new factories of Mozambique started about ten years ago.

The current position indicates information on the_range of methods and equipment is still lacking among processors. It is also true that some experienced processors have entered into purchases recently without checking the available options or the alternatives. There clearly remains an information gap.

The steam and cut process in African countries differs from the Mangalore style in very few ways. Calibration and "thermal shock" (steam treatment after heating) appear to work well. On the other hand the processors seem to have trouble drying the nuts correctly.

The main issues on cashew processing which were voiced by African processors were:

1. Lack of information.
2. Problems with absenteeism or finding labor.
3. Poor after sales service from equipment suppliers.

The study also adds a problem which is the management of the new equipment. Whilst a minority of factories demonstrated an in depth knowledge of the machines many do not have the necessary process management capabilities or "hands on" technical ability to get full functionality from their investment.

In East Africa it appears that the labor problem has encouraged the purchase of peeling machines but the advent of the machines has increased the level of service needed. The level of dissatisfaction with after sales service seems to be high. The lack of information on the other hand caused the orders of new generation equipment to be placed with a narrow range of suppliers. This may have led to a lack of competition in offering after sales service. The three complaints are inextricably linked as processors look for an answer to their immediate problem which is the cost of finding and managing their workforce.

In West Africa it seems that it is easier to recruit a workforce. This may be because people have fewer options for work and because the factories are generally of a smaller size as processing is now starting in West Africa. It could also be that peeling machines were put in place in a number of factories in West Africa much earlier in the life cycle of those factories reducing the size of the workforce required.

[1] Specific African countries are described in the full report which is available on request. Kindly contact cashew@giz.de

Figure 2.6 Cashew Nut Processing

	Process	Objective	Equipment seen in factories
Preparation	Stage 1 In-shell cashew nut sun drying	In-shell nuts are dried preferably on a concrete apron to a moisture level in the region 8% to ensure that the nuts will not deteriorate in storage.	1. Jute bags 2. Tools for turning the nuts on the apron 3. Large weighing scales
	Stage 2 Calibration & cleaning	In-shell nuts are graded into 3 or 4 different sizes to allow even heating, easier shelling and pre grading. Very small nuts , dust and foreign matter are removed.	1. Calibration machine usually rotating cylinder 2. Conveying method trolleys or bags or cartons 3. Moisture meter
	Stage 3 Steam cooking/roasting	In-shell nuts are steamed in batches usually 320kgs for periods ranging from 25-35 minutes to make the nuts easier to cut and to reduce breakage of nuts.	1. Boiler to generate steam with regulator 2. Batch cooker 3. Bins to convey the nuts after cooling
	Stage 4 Shell removal by cutting & separating	Almost everywhere in Africa the nuts are shelled by using a cutting tool which grips the nut and cuts the shell which is then separated by hand.	1. Cutting tables equipped with cutting tools or 2. Shelling machine (rare in Africa)
Peeling	Stage 5 Preparation for peeling i.Oven air curing/drying ii.Cooling iii.Steam "thermal shock" v.Cooling	The nuts have the testa or inner skin still intact. To prepare for removal of the testa by manual or machine methods they are heated to make this skin brittle and loosen. After cooling they are treated with a short steam treatment further loosening the testa. The "heat then steam" treatment is repeated up to three times in some factories. After treatment the nuts are allowed to cool.	1. Dryer oven powered usually with heat exchanger 2. Boiler to generate the steam 3. Or electric ovens (rare) 4. Trolleys with trays to hold the nuts in the oven 5. "Thermal shock" chamber and steam generator
	Stage 6 Removal of testa also called peeling	1.Removal of the testa is either manual by rubbing the nuts between the fingers and finishing with a small knife. Or 2.Peeling machine which usually utilizes a rotating cylinder followed by an air peeler. Some manual always.	1. Auto. peeling machine product with compressor 2. Grading/pick out line after peeler 3. Pieces/testa separator 4. Weighing scales, moisture meter, product bins 5. Manual grading tables and knives
Grading	Stage 7 Grading to standard i.Grading of wholes by size and color ii.Grading of pieces	The nuts are graded by size and colour into the international grading system. Grading in Africa is almost exclusively by manual method for wholes and by semi mechanized sieving for pieces. Some automatic grading machines have been tried with poor results to date. Color sorting machines are not usual.	1. Grading tables well lit 2. Basins/bins for the grades and conveyance 3. Weighing scales or 4. Grading machine (2 seen but not in use)
Packing	Stage 8 Packing i.Aspiration ii.Weighing iii.Filling iv.Vacuum/gas back flush/sealing	The cashew kernels are now cleaned with an aspirator, weighed into 25lbs or 50lbs batches and packed using a vacuum packing machine which extracts the air and flushes the pack with carbon dioxide to protect the kernels and increase the shelf life. The packed pouch is placed in a carton which is marked, taped and stored for shipment.	1. Packaging machine incorporating aspirator/cleaner 2. Metal detection in some factories 3. Weighing scales 4. Vacuum packing & sealing machine with gas back flush 5. Vibrating filler 6. Gas usually CO2

2.5 Processing in Brazil

The Brazilian cashew nut processing in Brazil has 23 large factories that operate through the mechanized and automated process with annual capacity to produce 240.000 tons of cashew kernels. These large factories work to only about 50% of their processing capacity. There are also the small factories that operate the manual cutting systems. They are present in many states of north eastern Brazil, with around 100 units and annual capacity of processing 20.000 tons of cashews.

There are three models of processing cashews in Brazil:

a. Craft Industry
b. Mini-factory
c. Mechanized system

The equipment for the first two (Craft Industry and Mini-factory), is developed in Brazil by local small engineering industries. Embrapa, the Brazilian research institution inputs design and technical support.

For the large scale, the first part of the process from intake to shelling, the equipment is developed in the state of Ceará by local engineering firms. These equipment supplies are not present in the African market but could provide a useful source for Africa processors and entrepreneurs. The equipment for the rest of the process, from the post shelling drying to grading and packing, comes from foreign industries and their subsidiaries in Brazil.

Embrapa suggested that the best model for Africa is the mini-factory system not the mechanized model. There should be a modular system. In this model the cooking, shelling, heating and peeling are done at the mini-factories and the final part of the process at the central cooperative. Alternatively they suggested two other models: all the process can be done at the mini-factory and only the grading, packing and commercialization at the cooperative or everything is done at the mini-factory but the cutting of the shell that would be done at the family home.

