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FINANCIAL INCLUSION FOR RURAL MICROENTERPRISES (FIRM)

CONTRACT: AID-EEM-E-00-05-0002



**REPORT ON INVESTMENT OPPORTUNITIES FOR VALUE
ADDITION ON AGRICULTURE AND LIVESTOCK PRODUCTS
IN MERU COUNTY- AVOCADO OIL PROCESSING**

FIRM-RFP-113

The publication was produced by Erickson International for review by USAID/Kenya's Financial Inclusion for Rural Microenterprises project.



MERU COUNTY
**INVESTMENT &
DEVELOPMENT
CORPORATION**

FINANCIAL INCLUSION FOR RURAL MICROENTERPRISES

AVOCADO OIL PROCESSING PLANT

Program Title:	Financial Inclusion for Rural Microenterprises
Sponsoring USAID Office:	USAID Kenya
Contract Number:	AID-EEM-E-00-05-0002
Contractor:	DAI
Date of Publication:	October, 2016
Author:	Erickson International



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1. Executive Summary

The avocado fruit is a rich source in vital nutrients and oil for cosmetics as well as culinary purposes. Avocados are primarily grown for the fresh fruit market, either domestic or export. Local varieties dominate Kenyan production, whereas fuerte and hass, varieties are suitable for avocado oil extraction and processing make up 20 and 10% respectively. This report describes the process of establishing an avocado oil processing plant in Meru. In undertaking this task, visits were conducted to other processors to establish the physical and technical requirements as well as determine the establishment costs.

Though the county is one of the major producers of avocado, its production is dominated with local; varieties whose oil content is very low. The suitable varieties (Fuerte and Hass) are not in adequate quantities to sustain a large industrial processing.

The proposed plant will require a total cash outlay of KShs 97,280,358.00. This includes the cost of construction and processing machine installation, other fixed and operating costs for the base year.

The projections above are based on the bare minimum, given the cost of fixed assets and operating capital required to run the plan.

Having carefully studied and analyzed the avocado production trends in the county and considered the proposed project we conclude as follows;

- a) The investor will require a minimum of 58.3 metric tonnes per month to produce 7 tonnes (7,000 liters) of avocado oil which is the minimum monthly requirement to break even.
- b) It may take a minimum of three years for the existing farmers to shift and start producing Fuerte and Hass Varieties in acceptable quantities.

Thus we recommend as follows;-

- a) The investment should start by developing the production of raw materials to a minimum of 700 tonnes annually to ensure reliable supply considering the 6 dry months (September – February).
- b) Farmer education on production practices and product handling should be a continuous process to guarantee quality of raw materials.



2. Objectives of the Report

The objective of this report is to present the viability of the proposed Avocado oil processing plant establishment. This report primarily considers the business case for production of Extra Virgin cold pressed avocado oil.

3. Methodology of conducting the study

The study of this proposed establishment was conducted in three phases as detailed below;

3.1 Phase one consisted of a prefeasibility study conducted in the county and the surrounding areas to establish the availability of appropriate avocado fruit for processing on an industrial scale.

3.2 Phase two involved conducting research in the various production methods, markets and uses of the avocado oil. In this phase a site visit was conducted to an operating processor and exporter of the extra virgin oil. The technical processes, physical and plant planning were studied.

3.3 The third phase consisted of developing the business case for the business in Meru using the lessons learnt from selected existing processors. Review of required process and finished product standards as well as marketing and pricing activities.

The activity also considered and benchmarked on best practices in food

processing locally and internationally, identified the processing plant and equipment (including price and manufacturer's specification), determined the necessary additions /accessories that can be sourced locally.

We also sought out prices of finished products and benchmarked with existing processors of similar target products locally and in the international market.

4. Background of Avocado Farming in Kenya

The avocado fruit is important for its nutritional values, as a rich source in vital nutrients and oil for cosmetics as well as culinary purposes. Avocados are primarily grown for the fresh fruit market, either domestic or export. There are 12 major cultivars of avocado, but the main ones grown globally are 'Hass' and 'Fuerte'. Local varieties dominate Kenyan production, whereas Fuerte and Hass, varieties suitable for avocado oil extraction and processing make up 20 and 10% respectively.

