COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

FOOD RESEARCH INSTITUTE

FEASIBILITY STUDY REPORT ON PLANTAIN PROCESSING AT ANUM APAPAM IN THE EASTERN REGION OF GHANA

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Contents

Executive Summary

Jillk Company Limited is a prospective agro processing company that is interested in processing plantain flour and other derivative products for both local and international markets.

In line with protocols of the Institute as explained and agreed to by Mr. Kofi Atua-Ntow, acting for and on behalf of Jillk Company Limited, a planned feasibility study was carried out by a four-member team led by Dr. (Mrs.) Charlotte Oduro Yeboah at the prpoposed site on 24th November, 2016.

It was observed that the proposed site was located at the hub of plantain cultivation. It also had good access road to farm, raw material market, and product market links. Electricity and water were also available. For other business services which could not be accessed within the village, they could be accessed from the district capital, Suhum, about 97.4km from the village of Anum Apapam.

The proposed site is therefore fit for the intended purpose for which the feasibility study was carried out.

1.0 Introduction

Plantains and bananas (*Musa sapientum* L.) are valuable starchy staples in Ghana. Ghana is the largest producer of plantain (*Musa sapientum* L.) in West Africa and the second in Africa after Uganda and Rwanda (FAO, 2010). Plantain is known to provide a rich source of dietary energy and also contribute to providing good quality diet. Processing of plantains into flour is limited as most plantain foods are eaten as boiled, fried or smoked. However, after the introduction on local and foreign markets of instant plantain *'fufu'* flours consisting of plantain flour and cassava starch, interest in plantain flours and other related instant foods have soared in urban and peri-urban areas in Ghana. Plantain belongs to the non-traditional sector of the rural economy, where it is used mainly to shade cocoa and is an essential component of the diet. More than 90% of the cultivated area in Ghana belongs to small holder farmers. In the Ghanaian agricultural sector, plantain is ranked third after yam and cassava (FAO, 2010) and contributes about 13.1% to the Agricultural Gross Domestic Product (AGDP). Plantain cultivation is of great socioeconomic importance in Ghana from the view point of food security and job creation. Dzomeku, et al. (2011), indicated that although plantain is a crop with permanent production, harvesting periods are influenced by external factors such as strong winds and rainfall. These production movements or periods in turn cause upward and downward price trends according to supply and demand volumes. Plantains are scarce on the market from May to August. The scarcity is due to the strong winds experienced at the beginning of the rainy season. During April/May the plants become dehydrated as a result of the five months dry season. Plantains become abundant on the market from September to March with the peak in December-January. As regards job creation, mechanized, traditional or inter-crop cultivation of one hectare of plantain generates 1.68, 0.39 and 0.19 permanent direct jobs per ha per year. In the light of this, it is estimated that one hectare of plantain generates an average of 0.75 permanent jobs (Rodriguez and Rodriguez, 2001). When set against the national cultivated area, this gives approximately 350,523 permanent jobs. This is equivalent of 70,000 families of five persons devoted to plantain.

The Food Research Institute of the Council for Scientific and Industrial Research was contracted by JILK Company Ltd. in Anum Apapam in the Eastern Region to conduct a consultancy for the processing of plantain products. These products are plantain flour, plantain chips and possibly

plantain leaves utilization in soap making. This report presents findings and possible option available for setting-up a processing facility at the client's premises.

2.0 Feasibility Study Findings

A four member team led by Dr. (Mrs.) Charlotte Oduro-Yeboah (Senior Research Scientist, and Head of the Food Technology Research Division) visited the proposed site on 24/11/2016. Other members of the team were Messrs. Jonathan Ampah (Research Scientist and Head of Equipment Design and Research Laboratory of the Food Technology Research Division), Jeremiah Lartey-Brown (Head of Consultancy Team of the Business Development Section), Bismark Yeboah (National Service Person with the Business Development Section).

The team was escorted by Mr. Atua-Ntow in the company of his senior brother from Nsawam and was met on arrival by some other family members.

Having inspected the land, some suggestions were made key among which were:

2.1 The location

The proposed project site is at Anum Apapam, a farming community which is about 97.4km from the district capital of the Suhum district. Adjoining towns and villages are Amanase to the East, Bawdua to the West, Dwenase to the North, and Atimatim to the South.

