COUNCIL FOR SCIENTIFIC AND INDUSTRIAL REASERCH

(CSIR)

FOOD RESEARCH INSTITUTE

BUSINESS PLAN FOR THE PRODUCTION OF MUSHROOM SPAWN AND COMPOST BAG

Prepared by

P-N. T Johnson, M. Obodai, D. D. Abusah and B. Awotwe

Food Research Institute
Box M. 20, Accra.

Tel: 777330/500470
Fax: 777647/ 500331
e-mail: fri@ghana.com

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EXECUTIVE SUMMARY

Introduction

This is a business plan for the production of spawn bottles and compost sawdust bags for mushroom cultivation by the Food Research Institute of the CSIR. The plan has been developed in response to the growing interest for the use of mushroom in the diets of most Ghanaians. Unfortunately, most present mushroom growers have been facing problems with the supply of spawn, the innoculum used and also the composted sawdust bags used for the cultivation of the fresh mushroom.

In order to meet the high levels of production anticipated for the two products, a special building space within the Food Research Institute building complex, at the Pilot Plant Site, will need to be adequately refurbished to serve as the production area for the business. The plan envisages that about 100 spawn bottles, per day, and about 24000 bottles annually will be produced. It also anticipated that 1300 and 300000 composted sawdust bags of will be produced daily and annually, respectively. The labour force required to achieved these targets consist of 8 Production Crews, a Manager and 3 supporting staffs.

Plant, Machinery and Equipment

The business will require certain machinery and equipment, such as an autoclave, a laminar flow cabinet, incubators and a laboratory oven.

Financial Analysis

Working on the assumption that the number of production days will be 240 days, a summary of the breakdown of the financial analysis is as follows.

Production capacity:	Spawn bottles	100/day and 24000/year
	Composted mushroom bags	1300/day and 300000 /year
Total Cost of Investment:	**$40,429**	
Fixed Assets:	**$24,683**	
Working capital	**$14,850**	
Pre-operational Cost	**$896**	
Total Revenue:	**$ 67,716 (Year 1) to $ 64486 (Year 5)**	
Net Profit:	**$ 49,806 (Year 1) to $ $36154 (Year 5)**	
Internal Rate of Return:	**69%**	

Please note that the first year profit is based on the assumption that the business will enjoy a year's moratorium of not paying tax as well as no payment of loan. This explains why it is far greater than the rest.

On the strength that the present interest rate on loans from the commercial banks in Ghana is about 40 %, the internal rate of return of 69 % is an indication that the business is viable. Since the present worth is positive therefore suggest that the mode of payment of the loan is good.

1. INRODUCTION

This is a business plan to revive and optimise the operations of the National Mushroom Development Project (NMDP), which was initially formed through the collaborative efforts of the Food Research Institute, of the Council for the Scientific and Industrial Research, the Export Promotion Council and the Ministry of Food and Agriculture. The NMDP set up in June 1990 had two separate units, research and commercial units.

The Research unit of the former NMDP is now the Mushroom Unit under the Food Microbiology Division. It has been conducting research into all areas of mushroom growing technology, mushroom biotechnology, and environmental implications. It also collects and maintains pure cultures of indigenous and exotic mushrooms in a National Mycelium Bank. It investigates efficient methods for processing and preserving mushrooms of both local and exotic strains. It also produces and supplies improved mushroom spawn to growers for commercial cultivation and carries out training programmes and extension services for farmers.

The Commercial unit of the former NMDP was set up under the supervision of the Ghana Export Promotion Council. It was set up to produce oyster mushroom spawned compost bags as well as fresh oyster and straw mushrooms for sale to the general public. In March 1998, however the commercial unit had to be closed down because of a number of reasons. Its activities were taken up by a number of private entrepreneurs. Unfortunately most of the private entrepreneurs who went into mushroom production still had to depend on the FRI to provide them with mushroom spawned compost bags. However with the recent mandatory requirement on the CSIR to generate 30 % of its budgetary requirements, the need has arisen for the FRI to take up certain commercial aspects of the Mushroom Industry which the present private mushroom entrepreneurs are unable to provide fully for their clients. This is because the mushroom industry has the potential to contributing to the economy of Ghana.

This document will therefore begin with a short resume of the country's economy, a SWOT analysis of the Food Research Institute and historical developments of the mushroom industry in Ghana. The characteristics of the mushroom products envisaged under this business plan will be discussed. The present market situation and business strategies to be adopted to optimise the returns of investment will also be discussed. The document ends with the projected financial analysis.

2. THE ECONOMY OF GHANA

Ghana is abundantly endowed with natural and human resources. The natural resources include mineral wealth, a good supply of arable land suitable for both crop and livestock production, forest resources, marine and fresh water fish stocks, and a good potential for hydro-electricity generation. The economy of the country is based on two distinct sectors:

i. large, traditional sector which consists principally of agricultural and informal activities; and
ii. relatively small, labour intensive industrial and service sectors.