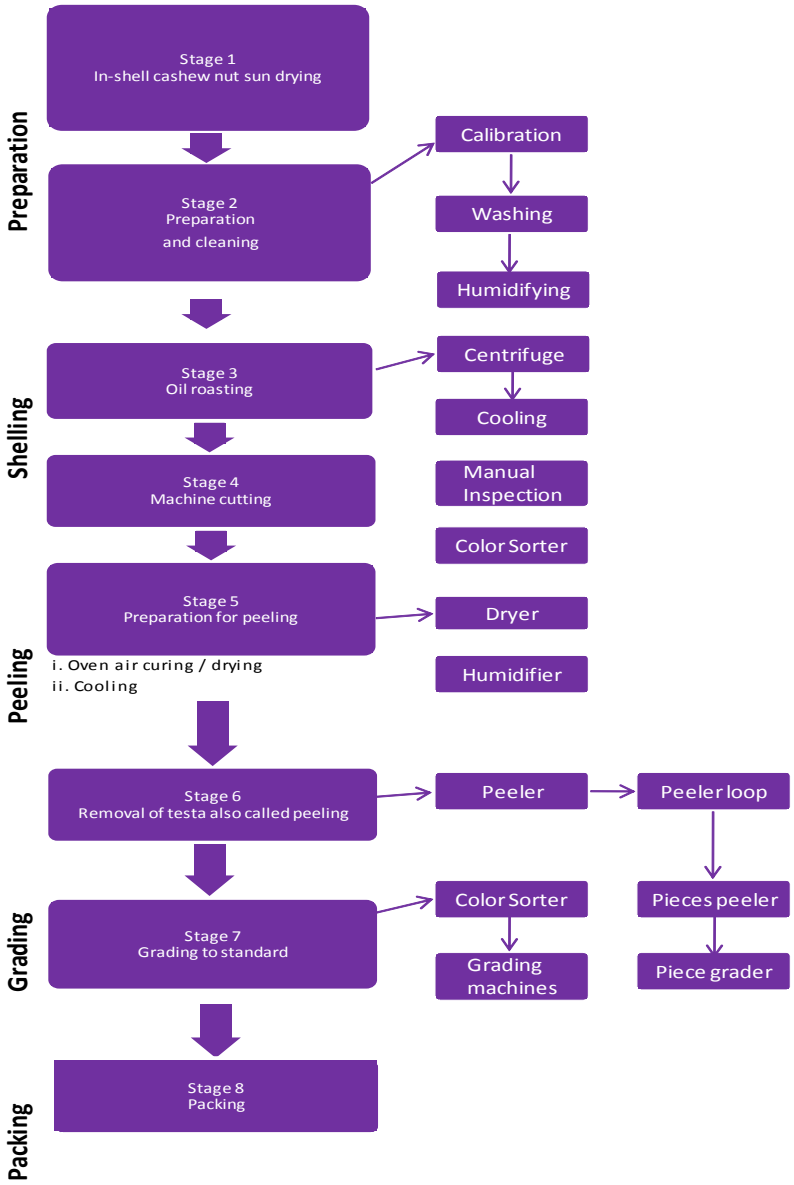
Table 2.1 Brazilian small processors productivity

Reference	Parameter	Value
Net shelling yield	percentage	21
Whole kernels from the process	percentage	80-85
Labor productivity - cutting process	kg/kernel/day	34
Labor productivity - grading process	kg/kernel/day	37
Labor productivity – peeling	kg/kernel/day	13

Brazilian small processors productivity

Productivity looks similar to African factories with wholes kernels a little lower and productivity a little higher. However this achieved with smaller capacity machines e.g. cookers 50 kg capacity.

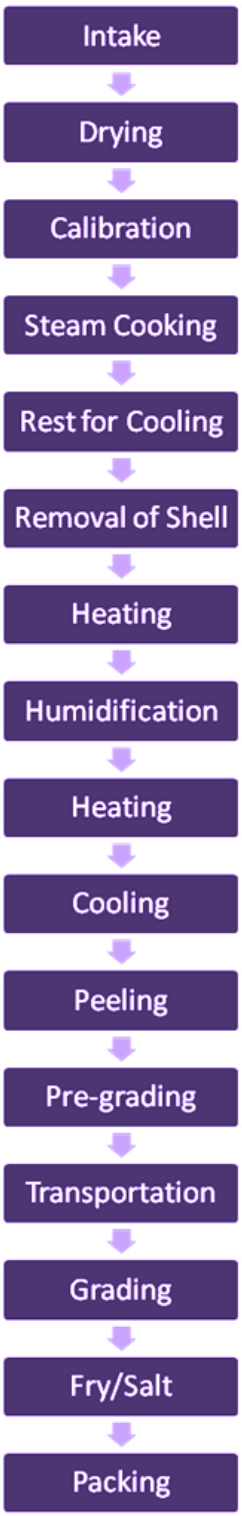
Figure 2.7 Cashew Processing in Brazil - Mechanised large scale model



Objective	Main Equipment
In-shell nuts are dried preferably on a concrete apron to a moisture level in the region 8% to ensure that the nuts will not deteriorate in storage.	1. Jute bags 2. Tools for turning the nuts on the apron 3. Large weighing scales
In-shell nuts are graded into 6 different sizes to allow even heating, easier shelling and pre grading. Very small nuts, dust and foreign matter are removed.	1. Calibration machine usually rotating cylinder 2. Manual handling into dry storage 3. Moisture meter 4. Mechanical handling from the dried nut storage
The in-shell nuts are washed with water, and then are humidifier with a steam-powered humidifier. Silos provide a space for nuts to dry, after which they are roasted in a oil roasting machine and centrifugated to make dirty CNSL out. Finally, the nuts are cooled in a machine, and stored in silos.	1. Washing machine 2. Humidification machine 3. Draining and cooling silos 4. Oil roasting machine 5. Cooling machine 6. Centrifuge
Nuts are shelled by passing through a shelling machine, composed by an hopper, and a sieve conveyor and kernels belt conveyor. After being manual inspected, the kernels enter, through a conveyor, in the kernel automatic inspection, which is done using a calibrator and a color sorter.	1. Shelling machine 2. Mechanical conveyor 3. Calibrator 4. Color sorter
The nuts have the testa or inner skin still intact. To prepare for removal of the testa by they are heated to make this skin brittle and loosen by heat exchanger using steam. After humidification they are sent to the mechanical peeling machines	1. Dryer units with radiators 2. Humidifier
Peeling machine which usually utilizes a rotating cylinder followed by an air peeler. Typically the process is repeated twice	1. Automatic peeling machine product with compressor 2. Grading/pick out line after peeler 3. Pieces/testa separator
The nuts are graded by size and colour into the international grading system. Some factories do the grading using colour sensors i. Grading of Wholes by size and colour ii. Grading of pieces by sioeving and vibration	1. Grading machine (vibrator) 2. Dicing machine 3. Color sorter 4. Unpeeled pieces air peeler and grader
The cashew kernels are now cleaned with an aspirator, weighed into 25lbs or 50lbs batches and packed using a vacuum packing machine which extracts the air and flushes the pack with carbon dioxide to protect the kernels and increase the shelf life. The packed pouch is placed in a carton which is marked, taped and stored for shipment.	1. Packaging machine incorporating aspirator/cleaner 2. Metal detection in some factories 3. Weighing scales 4. Vacuum packing & sealing machine with gas back flush

Figure 2.8 Cashew Nut Processing in Brazil – Small Scale Model courtesy Embrapa

Process



Equipment

The calibrator sorts to 4 sizes of cashew. It is composed of four rotors with perforated metal plate of 18mm, 21mm, 24mm, 27mm and supported by steel plate with the capacity of 300kg/h.

Cooking device for cashew shell built in steel with a cylindrical format, for the production of steam with the following components: Manometer, level display, security valve, assembled in steel base with kitchen gas burner, with capacity for 50kg of cashew/hour.

Manual Cutting Machine built in iron, with table, set-square and gearstick, activation pedal with steel knifes system to cut the shell. The capacity is to cut 100kgs of cashew a day per man with knifes for 18mm, 21mm, and 24mm or 27mm cashews.

Tables for the manual peeling, selection and classification of the cashew nut, made of steel plate and wood, with four legs, in the following dimensions: 60cm high, 90 cm large and 3 meters long.

Heater for drying the nuts, built in metallic plate with door, metal shelf for 14 treys, with thermometer, thermostatic valve, gas burners, with capacity for 42kgs in six hours, together with trey support and partition for the introduction of the treys where nuts rest.

The manual peeling system of Embrapa has a tray with a metallic web for the separation of the testa and brushes assemble over a wood metallic trey, with daily processing capacity of 300kgs. This equipment was not seen in any mini-factory visited.