The land size of Anum Apapam is about 1,018 km² and has a market square which is about 8m from the proposed project site. The project site is very close to the main road in the village – about 10 meters away. There is a direct access route to the proposed site.

The town has a population of about 19, persons. This has about 75% of active workforce. Adjoining towns and villages within about 5km reach have about the same population statistics.

2.2 Businesses within and around the community

Inhabitants of Anum Apapam are basically farmers and traders in raw farm produce especially plantain production. The village has a vibrant market which is known for its main staple – plantain. Market days are highly patronized by traders from across the country especially Accra. Some other traders also bring in other wares on market days for sale

3.0 Facilities / Amenities

3.1 Transportation

A tarred road links the community to Suhum, the district capital. The road extends further through Asumpa to Asamkese, about 8km away. Commercial vehicles ply this road on daily basis.

3.2 Electricity

About 85% out of settlements in the district, of which Anum Apapam is one, are linked to the national electricity grid.

3.3 Water

The main source of water to the village is potable water supplied by Ghana Water Company / drawn from mechanized/ manually-drawn boreholes

3.4 Other services

Other services and service providers such as banks, fire service, police, judicial services, registration and regulatory authorities, among others are located in the district capital.

4.0 Market Indices

4.1 Competition

The location of the proposed factory is in the hub of the plantain crop and other cash crops. There is no agro processing industry within the vicinity that indicates no competition for raw material for the processing facility.

The only indirect competition is that plantain serves as the staple food of the indigenes. The consumption level as compared to their production level is however insignificant, hence that competition is not so keen. The other competition which may have significant impact is that there are already off-takers for the produce – traders buy in bulk quantities on market days.

The marketing of plantain is challenging because of the dispersal of the production zones, the lack or poor lines of communication with urban consumption centers and the irregular supply in the

market by wholesalers and middlemen who set the prices. In addition, perishable produce like plantain suffers from continuous deterioration resulting from poor post-harvest management.

This aggravated loss of quality and quantity affects the final price. Plantain is more expensive on European markets than in North America. This is mainly the result of high transport costs and customs dues. Prices have been fluctuating around USD1.76/kg. Over the years plantain from Ghana to the European market attracts a higher premium than from other producing countries. In the early 90s the price of Ghanaian plantain was US$ 1.53 per kg over a 4-year period. The current world price of plantain is US$ 1.91 per kg (Lescot, 2000). The geographical location of Ghana places the country in a position to capture the European market compared to other exporting countries like Colombia, Ecuador, Venezuela and Costa Rica and the Caribbean regions.

4.2 Distribution / Clientele

Finished products from the proposed plant would serve as raw materials for fufu flour factories within the country and beyond. With the availability of facilities for production and distribution available, as stated, the location would be appropriate for the venture provided all other structures are put in place

5.0 Technical Feasibility

The major activities considered with this technical survey are:

- Plant location
- Plant capacity
- Process design
- Equipment layout
- Utilities
- Plant building and surroundings

5.1 Access to services (electricity, water, gas, air)

The proposed project would tap electricity from the available source (national grid). An alternative power source with an adequate capacity would be required in situations of grid outages.

Selection of an appropriate electricity-distribution system is very crucial for the success of any business. While a single-phase power supply may not be an issue with home users, companies need to rethink their strategy on electricity requirements by considering three-phase electricity supply. A properly designed clean electricity system can ensure a robust power-distribution network that can power multiple equipment with different power requirement.

The cost of installing and maintaining three-phase systems is substantially lower than that of single-phase systems. Three-phase systems substantially use less conductor material than that of single-phase systems (about 25 percent less for the same amount of power delivered). For the same amount of time, three-phase power lines can carry more power than that of single-phase power lines at a reduced cost. In addition to reduction in copper, a three-phase system requires fewer circuit breaker pole positions for 415 Volt loads. The power delivered is almost constant in three-phase power circuits, making them ideal candidates for transmission lines, power grids, industrial power and data centers.

5.2 Water

It shall be appropriate to explore the provision of a borehole as a backstop, specifically, within the plant area. Water reservoirs for at least two days production running would be required.