The economy has traditionally depended on exports of primary products with about 60% of the labour force employed in agriculture. Agriculture contributes about 46% to the Gross Domestic

Product (GDP) and is characterised by small-scale operations in staple food crops and cocoa production. The service sector is the second largest employer (about 25%) of the labour force, accounting for over 40% of real GDP from trade and public sector services, while the industrial sector accounts for about 14% of GDP and employment.
Ghana began Economic Recovery Programme (ERP) in 1983 and has undertaken a series of comprehensive macro-economic and structural adjustment reforms aimed at reversing the economic decline that had characterized the economy for almost a decade.

The thrust of the Government's economic policy is on;

- Liberalised trade (import/export) regime
- Liberalised investment regime sustained by a targeted investment drive;
- Export oriented, value addition industrial development strategy;
- Free zones development economy passing;
- Factory specific and export processing zones
  -Liberalised skies
  -Free ports

The policies implemented under the ERP and other reform programmes have brought about significant improvements in the country's economic position in general and private sector growth in particular.

3. PROFILE OF THE FOOD RESEARCH INSTITUTE

3.1 BACKGROUND

The Food Research Institute (FRI) is one of the affiliate institutes and centres of the Council for Scientific and Industrial Research (CSIR). It was incorporated into the CSIR in 1965.

3.2 MANDATE

The FRI is mandated to conduct applied research into problems of food processing and preservation, storage, marketing, distribution and utilisation, in support of the food industry and also to advise the Government of Ghana on its food policy.

3.2 VISION

The Food Research Institute's vision is to be recognised nationally and internationally as an S & T institution that is playing a key role in the transformation of the food processing industry to be internationally competitive with particular reference to product safety, quality and presentation.

3.3 MISSION

The Institute's mission focuses on providing scientific and technological support to the growth of the food and agricultural sectors of the national economy in line with corporate prioritisation and national objectives. Primarily, the FRI's mission is to conduct market-oriented applied research and provide technical services and products to the private sector and other stakeholders. To do this Food Research Institute presently conducts business in a conducive and transparent working environment. It has a cadre of highly qualified staff to render quality services and products to clients.

3.4 GOAL

The overall goal of the Institute is to assist in poverty alleviation through the creation of opportunities for generating and increasing incomes within small, medium and large scale food industry; contribute to food security, foreign exchange earnings and the application of cost-effective food processing technologies that are environmentally friendly.

3.5 OBJECTIVES

i. To develop and provide technical information, training and services to the private sector and other stakeholders in the food industry.
ii. To provide appropriate technology packages for processing and storage of raw agricultural produce to facilitate curtailment of post-harvest losses, promote value addition for local and export markets.
iii. To strengthen the FRI's capability and linkages with industry through human resource and infrastructural development, restructuring and re-organisation for effective commercialisation of operations.

3.6 ORGANISATIONAL STRUCTURE

A Director heads the FRI. He/She is responsible to a Deputy Director General and the Director-General of the CSIR. There is also a Management Board made up of individuals from the Private Sector, the Universities, NGOs and other Research Institutes.
The FRI has Administration, Accounts Divisions and a Business Development and Information Division. The FRI has four scientific divisions. These are;
The Food Processing and Engineering Division. Under the division are the Cassava Processing and Demonstration, the Pilot-Scale Production and the Engineering Units.
The Food Chemistry Division: This comprises of an Industrial Service Unit and a Mycotoxins Unit.
The Food Microbiology Division: This has an Industrial Service and Mushroom Research Units. The Mushroom Production will be based in the latter unit.

4. SWOT ANALYSIS OF THE FOOD RESEARCH INSTITUTE

4.1 STRENGTHS

i Technical Expertise

The main strength of FRI, just as most institutes of CSIR, lies in its organized technical and research grade staff with several years of experience and requisite expertise. These researchers have undertaken numerous research projects and have published several technical papers. In particular, it has a well-trained and experienced scientist in mushroom production and her experience and expertise will contribute in no small way to the success of the business.

ii. Research Facilities and Publications

FRI's other major strength is the availability of facilities for research and the existence of several project reports and technical publications that could be developed for the market or used as basis for consultancy and training. The institute therefore can capitalise on this to curve a niche for itself as a market leader in the provision of technical and consultancy services for food industries.

iii. Proven Track Record

FRI has over the years, since its establishment achieved success in its research activities, which have won its recognition and respect both locally and internationally. This recognition constitutes a strength which can be exploited to obtain research grants, equipment, vehicles and training and consultancy contracts from international agencies such as UNDP, USAID, DANIDA, IDRC, IITA and from local industrial as well as large scale agricultural projects.