The main growing areas in Kenya are Muranga, Meru, Nyeri, Kiambu, Kisii and Embu counties. Kenya produces an estimated 115,000 metric tonnes of avocado annually, 70% of which is grown by small-scale farmers. About 75% of the produce is exported.

The main production season for avocado is from March to August with Fuerte being available from March and Hass variety being available from May. However, given the tropical climate and different



avocado growing zones in Kenya, there are fruits throughout the year although in smaller quantities outside the main season period. These may not be economical

for oil production purposes. The Main varieties suitable for growing in Kenya are described in the table 1 below, Regulatory bodies to ensure quality

Table 1 Main Varieties of Avocado in Kenya

Variety	Variety's characteristics
Fuerte	Hybrid, Green, thin skinned pebbled fruits of very good flavour
Haas	Vigorously growing trees with black fruits.
Nabal	Green fruits with good flavour. Bears in alternate years
Puebla	Dark green trees bearing round purple fruits. Used as rootstock

control and standards include: (i) Avocado Growers Association of Kenya (AGAK) - coordinates the farmer groups and facilitates the linkage between producers and exporters.; (ii) Horticultural Crops Development Authority (HCDA) and associations such as the Fresh Produce Exporters Association of Kenya (FPEAK) regulating the quality of avocado right from production to export and (iii) KEPHIS is also actively involved in monitoring and educating farmers and exporters.

Avocado Production in Meru; All the production in Meru of avocados is done on smallholder farms. The harvest season is from March to August. Farmers market their avocados through middlemen who harvest, grade and transport to Nairobi for export. The rejected fruit is sold on the local market.

5. Avocado fruit and oil extraction

The avocado fruit has many varieties differing in sizes, forms and compositions of the fruit. The table 2 below shows the characteristics of different varieties average of size, oil content and seed/ pulp proportions. The fruit is pear-shaped and average weight range from 60g to 700g. The pulp averages from 60% to 75% according to the cultivar. The oil is contained in the cells of the fruit pulp. The oil content may also vary widely. (Jacobsberg, 1988). The oil content ranges from 10%-12% depending on the location of the farm and the fruit ripening stage.

Table 2 General Content in Avocado Varieties

Variety	Average Weight (g)	Pulp (%)	Seed (%)	Peel (%)	Oil (%)	Moisture (%)
Fuerte	192.86	70.9	17.04	12.06	11.23	82.85
Hass	200.04	71.45	17.04	11.06	11.52	81.56
Peruano	285.41	68.52	23.66	7.81	11.24	76.28
Lula	336.84	55.68	31.77	12.54	11.49	78.38



5.1. Avocado Oil Extraction Process

Chemical extraction by solvents and centrifugal or pressing are the two main oil extraction methods in use.

a) Chemical extraction by solvents

In this method the pulp is dried using warm air and mixed with hexane solvent. The resulting oil is refined in three stages: (i) deacidification to remove free fatty acids; (ii) bleaching to remove chlorophylls and their degradation products; and (iii) de-

odourisation. The final product is chilled at 5°C.

b) The centrifugation/pressing (Cold-pressed extraction):

In this method the skin and seed are removed, the pulp is ground to a paste, malaxed for 40–60 minutes at 45–50°C. The oil and water are separated from the pulp using a high-speed decanting centrifuge and in the final polishing centrifuges. This process is illustrated in Figure 1 below

Flow-chart of the cold-pressing mechanical extraction method from Alfa Laval.