5.3 Processing machinery and capacity

Items	**Qty**	**Price(USD)**	**Total price (USD)**	**Capacity**
Trough/miscellaneous	4	1400	5600	2000kg
Stainless steel table (4x8ft)	4	1600	6400	
Slicer	2	2250	4500	500kg/hr.
Grater	2	2000	4000	
Mechanical dryer	2	7500	15000	1 ton
Hammer mill	1	4000	4000	500-1000kg/hr.
Blanching system		12000	12000	
Sub-total			51500	
Miscellaneous 5%			2575	
Grand-Total			**54075**	

6.0 Resource and Environmental Feasibility

6.1 Processing Industry Location

The Processing Industry would be located in an environmentally safe area without pollution and any industrial activities that can pose serious threat or contamination of products.

6.2 Labor

The level and availability of human resources and skills to fulfill the requirements of the processing facility at Anum Apapam are currently available considering the fact that the location has a youthful population. Skilled and unskilled labor would be sourced from the community and surrounding towns and villages.

6.3 Road network

There is a good road linking the project site with its markets and other stakeholders.

6.4 Waste disposal

The proposed location is within a residential area. Odour emitted from production could however be controlled through the construction of a disposable drainage and septic system for environmental and safety reasons. Future plans would take into consideration the use of plantain peels (the main solid waste) in soap production and also for animal feed.

6.5 Access to raw materials

The company has its own plantain farm which can supply about 200 bunch of plantain in a week within the plantain season. Additional raw materials would be sourced from the village's market.

7.0 Benefits of Project

7.1 Social Benefit

Anum Apapam is a rural community with low socio-economic characteristics. The surrounding communities would benefit in a number of ways from the establishment of the proposed plantain processing industry through the creation of employment opportunities and markets for plantain. The indirect benefits of the processing industry would be the decrease in the number of households

living under the poverty line as livelihoods improves, a decrease in malnutrition and an increase in incomes for communities, especially for the women and the youth.

7.2 Company benefit

The industry itself stands to gain a lot from establishing the facility in the said area. Noted among the gains include;

a) Tax exemptions / tax rebates as a result of producing with between 80- 100% locally sourced raw materials and enjoying 5-year moratorium as a member of National Board for Small Scale Industry (NBSSI).

b) Alternative energy sources that are plausible i.e., use of solar system, firewood from the forest in the nearby community or biogas from the waste generated from processing plant.

c) Easy access to cheap labor thereby reducing its cost of production.

d) Equipment /up scaling / funding benefits from NBSSI, SDF, EDIF and related funding agencies or projects.

e) Enjoying social recognition as a result of performing its social responsibility in the area of employment, poverty reduction, gender engagement etc.

7.3 Gender impact of the processing facility

Women are bound to benefit the most from the establishment of such processing facility. Although both men and women will be employed to participate directly and indirectly in the processing facility, women in the area are more likely to be the main participants because the present processing stages involve more peeling and washing.

8.0 General Processing Operations and Equipment Needs

8.1 Plantain Processing Industry

Based on the plantain products of interest to the client the proposed plantain processing facility will have the basic equipment for plantain processing comprising of a washing trough, slicer, disintegrator, dryer, hammer mill, sifter and packaging machine.

8.1.1 Washing trough

Thorough washing in clean tap water is important for the removal of all sand particles and dirt, which could affect the quality of the final plantain product (Fig 1).

Fig. 1. Washing trough

8.1.2 Dryer

Drying may be carried out using a hot air mechanical dryer. The density of spread mash should not exceed 2.5kg/m^2. A lower spread density aids faster drying and that produces better quality flour (Fig. 3).

A.

B.

Fig. 3. A. Hot-air mechanical dryer B: Wood fuel bin dryer

8.1.3 Mill

Dried mash is normally milled in hammer mill into a fine particle size. Two types of milling machines have been identified as attrition (Fig. 4) and hammer mills (Fig 5). The hammer mills uses very fine sieves to give the desired texture of flour. The mills are powered by either 7.5kW

(10HP) electric motor or 6kW (8HP) twin flywheel stationary diesel engine and their capacities range from 200kg–250kg for the attrition and 1000kg–2000kg for the hammer mill.