4.2 WEAKNESSES

Presently, the main weaknesses of the FRI are inadequate infrastructure and lack of funds.

i. Inadequate Infrastructure

Although FRI has basic infrastructure in place for undertaking research and associated activities, some facilities at FRI are inadequate. While some divisions need more office and/or laboratory space, other structures are in need of repairs or rehabilitation.

ii. Lack of Funds

FRI lacks adequate funds to cover its research activities and proposed training schemes.

4.3 OPPORTUNITIES

The success of the country's drive for diversification for exports provides a number of opportunities for FRI to exploit in terms of securing additional funds for its research activities and commercialisation of its research findings. Growth prospects in the economy in areas such as food, agriculture and industry are expected to offer FRI opportunities for both fundamental and applied research as well as sale, on commercial basis, of some of its research findings, which are beneficial to the above-mentioned sectors of the economy.

One other important opportunity is the high rate population growth rate (currently estimated at 2.6 % per annum) with its resultant high increase in population and demand for food. Such development would present FRI with opportunities to derive revenue through rendering consultancy services to the food production and processing sectors of the economy by using the expertise at the institute.

4.4 THREATS

Increasing pressure on the national budget and government desire for private sector-led development are likely to result in further reduction in the levels of subventions to FRI.

Another threat that FRI is expected to face in the near future may be loss of skilled and experienced research personnel to the private and other public sectors. This is likely to occur given the rather recent low morale among research personnel within the CSIR.

Another major threat is the role and contributions of Non-Governmental Agencies. Though the Institute do recognise and appreciate their roles as development partners in Ghana, sometimes the activities of some of them have tended to appear as though they are in competition to what the FRI can offer to the general Ghanaian public.

5. DEVELOPMENTS OF THE MUSHROOM INDUSTRY IN GHANA

Traditionally, wild mushrooms such as the oil-palm mushroom, termite mushroom, woodear etc. are collected in the forest regions in mid March and early September and is a normal diet with the rural folks. There are, however, some traditional methods for their cultivation. These consist of the pit method for the production of the oil palm or straw mushrooms (*Volvariella volvacea*), and the traditional method of production of the termite mushrooms (Termitomyces spp.).

The oil palm or straw mushroom occurs naturally on felled and rotten oil palm trees(*Elaeis guineenis*) which has been tapped for palm wine (toddy). They are also found on fermenting cocoa wastes in cocoa growing areas and on dead logs, and sawdust of some forest tree species, such as the silk cotton tree (*Ceiba petandra*),*Triplochiton scleroxylon* and *Antiaris africana*.

Traditionally, the oil palm mushroom has been cultivated in some forest areas on cassava, cocoyam and yam peelings, or oil palm and cocoa wastes. A pit of about 21cm by 5cm is dug and lined with fresh banana leaves. Heaps of cassava, cocoyam, and yam peelings are put into the pit. A fresh fruiting body of the oil-palm mushroom is mashed and the brown suspension of spores sprinkled all over the surface of the materials. The heap is then covered with more fresh

leaves to retain moisture and avoid the direct sunlight. Mushrooms begin to appear after three to four weeks, especially during the wet season, and are ready for harvesting at the button or egg stage. Fresh materials are added to the heap from time to time to prolong the period of production. With this method the yield is low and unstable. In areas where cocoa is cultivated, beds of cocoa husk are moistened with palm wine and covered with fresh banana leaves to produce the oil palm mushroom.

The Termite Mushroom (*Termitomyces* species) is regarded as the 'King of the mushrooms' by the local people. It can be collected twice in the year. This is at the beginning of the major rains (late March to April) and before the minor rains (August to September). They occur on termite hills or mounds constructed by specific mushroom-growing termites.
In the Eastern Region of Ghana where these mushrooms are normally picked, the farmers cultivate it artificially. They put bundles of dried banana leaves and twigs on top of the termite mound producing the mushrooms and allowing the termites to invade them. These 'infested' banana leaves are then transferred to other sites on the farm to allow the termites to build their mounds. It takes two years for the first production of these mushrooms. Subsequently it produces termite mushrooms every year around the same time. These mushrooms are mostly eaten fresh and the surplus preserved by smoke drying over a fireplace, or sun-dried for future use.
The two methods listed above give very low and unstable yields.
In June 1990, the NMDP was set up to systematically develop and promote mushrooms as a non-traditional horticultural export product in Ghana.