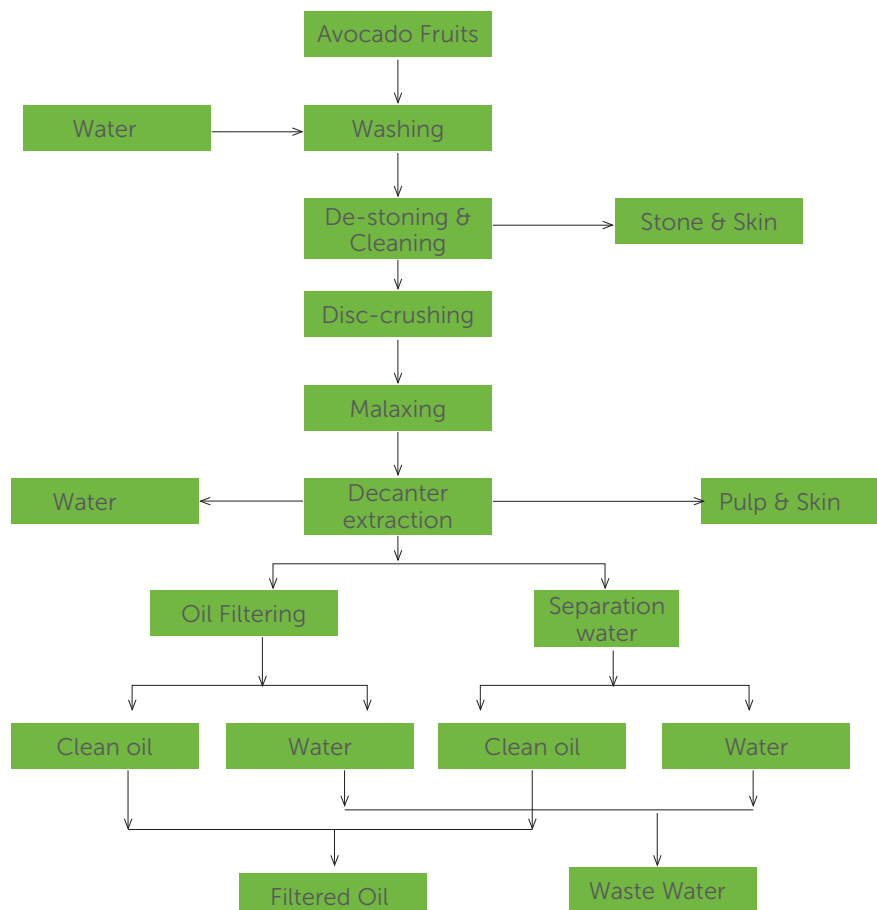


Figure 1 Avocado Oil extraction Process



5.2. Final Product-Codex Standards

The final oil product should adhere to the Codex standards as a minimum as well as the KEBS standard. These standards are described below;

- a) Virgin oils are obtained, without altering the nature of the oil, by mechanical procedures, e.g. expelling or pressing, and the application of heat only. They may have been purified by washing with water, settling, filtering and centrifuging only.
- b) Cold pressed oils are obtained, without altering the oil, by mechanical procedures only, e.g. expelling or pressing, without the application of heat. They may have been purified by washing with water, settling, filtering and centrifuging only.
- c) Nutrition and chemical Standards
 - The tables 3-5 below illustrates the minimum and maximum microbiological, Physio-Chemical and Organoleptic and chemical parameters for extra virgin Standards

Table 3 Microbiological Standards

Aerobic count:	≤ 100 ufc/ml
Mold and yeast:	≤ 100 ufc/ ml
Total coliform:	≤ 50 ufc/ml
Escherichia coli:	Negative/ 10 g
Staphylococcus aureus	Negative / 10 gr
Listeria monocytogenes:	Negative/25
gr Salmonella:	Negative/25 gr



Table 4 Physio -Chemical Standards

No		Minimum	Max
1	Acid value FFA (Oleic)	0.00	0.1
2	Peroxide value (meq/kg)		2.0
3	Iodine value	85	90
4	Moisture and volatile matter	0.00	0.1
5	Color (Lovibond scale)		
6	Saponification value		
7	Unsaponifiable matter		
8	Relative density 25 °C (water)	0.910	0.920

Table 5 Organoleptic and chemical parameters for extra virgin oil

Parameter	Description/value
Odour and taste	The characteristic avocado flavour and sensory assessment shows at least moderate (above 40 on a 100-point scale) levels of grassy and mushroomy/buttery hints with some smoky notes
Defects	Minimal to no defects, such as palm-tree and fishy notes below 20 and glue-like notes below 35 on the basis of a sensory panel average on a 100-point scale
Colour	Nice and intense green
Stability	2 years at room temperature when stored under nitrogen and in the dark
Acid value	<1%
Peroxide value (meq/kg oil)	<4
Free fatty acid (% as oleic acid)	<0.5%
Smoke point	>250°C
Moisture	<0.1%
Palmitic acid (16:0)	10%-25%
Palmitoleic acid (16:1)	2%-8%
Stearic acid (18:0)	0.1%-0.4%
Oleic acid (18:1)	60%-80%
Linoleic acid (18:2)	7%-20%
Linolenic acid (18:3)	0.2%-1%
Vitamin E	70 mg/kg - 190 mg/kg