The peeled kernels are returned to the co-op or central factory for grading and roasting

2.6 Key Drivers for change in processing

The above mentioned different characteristics of the processing industries are all influenced by several factors which have an impact on changes in processing:

Cost factors

a. Higher labor costs and lower availability in southern India and Vietnam
b. Lower prices for broken kernels relative to wholes over the past decade
c. Escalating energy, shipping and packaging costs
d. Volatility of prices
e. Lower cost and more efficient processing machinery

Customer driven factors

a. Food security and safety
b. Traceability requirements
c. Market structure - fewer, larger customers
d. Expanded international markets and the emergence of the Indian domestic market
e. Labeling and packaging demands from customers

Factors for successful processing operations

a. Good quality raw material which is dried properly
b. Working capital at a competitive interest rate
c. A process which gives an outturn of whole kernels at a minimum of 80%
d. A market for the inferior and broken grades
e. Availability of labor
f. Technical understanding of the process and the equipment involved in it
g. Attention to food safety standards
h. Market information on cashew nuts and on cashew nut processing.

The choice of equipment, machines and processing method is linked to each of these factors. Decisions made early in the life of a processing plant may determine success or failure. Cashew processing remains a profitable activity but requires a long term commitment from the processor.

3 Overview of the equipment market in Africa

Cashew nut processing equipment is not new. The machines which are available in the market today are not a technological revolution although there have some major innovations. They are part of a process of change which is increasing in speed. It is driven by a combination of changes in the labor market and developments in technology. The mechanization of the industry Worldwide is underway.

As far back as the mid 1960's mechanized integrated plants were found in Tanzania and Mozambique. These factories were surpassed by the Indian labor intensive processors who could produce at a lower cost. The political and economic problems sealed in the fate of the mechanized factories which stopped producing in the 1980's. In Brazil, where factories were built by companies who could raise the necessary investment capital, mechanization and large scale factories became the norm. These factories operated under an entirely different financial model to that elsewhere with high yields of broken nuts and higher costs.

The rapid development of the Vietnamese industry during the last 10-15 years, in an economic environment where employment options rapidly improved and where there is a culture of technical innovation, led to the development of new ideas for cashew factories. Innovation has gained momentum in recent years and now a range of technologies are available. The revolution is not in the technology but in the fact that these machines are produced in countries which can market at much lower prices than previously.

The market now has available new technologies in cutting, shelling and peeling as well as a range of options for packaging and movement of the product around the factory. These are sometimes seen as the answer to all the problems of the process but actually create a series of challenges of their own both in terms of procurement and management. Machines will play a greater role; small and medium cashew processors (and some large ones) will continue to need workers. The conditions and wages offered needed to attract those workers will be driven up by the market in current conditions inevitably leading to the use of more machines.

In addition to a lack of technology transfer there has been little in the way of innovation in cashew factories with a few notable exceptions. Until recent year's innovation in cashew processing plants especially in India and Vietnam has been the result of crises such as the unacceptability of tin packaging for many Western buyers, high levels of infestation of kernels or discovery of contaminated product e.g. BHC or micro-biological activity such as E.coli and salmonella.

Formal technology transfer has been largely absent from the cashew industry. We have begun to see some transfer as equipment manufacturers have started to market outside of their own countries. This is due to the development of better, lower cost machines but is also due to the opening of Vietnam.

Cashew processing equipment in African countries has for many years been served by a narrow range of suppliers. Muskaan, initially by offering a full service gained market share at a time when other suppliers were probably not interested and the new range of machines had not yet come to the market. The partnership developed the processing method as steam cooking and cutting similar to the system used in Mangalore which seems to have been a good choice as it is the preferred method among the more developed factories in India and Vietnam today. It is also suitable for use in small scale factories.

Information among Africa processors on equipment is sometimes poor and many suppliers are not enthusiastic. In conducting this study it took some time to convince the Vietnamese suppliers to engage and see it as a marketing opportunity. This may change attitude but interviews with processors and in Vietnam informed the study that generally the cashew processor had sought out the supplier rather than vice versa. Similarly Indian companies are unlikely to look for business in Africa but if processors ask for quotations they will offer. At this point in time the processor must "shop around".

In summary the market is slowly opening up but the two dominant companies continue to keep market share under pressure from cheaper prices from the Far East. Suppliers from Vietnam and China are less likely to offer the full service project. This is likely to maintain "full service" suppliers' market share with new processors and processors who do not have support from multinationals or overseas investors.

The study only found Brazilian equipment in one country. However the Brazilian national study has found a significant equipment sector in Brazil offering a range of equipment for "mini factories" ranging up to 500 tonnes in shell per annum. This equipment is scalable, simple and suited to small factories. The options from Brazil should not be neglected in making equipment decisions.

Market access challenges in the cashew equipment market

a. Lack of information and poor quality information.
   Many processors have not had the information to realize that there are a wide range of options. Whether a processor uses what this study describes as "the one stop shop" or the "do it yourself method" information on processing and the cashew equipment market is essential. The poor quality of the information available has directly led to companies buying machines which are wrong for them. The machines may perform according to specification but are often not the right machine for the particular environment or the supplier is not the right supplier. Frustration and waste of money follows.

b. Risk and perception of risk.
Suppliers see business in Africa as full of risks such as nonperformance, nonpayment, political upheaval. This causes them to alter their approach to the market. They are less likely to look for business in African countries. Some suppliers told the study that they are just not interested in exporting to Africa. Secondly, the equipment suppliers are disposed to offer prohibitive terms of sale. Finally they are unwilling to offer delivery as they view the problems of logistics as too difficult. This perception of risk limits competition.

c. The structure of the equipment market.
The cashew equipment market is primarily based in the main cashew processing countries. There are no modern mechanized equipment manufacturers in the African countries. There are only one or two international cashew equipment suppliers. This means that there is little understanding of the local conditions in each market. On the positive side there are no barriers to trade in cashew equipment in terms of tariffs or trade restrictions.

d. Lack of competition.
Following on from the first points the logical result is that there is a lack of competition in the sector in Africa. The equipment suppliers who either specialize in the market or are large enough to have a presence in the market can decide on prices and products.

e. Finance.
The lack of a developed financial services sector limits buying options. Changing perspective on risk will be a slow process. In the meantime processors need access to the type of financial services that are available to their competitors elsewhere in the World.

f. Scale.
Cashew factories of the kind usually found in African countries are small and local. As such, opportunity to benefit from technology transfers from related companies is very limited. Processors are unable to afford professional expertise even if available.

g. Management & process expertise.
The nature of many of the cashew companies in African countries means that the founder, the entrepreneur remains the decision maker on all issues including issues in which he or she has no expertise like new technology. A number of the cashew processing factories which were visited in the course of the study have poor understanding of the machines which they have already purchased.

4 Trend in cashew processing equipment

The background to the trend in cashew nut processing is of a growing market, highly volatile prices, rising costs and a tight supply/demand balance. There are more processors and more processing plants. In these dynamic times the cashew market is asking - how and where to best extract the valuable kernel?

a. Cashew processing is beginning to develop into a modern industry.
b. Labor and mechanization.
   Labor and mechanization are inextricably linked especially for the small and medium scale businesses. Changes in the cost of labor and workers demands for better conditions are central to developments in processing. The increased competition for labor in India and Vietnam and advances in machine performance has changed the calculation for processors. The conditions in the shelling sections of some cashew factories may be better than they once were but are still not attractive for workers who have alternatives.
c. Investment and capital requirements are rising.
   The use of more machines means higher levels of investment. Even a small factory today will need significant investment and the level is rising. Equipment suppliers generally do not offer open credit terms. Leasing or similar options may not be available. The financial barriers which small and medium sized processors have always experienced in African countries will grow unless financial services improve.
d. Food safety, traceability and sustainability.
e. Stricter enforcement of food safety standards by buyers is and will continue to impact processors. Failure to meet the standards in the medium term may well close markets. Compliance will involve investment, planning and good management.
f.
g. Organization of the process.
h. There has been a trend for many years to break up the cashew process. The trend continues where shelling in particular in Vietnam is often contracted out to smaller factories. This takes the part of the process which is most difficult to reconcile with food safety standards away from the main centre. It also spreads the labor requirement.