With the establishment of the NMDP, two main methods of production are currently being used. These are the plastic bag and the low-bed methods. These methods were introduced into the country from Taiwan and have been modified to suit Ghanaian conditions. With these methods there is an all year round production of some mushrooms, and they offer better, stable and higher yields . Over 100 -300 kilograms of oyster mushrooms are produced daily depending on the season. This can potentially be increased from 500 to 1000 kilograms of fresh mushrooms each day.
The first method is the Plastic bag method. This method is used in the production of the oyster *(Pleurotus spp.)* , woodier (*Auricularia spp.)* and monkey seat (*Ganoderma* spp) mushrooms .
The main material used as substrate is sawdust compost prepared from either *Triplochiton scleroxylon* , or a mixture of *Chlorophora excelsa* and *Terminalia invorensis* .
Fresh sawdust from either of these woods is initially mixed with 10% rice bran and 1% calcium oxide on a weight to weight basis and brought to a moisture content of 70% by adding water (using the squeeze test). It is then heaped on a cemented platform, and allowed to decompose for 21-28 days in the case of *Triplochiton scleroxylon* sawdust and 60 days for the mixture of *Chlorophora excelsa* and *Terminalia invorensis*. During decomposition the heap is turned every 4 -5 days to allow for aeration and uniform composting. After composting, the substrate is bagged in heat resistent polypropylene or high-density polythene bags dimensions (33x17cm) to a wet weight of about one kilogram. Each bag is fitted with a plastic neck of 2.5cm diameter 'PVC' pipe or cut bamboo and closed with a cap. The bagged substrate are then sterilised by steaming in a 200-litre oil barrel drum with a perforated lid at 100 C for 2-3 hours to kill competitors. After sterilisation the bags are allowed to cool and then sent to the inoculating room where each bag is spawned with 3-5 g good quality sorghum grain spawn. The spawned bags are

sent to a semi- dark incubation room where the temperature is maintained at 26 to 30 C for complete mycelia colonisation of the substrate. The mycelium permeates and degrades the substrates and virtually knits the substrate together. Most of the *Pleurotus* species under cultivation require between 30 to 33 days for complete colonisation, whilst *P. cystidiosus* and *Auricularia* species requires between 45 to 65 days. After the mycelium have fully colonised the substrate, they are allowed to 'thicken' (form pinheads) for about a week and then the bags are sent to the cropping house for cropping and harvesting. In the case of the *Auricularia* species , 12 diagonal slits of 4cm are made around the bag and left in the incubation room for 14 days before they are sent to the cropping house.

The cropping house is a wooden framed structure, covered on the outside with local sedge or woven mats, and roofed with thatch to allow for aeration and water retention. Inside the cropping house are wooden or bamboo racks on which the bags are arranged horizontally on top of each other. Cutting off the neck exposes the surface of the bags. To obtain good flushes a high relative humidity of 85-95 %, and temperature between 24 and 28 C is kept in the cropping house. This is maintained by watering regularly with at least 4 buckets of water twice a day in the wet season, and three to four times in the dry season. When these bags are opened it takes 5 to 7 days for the pinheads to appear and 36 to 48 hours for the mushrooms to be ready for harvesting.

The second method is the Low bed method. This method is used in the cultivation of the oil-palm mushroom (*Volvariella* spp.). The substrates used in this method among others are rice straw, maize stover, sorghum stover, cotton waste, banana leaves and pseudostem, oil palm pericarp fibre and empty bunches, peelings from root tubers such as cassava, cocoyam and yam.

A bed is made with the help of a wooden trapezoid mould frame with both ends opened. The dimensions are base 35mm, top 30cm, the height 35cm and the length 91cm or more. Dry bedding materials such as rice straw, maize stover, etc. are soaked overnight. Some materials such as cotton waste are soaked , shredded and used immediately. The wooden mould is placed on the ground (cemented floor or soil which has being initially treated against termites if there are any) with the base downwards. The soaked materials are put into the mould, up to one-third the height and compacted. The mushroom spawn (with the chlamydospores formed) is dispersed into pieces by shaking the bottle. This is then sprinkled on top of the materials, along the periphery inside of the mould. This is the first layer. Two more layers are made in the same manner. With the top-most layer the entire surface is inoculated with the spawn. The wooden mould is then removed and used to make more beds. The beds are spaced about 10-15 cm apart . In between the beds a layer of composted sawdust of *Triplochiton scleroxylon* is placed. At least 5 beds are made in a row parallel to each other. The beds are then covered with transparent plastic sheets and woven mats placed on top of them to prevent the beds from drying up by sunlight or wind. The beds are left for one week, after which the polythene and woven mats, which had been used to cover them, are raised off the beds to a height of 15cm. This is to allow for aeration, and also to allow enough space for the growing mushrooms. Mushroom pinheads appear 3-5 days later on the beds as well as the ground, and button to egg- stage mushrooms are picked 48 hours later. The average yield per bed varies between 1.2 to 2 kilograms. With the low bed method of production of the oil palm mushroom, several kilograms of these mushrooms can be produced daily.