5.3. Types of Avocado Oil Produced in Kenya

There are three types of avocado oil produced locally. The uses range from culinary, cosmetic and medicinal. These types include;

a) Extra virgin (100% pure avocado oil)

Extracted from the Hass avocado type, this oil has high levels of mono-unsaturated fatty acids and a burning point of 250degrees. Based on the extraction method the extra virgin oil is classified as;

(i) organic with no added chemicals nor flavour in it or (ii) conventional type that has some added chemicals, preservatives and flavours. This oil is excellent for salad dressing and gourmet cuisines.

b) Crude Avocado Oil

Crude oil is classified as mono-unsaturated oil. Used in the medical and cosmetic products, it is rich in potassium, lecithin, amino acids and vitamins A, E and D.

c) Refined Avocado Oil

Refined avocado oil is clear, light and non-tacky with penetration characteristics. Its smell and taste is very pleasant, faint nut like tone.

5.4. Producers and Suppliers of Avocado oil in Kenya

The main producers of avocado oil are:

- Olivado-at Sagana in Muranga
- Mount Kenya Avocado Oil - Marmanet, Laikipia.
- Old Land Trade Company, Kisii

5.5. The market for avocado oil

About 90 % of the avocado oil produced locally is exported. The main markets include Europe, the United States and East Asia (Malaysia, Japan, and South Korea)

China and India are the principal producers and suppliers of avocado oil to the international markets. They account for 40% of the world supply. The United States, Malaysia and Germany are the major markets for avocado oil accounting for 24% 8% and 7% respectively.

5.6. Proposed Plant Capacity and Production Programme

a) Plant Capacity

The envisaged plant will have annual production capacity of 126 tonnes (126,000 litres) of avocado oil per annum. Extraction conversion; Table 6 below illustrates the extraction conversion rate of Hass variety based on the average fruit size of 192grams

Table 6 Extraction /conversion rate

Grams	Extraction Rate %	Grams	Liters
192	12%	23.04	0.02
1000	12%	120	0.12
1,000,000.00	12%	120,000.00	120
8,333,333.33	12%	1,000,000.00	1,000.00
8.33(tonnes)	12%	1.00 (tonnes)	
58.3(tonnes)	12%	7.00 (tonnes)	
58,300,000.00	12%	7,000,000.00	7,000.00



b) Production Programme

Considering the need for raw material availability, the processing plant will be planned to start operation at 64% of the capacity in the first years, and will grow to 77% and 100% in the 6th year of operation.

c) Raw and Auxiliary Materials

The main raw material required is ripe avocado fruit. This will be grown in Katheri, Abogeta, Abothuguchi Central Akachiu, Giaki, Kamako, Kanuni,

Karirwara, Kathera, Kiagu, Kigane, Kinjo South, Mikumbene, Mitunguu, Mwanganthia, Nkuene ,Nyaki East, Nyaki West , Nthimbiri, Thuura, Mikinduri, Mbeu, Kariene, Kitheo ,Mlango.

d) Machinery and Equipment

The list of machinery and equipment required for processing of the avocado oil is listed in Table 7 below. The imported components are recommended to be sourced from Alfa Laval Technologies.