There are changes too in the process. The trend in India and Vietnam is for “steam and cut” to replace drum roasting/cracking and oil bath roasting.

a. Technology and management.
b. The trend toward the use of technology even in the limited form of cashew processing machines is making new demands of the owners and managers of small and medium size cashew processing plants. It is important that managers understand how the machines work and the factors that influence its success or failure.
c. Environment and energy.
   Environmental concerns will impact the cashew industry when customers start to conduct environmental audits on processing plants. They will consider the emissions into the air and water in particular. One factory in India has been closed. In Vietnam the first concern is emerging with the oil bath process for pre-cooking in shell cashews. More efficient boilers and CNSL extraction plants will be required. The cost of fuel oil and therefore sea freight is another factor. For how long will it make sense to ship five tonnes of in-shell to India and one tonne of kernels back to the USA?

Mozambique 2011: Environmental issues

5 Conclusion and database

5.1 "Knowledge is power"

It's a cliché but it is true. This study has seen unused or underused cashew processing equipment in a range of factories in the six African countries visited. The basic requirement of making a good purchasing decision is to have as much knowledge of the available products, processing and the market for the products. Researching properly and taking time to make a decision will save money. A study on purchasing of health care equipment has estimated that 50% can be saved at time of purchase, 35% with the right management and utilization and 10% on maintenance – all by making the right decision when procuring[2].

Making the right decision is especially important given that in Africa most equipment is imported and most vendors demand payment prior to delivery. The power of the buyer to demand modifications and to question vendors' performance claims after delivery is limited.

The cashew processing equipment market has opened up considerably in the past five years. There are now a wide range of suppliers both of specialist and generic equipment (compressors, generators and boilers). Specialist cashew equipment can be sourced from many countries including India, Vietnam, Italy, China, Sri Lanka, Thailand and Brazil. As the market grows the decision making process will become more complex. Knowledge will become more valuable.

Purchasing musts for the processor

a. Assess equipment needs thoroughly.
b. Research all the available equipment solutions as thoroughly as possible.
c. Set a budget – you can only purchase what you can pay for.
d. State as clearly as possible what is needed – draw up a "statement of needs".
e. Think long term.
f. Obtain quotations from more than one vendor usually a minimum of three. Always obtain a written quotation and after decision a written contract.
g. Ask for references from other buyers preferably in similar situations to you. Check the references.
h. Check import restrictions and duties. Many governments will waive restrictions.

[2] Reference Universal Hospital Services 2005

Purchasing strategies

There are two strategies generally employed by small and medium cashew processors.

a. "One stop shop" – after carefully assessing the options and selecting three suppliers ask them to quote for the full supply of equipment for the factory. This involves placing your trust in your judgment to select the best supplier and the supplier's integrity and capability in fulfilling the commitment. This is a suitable strategy if the buyer's knowledge is limited, in start-up businesses or has difficulty with communications. It probably means that not every piece of equipment will be the best available but it does mean that the supplier takes responsibility for ensuring that it all fits together e.g. the compressor works with the peeling machine or the boiler with the cooker.

b. "D.I.Y – do it yourself – if the processor has enough knowledge, experience and access to good communications then this strategy may work. This means going to all the different suppliers and trying to put together the best equipment from each as a coherent process. It is more demanding, takes more time and involves higher risk. This strategy is probably best suited to processors who want to expand, renovate or open new plants. The logistical challenges and service challenges of operating in this way suggest that it should only be considered if good technical knowledge will be available on site at all times and if there will be good communications available to contact suppliers.

The "one stop shop" is the recommended strategy for new entrants to the market. However it probably is the more expensive route in that the buyer is not able to pick and choose the lowest price items on offer. It is very important to choose the supplier well and to make sure that they have the capability to carry out the actions promised.

Assessing Cashew Equipment needs

A good equipment supplier will try and supply the appropriate equipment but their business is to sell equipment so the processor must first identify what is required. In order to identify the nature and capacity of the equipment the following factors should be considered as a minimum:-

a. Size and capacity of the plant to be operated and future plans for expansion: It is important to identify the likely capacity of the plant to be built. A factory must have enough equipment to process the raw material it can source. This is often limited by working capital availability. Many factories have invested in equipment well above their financial capacity to utilize. In the case of manually operated plants this was not as significant a problem as the equipment was minimal so that additional workers could be employed. What are the long term plans? Will the equipment fit with expansion plans? Is it economic to run two small machines side

by side or should one larger capacity machine be bought at the outset?

b. Location of the plant is important in terms of access to raw material, climate and how it might affect operation of sophisticated equipment, storage of raw material, access to spare parts, communications, and access to utilities. Processors must ask themselves if they should install sophisticated equipment in remote areas where communications are difficult or electricity supply is subject to regular interruption.
c. Raw material: Firstly there must be enough raw materials available to meet the processing capacity of the factory. Ideally this should be local as transport costs are likely to escalate over time. Not all cashew nuts are the same. Anyone involved in processing must be aware of the yield to be expected, the sizing of the nuts, the moisture and variation over the year, the ease of peeling, the thickness of the shell and the oil content of the nuts. Knowing the product will help decide which equipment to purchase to process it.
d. Technical knowledge and local service capability: As the processing of cashew nuts develops and more sophisticated machines become available it is essential that processors must have the basic service skills to keep the machine running. In Tanzania one processor told the study that they have a qualified engineer on site that can identify a problem explain it to the manufacturer over good communication links and resolve problems. Another in Mozambique told us that they waited for weeks to have a machine checked as they had no local access to someone who could identify the problem. If local service ability is limited then it may be sensible to buy two smaller machines instead of one high capacity machine in the event of the breakdown of one machine at least the other would be still running.
e. Power and fuel supply. It is obvious that an electric machine needs an electricity supply. This may mean that a backup generator is required too. What is the cost of electricity? How much light is required? What if a second shift is introduced? Will cashew shells be used for boilers? Will the cashew nut shell liquid have been extracted? Are local supplies of fuel available?
f. Labor and labor practices: For most small and medium cashew processors a good part of the process will remain manual for the foreseeable future. It is important in assessing equipment options to consider how workers will interact with the equipment in the factory e.g. cutting tables for example. What is the likely turnover rate of workers? What is the likely rate of absenteeism, skill level and local traditional processing or other occupations?
g. Equipment management: The ability to manage the equipment especially one of the most lacking features observed in the study field visits. The more sophisticated the equipment the more machine management ability is required. Only two of sixteen factories visited displayed an in depth knowledge of the factors which influence the performance of peeling machines for example although many displayed a good understanding of the oven drying and “thermal shock” process.

Assessing Suppliers

The cashew processing equipment market has developed in recent years so that a wide range of equipment is available from a range of different countries. Given that procurement decisions may critically impact the performance of the processing plant it is important to carefully select the supplier.

Suppliers should be assessed over a range of factors especially bearing in mind that payment terms are usually – “payment in advance” or letter of credit. Therefore there are financial risks that the supplier will not perform the contract because he goes out of business or simply defrauds. There are also the risks that the quality of the product supplied will be inferior. These risks can be avoided by checking on the supplier and developing a relationship with the supplier prior to placing the order so that the processor makes the requirements clear and the equipment supplier confirms that he is capable of executing those requirements. The following series of questions are drawn from problematic experiences of processors which were related in the course of the study.