6. Product Details

This business plan is for two activities;

Mushroom Spawn Production

Production of bags for cultivation of mushroom by the Plastic Method

1. Mushroom Spawn Production

Product Specification

It is expected that the spawn from the laboratory will be pure and uncontaminated with other micro-organisms. Packaged in 330ml bottles.

The specifications in terms of colour, consistency, contamination, smell are given below:

Colour

Have pure white colour of mushroom mycelium for oyster

White mycelium with pinkish chlamydospores for oil palm mushroom

Greyish with black spores for abalone spawn.

Consistency

The sorghum grains should flow freely during inoculation of bags. Moisture content to be approximately 40%.

Contamination

Should have NO other colour of mycelium than those approved of under section colour

Smell

Spawn is expected to smell like fresh mushrooms

2. Compost bags production

Product Specification

The product is expected to be 1 kilogram weight fully thickened compost bag in heat resistant polypropylene bags.

The specifications in terms of colour and compaction are given below:

Colour

Have pure white thick colour of mushroom mycelium on bags with pinheads forming

Compaction

Well compacted compost bag with no bacterial growth at the base

Fig. 1: SCHEME FOR THE PRODUCTION OF SAWDUST COMPOST BAGS (PLASTIC BAG METHOD)

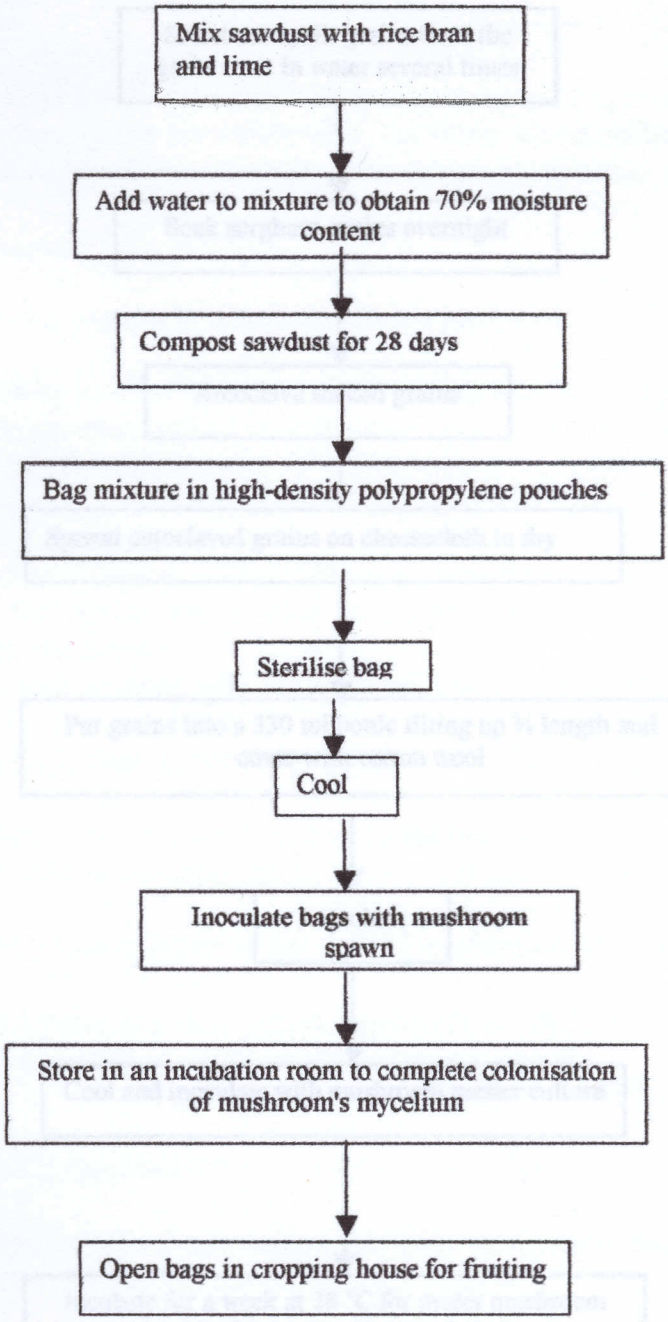
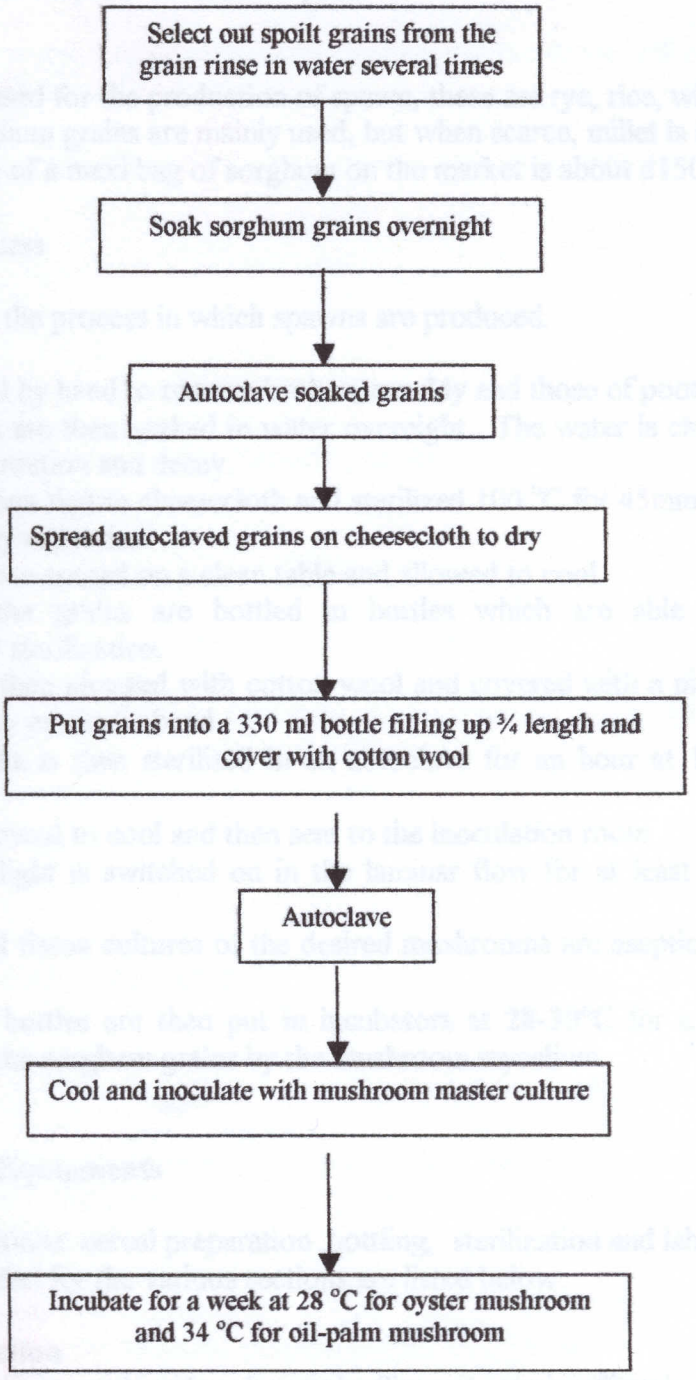