Table 6 Extraction /conversion rate

No	Description	Qty	Cost ('000 KShs)		
			Local assembly	Imported Cost	Total Cost
1	Oil refinery	1 set	1,500	7,500	9,000
2	Filling machine	1	100	1,313	1,413
3	Filter press	1set	300	1,700	2,000
4	Avocado washer and de-stoning and peeling machine (Peruzzi Food Processing).			1,616	1,616
5	Washing basins (stainless steel basins)	4	600		600
6	Hot water washing basins (stainless steel)	4	600		600
7	Settling tank	2	320		320
8	Disc crusher for avocado fibre and skin chopping to minimise emulsion risks.		220	500	720
9	Extra-virgin olive oil-Line flash thermal conditioning system			800	800
10	Boiler (hot water generation)	1 set	500	3,000	3,500
11	Atmosfera malaxers/kneadings. Hermetic design for preserving the aromatic fraction of avocado oil.				tbc
12	Chilling Unit (1000 M ³) (UK)	2 set		3,460	3,460
13	Other Equipment laboratory equipment, measuring devices, tools, etc...		300	2,700	3,000
14	Styrofoam and Cooling system (100Msq)		1,820		1,820
15	Decanter centrifuge for avocado oil and water separation from solids.			3300	3,300
16	Disk stack vertical centrifuge for avocado oil purification and potential oil recovery from water.			4004	4,004
	CIF Landed Cost	-	6,140	19,110	36,153



e) Source of Technology

The machinery and equipment required for processing avocado fruit to produce oil for industrial use can be procured from: Alfa Laval in Australia- alfalaval.com +46 46 36 65 00 +46 46 32 35 79 info@alfalaval.com

f) Land, Factory Building and Civil Works

The required land is approximately three acres to hold the factory building administration and general purpose building, pathways, and space for expansion in the future. A total of 2800 square meters of land is required for the factory house.

g) Proposed Location

Proximity of raw materials and availability of infrastructure will determine the location of the plant. A possible location would be in the proximity of Mikinduri Tigania West Sub County.

- existing processors in those regions. ;
- iii) Poor cash flow emanating from low volumes of raw materials hence low income may be realized from processing;
- iv) Layoffs might spark labour disputes during dry months when the plant is not operational.

Constraints faced by producers of raw material include:

- i) Frequent droughts resulting in crop failure;
- ii) Limited access to information from extension services;
- iii) Lack of adequate supply of certified seedlings,
- iv) Poor road networks to transport the harvested fruit,
- v) Use of pesticides to control pests and diseases leading to rejection of the fruit by the processor.

6. Potential Risks facing the business

The risks facing the proposed business can be divided into two i.e. risks facing the agro processor and the risks facing the producers of the raw materials

Agro-processors face numerous constraints including:

- i) Expensive power supply coupled with frequent power cuts;
- ii) Unreliable supply of raw materials to sustain the processing thus the plant may operate below its capacity generating losses. The seasonal nature of the fruit may render the plant idle from September to February unless the raw material is sourced from other regions, facing competition from

7. Conclusions and Recommendation

Having carefully studied and analyzed the avocado production trends in the county and considered the proposed project we conclude as follows;

- a) The investor will require a minimum of 58.3 metric tonnes per month to produce 7 tonnes (7,000 liters) of avocado oil which is the minimum requirement to break even.
- b) The total volume required per production year (6 months) will be 700 tonnes of avocado
- c) It may take a minimum of three years for the existing farmers to shift and start producing Fuerte and Hass Varieties in acceptable quantities.



Thus we recommend as follows;-

- a) The investment should start by developing the production of raw materials to a minimum of 700 tonnes annually to ensure reliable supply considering the 6 dry months (September – February).
- b) Farmer education on production practices and product handling should be a continuous process to guarantee quality of raw materials

8. Financial Plan

The financial projections contained in this section is based on the following foundation

- a) The projections are based on the premise the investor will be able to process 7,000 litres of finished oil per month.
- b) The plant will require a total cash outlay of KShs 97,280,358.00 This includes the cost of construction and processing machine installation, other fixed and operating costs for the base year.

- c) The Cost of machinery is based on actual prices CIF up to the port of Mombasa as at August 2016. These estimated from specific manufactures.
- d) Costs of local assembly parts are from Nairobi's industrial area.
- e) Prices of the finished products were acquired from existing producer.
- f) Visits were conducted to other processors establish the physical requirements.
- g) The cost of construction and the building design is from an existing avocado oil processor and took into consideration future expansion needs, lessons learnt from selected site visits and machine manufactures' specification. It also took into account the basic industrial safety and standards in Kenya and globally.

A summary of financial projections is provided on a different document accompanying this study.





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