Assessing the suppliers offer

a. Is the suppliers approach to sales open and responsive? Do they respond quickly to questions? Do the answers demonstrate an understanding of the process?
b. Who have they supplied in the past? Does their performance tally with reports from other processors, suppliers, trade associations?
c. Is this the latest model of the machine? Will you have access to future innovations?
d. What are the contract terms? Price? What are the payment terms?
e. Do they offer a warranty? For how long?
f. Do they offer a service contract? Where is the service technician located? Is there an agreed response time to a service request?
g. Will they ship and install the equipment? Will their installers be able to come to your country?
h. Do they offer a full range of equipment? If they supply ancillary equipment sourced from another manufacturer e.g. compressors who is responsible for service? Who is responsible for spare parts? What are the terms of supply of spare parts? Do they keep a stock of spare parts? Will they supply you with a set of spare parts with the order?
i. Will they provide a user manual? What language will it be in?
j. Where are they located?
k. How do they propose to resolve disputes?

Assessing the risk of dealing with a particular supplier:

What can go wrong? - Questions for the processor to manage the risks of dealing with a supplier.

Relationship:

a. Have you met a senior staff member of the supplying organization?
b. Do you trust them? Have you seen the equipment working?

Financial risks

a. What are the payment terms?
b. How long has the supplier been in business? Has the company been stable over that period? Have directors, shareholder left? Is the company a limited company? Is it private, public or state owned?
c. Have you taken a bank of credit rating agency reference on them?

Equipment quality risk

a. Does the company have the experience, knowledge and organization to handle the order?
b. Do they fully understand the processors requirements?
c. Have you seen their product demonstrated in a factory similar to yours?
d. Does the supplier have the rights to produce the machine he is offering?

Delivery risk

a. Where is the supplier located?
b. Are there any trade restrictions or duties on export from the country of manufacture or on import to your country?
c. How long will it take to build and ship the equipment?
d. Have they shipped to your country before?
e. What documents will they provide for customs clearance on arrival?
f. How will it be shipped? What is the transit time?
g. How will it be packed?
h. Whose responsibility is it to insure the equipment in transit?

Long term thinking

Purchasing of equipment is a long term decision which involves capital investment, planning and management of resources and logistics. The installation of the equipment is a major task which has to be planned from the initial decision to purchase right through to the day when the equipment is commissioned. There is another very important aspect to long term decision making in the procurement of equipment which is the cashew market and the prospects for the cashew kernels that the factory and in particular the equipment that is to be bought will produce.

The study of cashew equipment has shown that the currently available equipment involves striking a balance between deterioration in the product produced and the saving of time and labor. What will happen to the market for fancy splits and pieces if every processor switches to equipment which produces more broken cashews? Volatility of price is a given so why would a processor make major decisions based on what might be a short term trend in the market? If an equipment purchase depends on a particular price trend continuing then you are effectively speculating on the market. It is then very important when considering the economics of cashew equipment to assess long term market considerations and not just short term trends.

5.2 Overcoming Market Access Challenges

The study considers some strategies and remedies on a corporate and trade level under the following headings:

Development of the Information Infrastructure: more information for processors

a. Given the response from equipment manufacturers especially those in Vietnam and Brazil to this study it seems clear that the African cashew sector needs to turn the normal buyer/seller relationship upside down by starting to promote itself to the equipment supply industry. The competition sparked will improve service and reduce prices. Individual companies can do this and the trade association, should do it.
b. The information must flow both ways so that better information will become available to the processors and potential processors. This in turn will prepare processors for discussions with their banks and investors.

Build up management and production skills

a. Production capabilities: The natural development of innovation and “learning by doing” which would usually distinguish the successful business have to a large extent been interrupted in the African cashew industry.
b. Without these skills systems for problem solving which would develop into purchasing and development strategies cannot evolve.
c. Many of the processors remain as simple structures. First generation businesses built by entrepreneurs with a few supporting staff sometimes with little experience of food processing may make decisions based on their competitor’s action or on the assurances of the salesman or just out of frustration with the workers not turning up.
d. Development of skills in factory and labor management is now crucial as technological advance impacts this industry.

Development of effective communication skills

a. The ability to transmit information, skills and technology to suppliers, service firms and consultants is essential if a firm wants to develop its technological capabilities.
b. This includes production capabilities which have to be communicated within and without the organization.
c. It is important to be able to communicate with labor in an effort to discourage absenteeism and turnover of workers. Good communication with workers will impact how technological changes are absorbed.
d. Communication ranges from the simple requirements like a telephone line to internet access to the ability to speak a foreign language.

Procurement and procurement policy

If an enterprise can secure the level of information and develop its production management it should put in place a procurement policy to ensure that the information and capability resources are exploited to full advantage.

5.3 Cashew processing equipment evaluation criteria

The objective is to develop a database and assessment of the available equipment over a range of areas and to present this together with comments from the consultants on their findings and information on the manufacturer. This will give potential buyers information on three levels (processors, suppliers , consultants) and we hope will stimulate the kind of discussion necessary to make this a continuous process after implementation of the dissemination plan by the ACA.

Table 5.1 Assessment Criteria

a. Manufacturers & brand names	Listed by country
b. Capital cost	
d. Time in production	When was machine the first developed?
e. Upgrade/Improvement	Are there any upgrade or improvement plans?
f. Processing capacity	for example number of kgs per hour in-shell or kernels
g. Efficiency	for example percentage of kernels broken in process
h. Power requirements/source	Electricity, diesel. How much?
i. Expected lifetime	Durability over time or volume
j. Ease of use	Training required for use & skill level required. Are their hazards for workers?
k. Maintenance	Does it need specialist training?
l. Range and availability of spare parts	Cost, location
m. Scalability	How easily the equipment can fit into a larger or smaller process. Can it be upgraded?
n. Cleaning characteristics	How easy to clean? What are the control points?

Table 5.2 Asessing the equipment

Each piece of equipment ist considered in a range of categories

Category	Description
Ease of use/ factors	How many workers per machine? What level of skill?
Place in the product flow	How easily does it fit in? Does it limit or is it limited by subsequent stages of processing?
Maintenance requirements	Parts , service interval, ease of use, lifetime
Control points	How likely is the machine or equipment to cause a food safety problem, control point or violation?
Scalability	Does it fit into large and small processes? Can it be upgraded?
Capital Cost	The cost of the machine

5.4 Cashew processing equipment supplier evaluation criteria

A top class machine from an unreliable supplier is of little value as it may never be properly commissioned or it may fall out of use for want of service or spare parts. Therefore it is essential to evaluate the quality of suppliers especially as many of these will be foreign companies to the new processing company.

It is even more difficult to conduct an absolute evaluation of suppliers. We can only draw on their own claims, references and the comments from their customers. Therefore the study has utilized a similar evaluation method as we have proposed for the equipment itself.

Stage 1 A list of cashew equipment suppliers has been drawn up and categorized by country of origin and the equipment they produce.

Stage 2 The study team interviewed each of the cashew equipment suppliers to discuss their products, their company and their customers. A record card has been produced for each equipment company drawing on information produced by themselves, by their customers and on the evaluations of the consultants who interviewed them. This contains the information necessary for the formulation of a database of equipment suppliers.

Stage 3 Suppliers are assessed in four main categories:

Pre-sale – this includes their approach to sales and collaboration, pricing, contract terms, payment terms, warranty, installation, response time, range of equipment, location and dispute resolution mechanisms.

Equipment assessment: drawn from the equipment assessment already discussed

After sales – Almost as important as the purchase itself this includes order lee time, Installation cost and rates for labor , spare parts included with order, location of service team or agent, shipping costs and restrictions from manufacturers country to destination, contract compliance, access for a buyer to future innovations and improvements.