Fig. 2: SCHEME FOR THE PRODUCTION OF SPAWN FOR MUSHROOM CULTIVATION



Production Plant and Process

Production yield

In a well-organised and operated spawn production centre, the production yield is about 95% for oyster spawn and 75% for oil palm mushroom spawn.

Raw material supply

Various cereals can be used for the production of spawn, these are rye, rice, wheat, millet and sorghum. In Ghana sorghum grains are mainly used, but when scarce, millet is the alternative. On the average, the cost of a maxi bag of sorghum on the market is about ¢150,000.00.

Description of the process

The following describes the process in which spawns are produced.

- Grains are sorted by hand to remove broken, mouldy and those of poor quality.
- The good grains are then soaked in water overnight . The water is changed several times to prevent fermentation and decay.
- The grains are then tied in cheesecloth and sterilized 100 °C for 45minutes,at this time the grains are slightly expanded.
- The grains are then spread on a clean table and allowed to cool.
- After cooling the grains are bottled in bottles which are able to withstand high temperatures for sterilization.
- The bottles are then plugged with cotton wool and covered with a piece of paper, which is held in place by an elastic band.
- The spawn media is then sterilised in an autoclave for an hour at 121°C and at 1 bar atmosphere.
- The media is allowed to cool and then sent to the inoculation room.
- The ultraviolet light is switched on in the laminar flow for at least an hour before the process
- Freshly prepared tissue cultures of the desired mushrooms are aseptically transferred into each bottle
- The inoculated bottles are then put in incubators at 28-30°C for a week for complete colonization of the sorghum grains by the mushroom mycelium.

Plant Machinery and Equipments

There are four main sections: cereal preparation ,bottling, sterilization and laboratory sections. some of equipment needed for the various sections are listed below.

Cereal preparation section

Bowls and washing tanks to wash and soak cereals. Sieves to strain off grain.

Bottling section

Autoclavable 330ml bottles, cotton wool plugs, elastic rubber bands and newsprint.

Sterilization section
Autoclaves

Laboratory equipments
Analytical balance, pH meter, incubators, oven, laminar flow cabinet, refrigerator, inoculation needles, petri dishes, test tubes, spirit lamps etc.