Fig. 4. Attrition Mill

8.1.4 Hammer mill with sifter

Milling of chipped plantain and subsequent sieving of plantain flour in a combined operation to remove much fiber from the product as advice in order to improve the smoothness and total quality. The sifter is equipped with a 550-micron mesh (Fig 5).

Fig. 5. Hammer mill

8.2 Production of Plantain Products

8.2.1 Plantain flour Production

Plantain flour can be used as a substitute for imported wheat flour in the baking and confectionary industry. It is very adoptive as a raw material in the food and beverage industry for the manufacture of bread, biscuits, noodles and baby foods.

Good Manufacturing Practices (GMP) and Good Hygienic Practices (GHP) must be followed in the production of plantain flour to obtain quality products. Non-compliance to GMP and GHP will result in low standard flour.

The production of plantain flour must be completed within a cycle of 24 hours to ensure safety of the product. The plantain flour is always packaged in a polythene bags to prevent any moisture being absorbed from the air. This is especially important in areas of high humidity. The bags should then be stored in a cool dry location. Approximately, 15-22% recovery rate is obtained in the processing of plantain. The processing area should always be kept clean with good drainage system for safe disposal of the effluent into a soak-away to avoid environmental pollution and public health hazards. The processing of plantain flour involves the slicing, spreading, drying, milling, sifting and packaging.

The following machines and constructions are most suitable for plantain flour production:

1. Washing troughs
2. Stainless steel knives
3. Tiled concrete washing troughs
4. Slicer
5. Cabinet dryer
6. Hammer mill
7. Attrition mill
8. Mechanical flour sifter
9. Weighing scale
10. Sealing and stitching machine
11. Polypropylene sacks for storage

8.2.2 Plantain fufu flour

In the production of plantain *fufu* flours, the plantain is streamed, mashed, dried and milled into fine powder. It is reconstituted with cassava or potato starch into *fufu* flour. In order to obtain best quality *fufu* flour similar gummy quality starch must be introduced into the final product. These are the main machines and construction works necessary for *fufu* flour production. These include:

1. Plantain reception area
2. Plantain peeling shed
3. Washing troughs – 2 stage washing – (washing and rinsing)
4. Plantain graters. - 3 stands – 2 on electric on standby/on diesel engine
5. Streaming troughs
6. Drying of chips
7. Milling machine – plate/hammer mill

8.2.3 Production of Plantain Chips

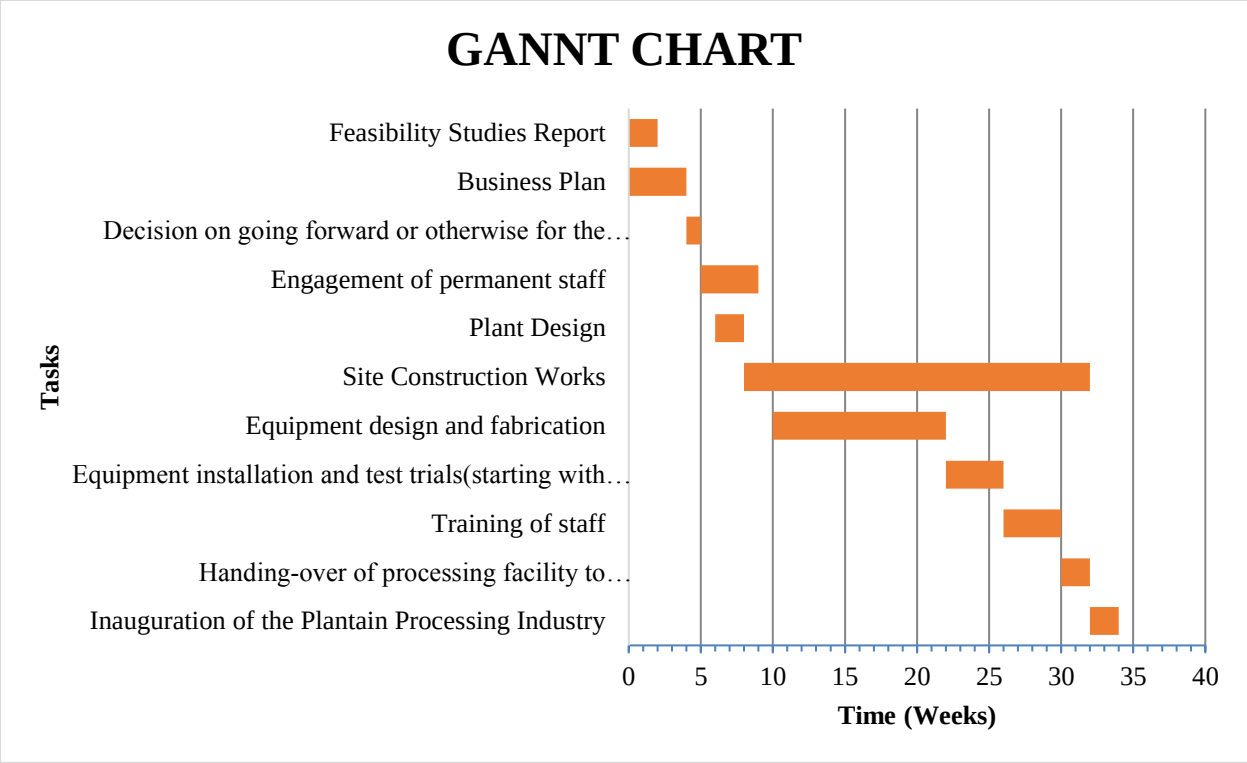
In the production of plantain chips, plantain is peeled, sliced, blanched and fried in hot oil for a period. The processing procedures requirements are:

Equipment for plantain chip production

1. Stove oven – L P G
2. Water cooking vessels/steam cooking vessels
3. Frying system
4. Slicers

9.0 Timelines for Plantain Processing Industry

Barring any changes (changes should be done at all cost where very necessary), work is expected to progress as follows:



10.0 Recommendations

The following recommendations were made based on the feasibility studies carried out in order to achieve the establishment of the plantain processing industry at Anum Apapam:

i. The Plantain processing factory requires a minimum of 100 acres of land for the cultivation of plantain to serve as a backup farm to supply raw materials to feed the facility in times of shortage.

ii. Investor should start planting alongside putting up the structures to ensure that as the facility gets ready, there would be enough plantain to feed the plant.

iii. Organization and registration of out-grower farmers needs to be carried out so as to ensure commitment on the part of the out-growers for regular supply of raw materials.

iv. Formation of plantain bulkers groups within the surrounding communities must commence immediately.

v. Construction on the proposed location for the processing facility needs to be commenced as soon as possible to enable early commencement of operations.

vi. The proposed project would need about 30KW in the interim from Electricity Company of Ghana to power the processing facility.

vii. Investor needs to develop a business plan to suit its model of operation for easy access of credit facilities and sustainability.

viii. Equipment earmarked for plantain processing must be procured immediately.

ix. Engagement of employees for the plantain processing industry is crucial and must commence immediately

x. Training of key employees at the processing industry must be carried out before commissioning.

11.0 Conclusion

Considering proximity to raw materials, availability of amenities, among other factors, the proposed site is deemed appropriate for the set-up of a plantain processing plant. Appropriate structures are however an essential component of the enterprise.

Taking the net social benefit of the proposed agro-processing facility into consideration, it can be concluded that the agro-processing facility is anticipated to be socially, economically and institutionally feasible. A vibrant plantain processing industry would be established when all recommendations and timelines are followed exactly as presented.

12.0 References

Dzomeku, B. M., Dankyi, A. A. and Darkey, S. k. (2011). Socioeconomic Importance of Plantain Cultivation in Ghana. The Journal of Animal and Plant Sciences. 21(2): 269-273.

FAO, (2010). (Food and Agriculture Organization). Food and agriculture indicators ESSA

Rodriguez M. J. L. and Rodriguez, S. A. (2001). Socioeconomic aspects of plantain cultivation in Colombia. INFOMUSA. The International Magazine on Banana and Plantain. 10(1): 4-9.

Lescot, T. (2000). The importance of plantains and cooking bananas in Africa: outlets for the subtropical zones. INFOMUSA. The International Magazine on Banana and Plantain 9(1): 25-28.