Supplier risk management – Level of cooperation with the study, contract fidelity record (largely drawn for past clients), experience in export markets, understanding of the market and therefore the buyer's needs.

6 Annex: Guidelines on cashew processing equipment for small and medium factories

This section offers a summary of the large pieces of cashew equipment. The tables that follow 6.. – 6.10 give a brief overview and evaluation of the major pieces of equipment found in a semi-mechanized cashew factory, typical of those visited in the course of the study. These tables look briefly at the function, capability, capacity, ease of use, maintenance, scalability, suppliers and price. The commentary is based on comments made to the study by processors and equipment suppliers. They are not intended to be a comprehensive guide but only to give an indication. Further detail and analysis on fifty selected machines can be found on the database cards – Equipment Evaluation, which is available in a separate document.

Details of the suppliers can be found on the database cards – Supplier Evaluation and the supplier listing.

Note: A small factory for the purpose of this study is three tonnes per day and a medium is up to 10 tonnes per day in shell basis.

Grading by hand

Peeling

Table 6.1 In shell calibrator

Stage in the process	At the beginning of the process working with dried nuts either before going to storage or taken from storage before going to cooking
What does it do?	It removes foreign matter and divides the nuts into different grades by size usually 18mm 20mm 22mm 24mm. Machines are available which will grade into three, four, five or eight different sizes. The sizing will impact the shelling section so the number of calibers needs to be considered carefully
Capacities available	Ranging from 500kg per hour up to 2 tonnes per hour. Capacity is not a major problem as the entry level machine is 1 tonne per hour. There is a minimum quantity of 200kg to make a calibrator do its job well.
Ease of use	Simple rotating cylinder with a series of screens allowing the nuts to fall through in increasing sizes
Maintenance	Must be cleaned as debris can become stuck in the screens.
Control	Straightforward a simple electric motor and rotating cylinder. The speed of the rotation must be monitored if poor performance is experienced
Suitability for small factories	Some small factories do not use calibration but it ensures economies and faster processing later in the chain. It's essential if a shelling machine is to be used.
Options	Most calibrators can be used with an elevator and automatic conveyance system at additional cost.
Scalability	High for small and medium due to entry level capacity
Look out for	Electric motor size for the load and the lifetime
Possible developments	None were mentioned
Current suppliers Africa	Muskaan , Cao Thanh Phat , Vietmold,
Possible options	Agrotech, Brazil / Phuc Thanh, Vietnam
Price range	$5400 - $8400

Muskaan calibrator with elevator

Brazil Mini factory calibrator

Table 6.2 Steam Cooker

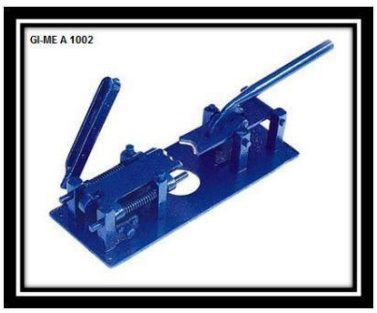
Stage in the process	The cooker is the first stage of processing after calibration
What does it do?	The in shell nuts are cooked using steam to make them easier to cut, to reduce breakage and to protect workers hands. This is a very important stage where problems are often encountered
Capacities available	320kgs – 4 bags and 600 kg
Ease of use	Cookers are simply loaded and timed. There are many variations on the time of cooking which some processors says changes as the nut does. From 13 -35 minutes were quoted by processors. The rotary cookers are more difficult to use but save time in cooking and a bigger batch size.
Maintenance	Simple process but the boiler must be working properly and the steam pressure must be carefully controlled. Rotary cookers fitted with elevators need more maintenance
Control	The Indian style is controlled by letting the steam in and waiting. The rotary cookers have a control system
Suitability for small factories	The smaller size can cook 2.5 tonnes per day which makes it ideal for the small factory. The rotary also fits a small factory but probably needs more technical expertise which small factories may not possess.
Options	If you are steaming these are the two options
Scalability	Both are scalable in that the processor could cook for two shifts and cut for one. Most factories expand by buying a new cooker. Make sure that the boiler initially installed allows for capacity to expand cooking
Look out for	Valves and lines on the Indian one. High pressure on The rotary cooker if using a high capacity boiler
Possible developments	No developments discussed
Current suppliers Africa	Muskaan , Cao Thanh Phat
Possible options	Other Indian suppliers , Viet Mold , for small units 50kg Brazil
Price range	320 kg Cooker only $2000 – 4500 320 kg Cooker with small boiler range $7500-8400 600kg Rotary cooker with loader $6500-7800

Brazil mini factory cooker

Table 6.3 Manual Cutting Machines

Stage in the process	After cooking and cooling the shell is removed
What does it do?	The shell is cut without cutting the kernel so as to keep it intact. In African factories figures ranging from 90% to 97% unbroken nuts were mentioned at cutting
Capacities available	Manual cutting is a function of how many people and how many cutting tools. In African factories the daily shift quantity is in the range 35 – 40kgs per worker
Ease of use	It's probably more about habit and practice for workers. The Vietnamese two pedal tables have the best record in cutting volumes but workers elsewhere often do not like them. The Muskaan tool is favored in Africa but some people say that the springs make it less accurate. This is really about well trained workers.
Maintenance	Blade must be kept sharp and adjusted if possible for the nuts being shelled. The nut emerges from the shell at this stage so cutting areas should be clean but they are not
Control	Its individual control
Suitability for small factories	Most certainly used in most small factories
Options	Standing pedal and lever , seated 2 pedal , seated single lever – there are a range of variations
Scalability	Highly
Look out for	Problems with workers using pedal and level. Some health issues reported
Possible developments	Mechanization is on the way but still some issues to be resolved
Current suppliers Africa	Muskaan, Gayathri.
Possible options	Brazil Agrotech
Price range	$68 - $333

Ghana with pedal



India

Brazil

Table 6.4 Automatic shelling machine

Stage in the process	Removal of the shell
What does it do?	Automatically remove the shell
Capacities available	20kg per hour to 150 kg per hour Mainly in the 20-40kg range
Ease of use	This is where the process may get complicated. All shelling machines no matter what type depend on the blades being properly adjusted and the chutes or pipes being properly calibrated
Maintenance	Cleaning must be regular, blades must be cleaned and sharpened
Control	Ranges from the Buddhi model where the nuts are manually fed , manipulated and cut to the Chinese machines which are electronically controlled
Suitability for small factories	Suitable once a little technical know-how is on hand
Performance	Claims for manufacturers range from 75% cut to 90% cut on the first run. These machines do work as they are used in India and in Vietnam. Sometimes processors use them for smaller nuts to reduce cost of breakage.
Options	Manual cutting
Scalability	Mainly small machines allowing them to be saleable by putting many in the same area
Look out for	Noise. Uncut nuts percentage may be high. How are the nuts removed from the shell after cutting? Most machines do not do this.
Possible developments	Plenty of work on-going It may be just a matter of time until cutting sections are partly mechanized. Muskaan informed us they are working on a machine. Buddhi is continually adjusting the machine. In Vietnam larger scale machines are being worked on.
Current suppliers Africa	Buddhi
Possible options	Cao Thanh Phat , Mekong Technology , Si Chuan (China)
Price range	$1300 - $12200 depending on capacity