List of plant, machinery and equipment for spawn preparation presently at the Pilot Plant building of the FRI

Plant/Machinery & Equipment	Purpose or use	Comments
Autoclave	For sterilizing media	Old, and does not function properly
Incubator	For incubating spawn	Inadequate
Laminar flow cabinet	For the inoculation of spawn	
pH meter	To determine pH readings of media prepared	Needs to be repaired

Bag Production (Plastic Bag Method)

The Production Process

Compost formulation
The compost is produced on a concrete floor under a shed. White wood sawdust mainly 'wawa' is enriched with rice bran, and lime. It takes about four weeks to decompose, requiring periodic turning to enhance uniform composting.

Bagging and Sterilization
The compost is filled into heat–resistant poly-propylene or high density polythene pouches and compacted. The open end of each bag is pushed through a PVC ring and fastened to provide an opening for the introduction of the mushroom spawn or 'seed'. The opening is plugged with cotton wool and covered with paper to prevent insect and mite infestation during incubation.

The bagged compost is sterilized by steaming at 100° C in oil drums or a sterilization chamber for 3-4h.

Spawning and Spawn-Running

After sterilization and cooling of the bags, active mushroom spawn is introduced into each of them under aseptic conditions. A 500ml. bottle of spawn is sufficient to inoculate 100 compost bags . The spawned compost bags are kept in a dark or semi-dark incubation room or shelves until the spawn has fully penetrated the compost downwards. The incubation period varies between 25-35 days depending on the oyster mushroom variety.

Mushroom fruiting and Cropping

Compost bags impregnated with spawn when opened under conditions of good ventilation, adequate light, right temperature and high humidity in a cropping house will produce mushroom initials within 3-5 days and mature mushrooms can be harvested two days later.

With daily watering 5 to 7 flushes of oyster may be harvested at 9-14 day intervals for a period of 8-12 weeks, giving 4 to 6 1/2 cycles per annum. At the end of the growing cycle the spent compost bags are removed and replaced with new bags.

The mushroom cropping house may be a single wooden structure with walls of straw and roof of thatch to provide the required growing conditions. Shelves which are required for the packing of the bags can be made out of bamboo or wood.

Plant Machinery and Equipments

There are six main sections: Composting, bagging, sterilization, inoculation, incubation and cropping . Some of equipment needed for the various sections are listed below.

Composting section

Shovels and wheel barrows for mixing the compost.

Bagging section

Heat resistant polypropylene bags, cotton wool plugs, elastic rubber bands PVC pipes and newsprint.

Sterilization section

Oil drums for sterilization.

Inoculation section

Good quality mushroom spawns

7. MARKET ANALYSIS

Mushrooms are known to be collected from the wild especially with the onset of the rains in mid-March. It used to be the major item in the diet of rural people.
Two main generic species sold on the market are

- The Oil-palm mushroom (or straw) locally known as Domo, which grows on rotten oil-palm trunks.
- The Termite mushrooms. These grow annually on termite hills.

Due to seasonality nature of the products, consumers tend to forget about these two mushrooms when they are not in season.
The Food Research Institute has lately introduced onto the Ghanaian market the oyster mushroom. This is fast gaining popularity especially with restaurants and hotels.
However some supermarkets in Accra sell canned and frozen imported button mushrooms. These compete with the fresh oyster mushroom.

7.1 MARKET SEGMENTATION

Three types of mushrooms are found on the Ghanaian market. These are

- the Domo, (the oil-palm mushroom) and the Termite mushrooms.
- the Oyster mushroom produced by mushroom growers most of whom have had training from the Food Research Institute.
- imported button mushrooms in cans, jars and the frozen ones.

In Accra, the first two are sold mainly in the markets like Makola, Agbogloshie, Kaneshie etc. The oyster and imported (canned and frozen) mushrooms are sold mainly to hotels, restaurants and other supermarkets. These are patronised mainly by the middle and upper income groups as well as vegetarians.

7.2 PRODUCT PRESENTATION IN THE MARKET

The oil palm and termite mushroom are commonly sold in the fresh form just after harvest without further processing. These mushrooms are sold mainly by women who invariably are retailers of other fruits and vegetables. The oyster mushroom is packaged in polythene pouches usually in the fresh state. In a few cases there are presented in the dried form.
The imported button mushrooms are canned and frozen. Table 1 lists the prices of a few imported mushrooms and local mushrooms (oyster and termite) found in Accra.