Buddhi

Gavathri

Table 6.5 Oven dryer

Stage in the process	After cutting before peeling
What does it do?	The nuts are heated on trays to make the testa brittle so as to enable easy peeling thus reducing breakage in peeling and increasing capacity. This can be done from a variety of sources including steam boiler which can be fuelled with cashew nut shells with a heat exchanger or electricity or oil fuelled
Capacities available	Readymade solutions range from 500kgs up 5000kgs
Ease of use	If a modern dryer is fitted with electronic controls and fan air circulation it is easy to use. Older models without the air circulation can mean manual rotation of the trays or scorching of some of the nuts
Maintenance	Regular cleaning. Testing of indicators
Control	Many modern have full electronic control. Some of the older type built for areas without electricity are controlled by the time in the oven at a certain temperature. In some factories the temperature on second runs is reduced gradually. Time is everything to know the raw material in order to judge the time.
Suitability for small factories	Range of capacities. If start up make sure your boiler has capacity for increase in this area
Options	The options are on the fuel used and whether going for a modern or manual rotation.
Scalability	Subject to power supply. This machine is big and costly. It lacks in scalability so decisions in this area from the outset must take into account expansion plans.
Look out for	Boiler capacity. Quality of control equipment varies. Uneven heating. Quality of trays – are they food grade?
Possible developments	Small scale continuous drying system incorporating cooling tunnel and humidifier
Current suppliers Africa	Cao Than Phat, Muskaan , Vietmold
Possible options	Gayathri has small and large models.
Price range	$8000 (1.5 tonnes steam) - $39000(fully electric steel construction.

Afokantan Benin – Muskaan

Table 6.6 Thermal shock

Stage in the process	After drying to prepare for peeling
What does it do?	After drying the nuts are cooled and then treated with a short burst of steam in a chamber to further loosen the testa
Capacities available	Usually locally made. Size limited by the boiler
Ease of use	Product wheels on trays from cooling to the chamber and is timed
Maintenance	Cleaning and checking steam outlets.
Control	Usually by time
Suitability for small factories	Highly
Options	
Scalability	Add as see fit
Look out for	
Possible developments	Equipment manufacturers offer humidifiers. This product is best built locally. Technoserve can supply design and support
Current suppliers Africa	NA
Possible options	NA
Price range	$1000 - $3000 depending on capacity Top is 4kg

Thermal shock Benin

Tray Trolley Burkina Faso

Table 6.7 Peeling machines

Stage in the process	After shelling and drying to loosen the testa
What does it do?	The nuts are peeled by rotating springs or brushes which loosen the testa and are then further peeled by air
Capacities available	There are machines claiming up to 250kg per hour However the machines do not peel all of the kernels the first time and the nuts often have to be run through the machine 2 or 3 times. Levels of breakage vary from factory to factory depending on the nuts and how well the machine is adjusted
Ease of use	This is not easy to use and needs trial and error as well a good technical knowledge to get the most out of the machine. It's very important to read the manual and to make sure the supplier supplies a manual in your language
Maintenance	Cleaning is essential and some say the springs slip out of place and have to be adjusted. Depending on usage one processor suggested a full maintenance twice each year.
Control	Electronic control the setting is easily adjusted once you know how to adjust them.
Suitability for small factories	Not for very small factories. The Agrotech small scale machine might be a better solution.
Options	Manual peeling is the only option
Scalability	With high capacity there is room to expand but this machine should not be introduced until the manual peeling staff are trained as there will always be an element of manual peeling ranging according the African processors from 20-40%
Look out for	Being sold last year's model there are changes
Possible developments	There are fourth generation peelers with two peeling heads being developed in Vietnam. Oltremare is developing their machines
Current suppliers Africa	Oltremare, Cao Thanh Phat
Possible options	Muskaan, Viet Mold , Phuc Tang
Price range	With compressor $30,000 to $65,000

Oltremare Mozambique

Table 6.8 Cashew Wholes Grading Machines

Stage in the process	After peeling the nuts are ready to be sorted into the different grades
What does it do?	It arranges the nuts by size
Capacities available	80-100 kilo per hour
Ease of use	The least successful of the cashew processing equipment. A whole range of problems reported from poor grading to breakage of the nuts. It seems as if there is still some way to progress in this area
Maintenance	Electronic machines. Need to be cleaned regularly and in some case opened for cleaning. This is a high level of maintenance according to comments from users and others who decided not to buy
Control	Electronic
Suitability for small factories	Not suitable due to cost and volume and probable technical complication of the machine
Options	Manual grading
Scalability	Not saleable for the small and medium
Look out for	Manufacturers claims exaggerated
Possible developments	Someday there will be a technology for the small and medium processors
Current suppliers Africa	Oltremare
Possible options	Cao Thanh Phat, Viet Mold, MK Tech,
Price range	$5000 - $10,000

Oltremare Grading Machine in Mozambique

Table 6.9 Cashew Pieces Grading Machines

Stage in the process	After peeling the pieces must be graded into the various grades
What does it do?	It sorts all the pieces by size to fit the international standards. This is done by vibration over falling sieves.
Capacities available	Up to 5.5 kilos per day
Ease of use	All very straightforward
Maintenance	Cleaning essential
Control	By electric switch
Suitability for small factories	Yes
Options	Manual
Scalability	Yes given the capacities available but planning essential
Look out for	Poor fabrication quality. Poor food safety standards these machines are often very roughly made
Possible developments	Continuous for small scale
Current suppliers Africa	Muskaan,
Possible options	Most manufacturers have one and little difference between them
Price range	$2400 - $3800

Muskaan Cylinder Machine at Miranda, Mozambique

Flat tray sieve machine

Table 6.10 Vacuum packing machines

Stage in the process	The final stage – packing
What does it do?	Usually manual fed from a hopper this machine aerates and cleans the kernels, weighs them into the required pouch size. The pouch is then formed and loaded manually before being placed in the vacuum packing machine where it is sealed. Pouches are then stored until ready for shipment when they are packed into cartons, marked and taped.
Capacities available	Capacities are in the range of two tonnes per hour. Most factories have over capacity in this area but vacuum packing is essential for the export market.
Ease of use	These machines are the most sophisticated in the cashew factories and are easy to use. It is possible if the settings are incorrect that the flexi pouches can be too loose or worse too tight causing the nuts to block together which is now not acceptable under the specifications
Maintenance	Food grade machines generally easy to clean
Control	Straightforward electronic
Suitability for small factories	Capacity generally too high but essential for export.
Options	For domestic uses sometimes tin packing is used
Scalability	At 2 tonnes per hour the machine will keep most small and medium factories covered for some time
Look out for	Poor vacuum. Poor quality gas. There is a big variation in the price of sumables especially the pouches which can vary from one to another by - shop around.
Possible developments	More developed machines are available but perhaps unnecessary at this point.
Current suppliers Africa	Oltremare, Multivac, Muskaan
Possible options	Blue Lantern , Vietnam
Price range	With packaging equipment it is possible to pay any price depending on the quality and capacity Vacuum packer with conveyor and screen $15000-25000:Small scale packer from Royal Industries $3300 Metal detector unit $13000-16000

Packing at Kona Agro, Ghana

7 Annex: Sample Cashew processing equipment evaluation card

These cards contain basic information about particular machines all through the cashew process, the type of equipment, where it fits in the process, who supplies it, their terms of payment, the processing capacity according to the maker and any feedback that the study received plus its power requirements.

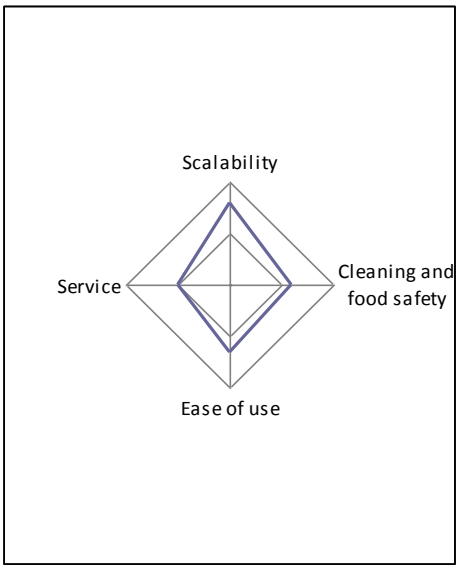
The evaluation criteria that are applied are as follows:

a. Easy to find alternative suppliers?
   This tries to measure how many suppliers of this kind of equipment are in the market. The closer the blue bar is to the right hand side the more alternatives there are in the market.

b. Price $5.900 Free On Board Vietnam
   This ranks the price on a scale of 1-5. Five yellow dollar balls mean it is the most expensive in the range that the study found. One means it is the least expensive. In this example three yellow balls mean it is a mid-range price.

c. This is a radar chart.

Figure 7.1 Radar chart



This chart ranks the equipment on a scale of 1-20 in four areas
Scalability: How it can grow with the factory.
Ease of use: How complex is the operation of this machine? How easy is it to use?
Service: Level of service from the manufacturer
Cleaning & Food Safety: How easy is the machine to clean? Are there any food safety concerns?
The perfect machine would be the same size and shape as the diamond outline.

d. Suitability for small and medium factories

Number of stars out of a top score of five: Five is very suitable. One is not suitable.

Equipment Evaluation Card No. COO1

Date: 22 Feb 2011

Regular exporter to Africa

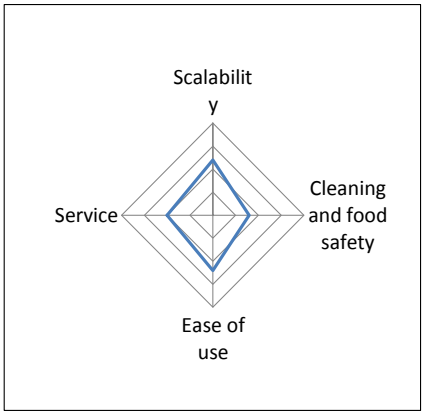
Carriage for load

Type of equipment	Steam Cooker, Rotary , self loading. Taiwan manufactured motor 0.75kw
Place in the process	Cooking of nuts in preparation for shelling
Manufacturer	**Cashew Ltd.**
Easy to find alternative suppliers?	

Price of equipment	$7100 FOB Vietnam Will quoted for shipment on request
Terms of payment	40% advance balance on shipment
Installation cost	Travel plus costs (full service) available

Power requirement	3 phase 0.75kw
Place in product flow	Fits well with medium sized process larger batch size saves time. Probably best to use with CTP boiler

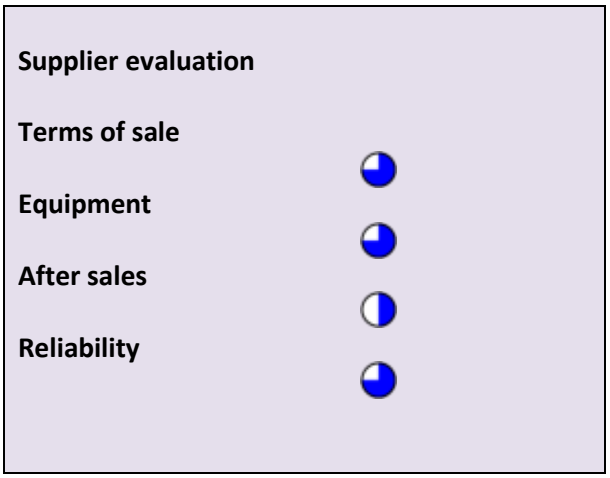
Processing capacity	
Claimed by supplier	600 kg 15-25 minutes total cooking time per batch
Reported by processors	640 kg (8 bag) 13 minutes quoted after steam emerges from cooker
Efficiency	
Claimed by supplier	Larger batch size leads to faster cooking and less energy usage from the boiler. Temperature 170C
Reported by processors	Good machine. Adjustable steam pressure working on trial and error basis to fine tune
Expected life time	Long life
Floor space	L 1.2 x W 1 x H 3 meters



Suitability for small / medium size factories

8 Annex: Description of supplier evaluation cards

The supplier evaluation cards provide a range of information about the supplier which self-explanatory such as trade references, years in business, customers, terms of sale and after sales service. The study then gives an overall ranking of the supplier taking the information and comparing it to the other suppliers in the sector and showing this using Harvey Balls. Simply thee more blue shading in each ball the higher the study ranks this supplier compared to the other suppliers on the four areas.



This supplier scores well on terms of sale, his equipment is regarding of high quality but his after sales service is not as good.

He is regarded as reliable but not the most reliable

What does each term mean?

Supplier evaluation: - How suitable is this supplier as a vendor for small and medium cashew processors in Africa?

Terms of sale: From the buyer's point of view how restrictive are the terms of sale like payment terms, time between sale and delivery, delivery terms and installation terms. For example if a supplier demanded 100% advance payment when the normal in the market was 50% he will score low. If it takes three months for delivery he will score lower if the market normal is less than three months.

Equipment: How good is his equipment from the point of view of the small and medium processor in Africa?

After sales: Does he stock spare parts? Where? Does he offer a service contract? The better the after sales service the higher the ranking will be.

Reliability: This is important in two ways. Firstly, is this supplier likely to take advance payment and then go out of business or just not deliver the order? Secondly, how likely is this supplier to keep on schedule and follow up on problems? This is ranked by looking at the supplier's record, length of time in business, complaints from processors , quality of the customer list, whether or not he has given trade references and cooperation with the study.

These evaluations are relative within the cashew equipment sector. For example after sales service is weak in the sector so all the scores are low. Payment terms are generally restrictive – some percentage in advance or letter of credit so a supplier offering 30% in advance instead of the normal 50-60% will be given higher score.

List of Acronyms

AFI	Association of Food Industries , USA
ACi	African Cashew Initiative
ACA	African Cashew Alliance
BRC	British Retail Consortium. Food quality standard
CENTA	Combined Edible Nut Trade Association (UK)
CEPCI	Cashew Export Promotion Council of India
Cfr	Cost & Freight
CIF	Cost, Insurance & Freight
CNSL	Cashew Nut Shell Liquid – by product
CY	Container Yard
EFTA	European Fairtrade Association
EU	European Union
FAO	Food & Agriculture Organisation (UN)
FDA	Food & Drug Administration (USA Govt)
FiBL	Research Institute of Organic Agriculture
FLO	Fair-trade labelling organisation
FOB	Free on Board
Ha	Hectares
HACCP	Food safety system “Hazard Analysis and critical control points” based on analysis and prevention
IDR	Indonesian Rupiah
IFC	International Finance Corporation (World Bank)
IFOAM	International Federation of Organic Agriculture Movements
INC	International Nut Council (Trade association tree nuts)
ISO	International Standards Organisation
ITC	International Trade Centre
Kg	Kilogram
Lb	Pound (unit of mass)
M	Million
Mts	Metric tonnes
NVZ	Dutch Dried Fruit Association
OECD	Organisation for Economic Cooperation & Development
OTA	Organic Trade Association
PTNPA	USA Peanut and Tree nut Roasters Association
SADI	Smallholder Agriculture Development Initiative
SINDICAJU	Brazilian cashew nut manufacturers association
TBA	To be advised
UAE	United Arab Emirates
UK	United Kingdom of Great Britain & Northern Ireland
UNECE	United Nations Economic Commission for Europe
US	Unites States of America

USD or US$	US Dollar
USDA	United States Dept. of Agriculture
Vinacas	Vietnam Cashew Exporters Association
Waren Verein	Hamburg Waren Verein – German trade association Nuts and Dried Fruits

Published by:

Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

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