Table 1

Origin, weights and prices of mushrooms sold in some markets and supermarkets in Accra

SHOP	TYPE OF MUSHROOM	COUNTRY OF ORIGIN	WEIGHT (g)	PRICE (¢)
SOYRC, Osu	1. Oyster 2. Lutece in glass jars 3. La Maison	Ghana France France	200 170 230	4500 12,400 15,500
ELF Filling Station near 37 Military Hospital	Oyster	Ghana	200	4300
A-Life, Teshie	Lutece in glass jars	France	170	12,400
KOALA Supermarket	1. Frozen button mushrooms (in polymeric pouches) 2. Sliced Emborg (in polymeric pouches)	Belgium Belgium	1000 450	48,000 18,500
TOP-IN-TOWN, Osu	Canned Mushroom	Holland	170	9,800
Madina Shell Shop	Canned Mushroom	Holland	170	9,600
QWIK PIK, Osu	Canned Mushroom	Holland	230	15,600
Makola, Central Accra	Termite	Ghana	200	5,000

7.3 PRICES

As at the end of December 2000, the average price of the termite mushroom was ¢5000 per 200 g. However, prices for the various species of mushroom differ from one sale point to another.
Due to interest whipped up by the Food Research Institute and the Export Promotion Council, quite a number of people have been trained in the production of mushroom. This has even resulted in the formation of an association known as the Mushroom Growers Association. One of the aims of the this association is to help members to achieve better returns in their investment by ensuring equity in their pricing. Though the association have agreed to a price of ¢8000 for 1000 g of the oyster mushroom, there are a few other mushroom farmers, some of whom are not members of the association, who are trying to undercut them by offering the 1000 g of fresh

oyster for ¢7000 on the other extreme, there are other farmers who are selling the same quantity of the oyster mushroom for as much as ¢12,000.

7.4 DISTRIBUTION

Fresh mushrooms are usually distributed directly from the growers to the selling points (i.e. markets) or consumers. Most of the imported mushrooms are displayed through the usual retail outlets for other imported food products. Most shops visited in Accra were outlets for imported mushrooms. Table 2 lists some selling points for oyster and /or button mushrooms.

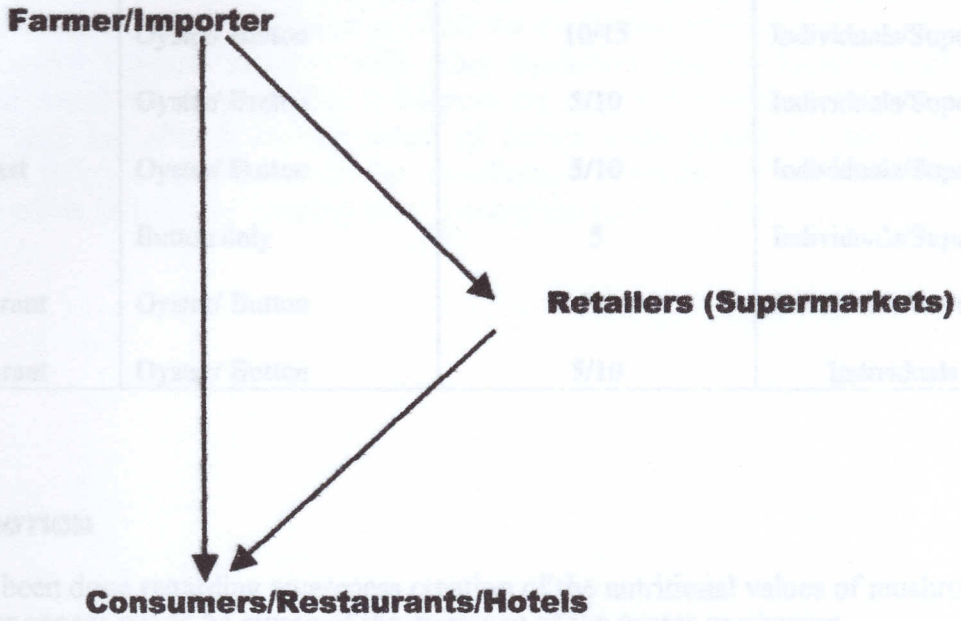


Fig. 3 Distribution Channel for Mushrooms

Table 2

Types and quantities of mushrooms supplied to some hotels and restaurants in Accra

Name of Hotel/Restaurants	Type of Mushroom	Quantity of Mushroom Purchased (in kg) per week	Source of Supply
Shangri-La	Oyster/ Button	10/15	Individuals/Supermarkets
Golden Tulip	Oyster/ Button	10/15	Individuals/Supermarkets
Nogahill Hotel	Oyster/ Button	6/10	Individuals/Supermarkets
Magthomas Foods	Oyster/ Button	5/8	Individuals/Supermarkets
La Palm Hotel	Oyster/ Button	10/15	Individuals/Supermarkets
Paloma Snacks	Oyster/ Button	5/10	Individuals/Supermarkets
Sisters of the East	Oyster/ Button	5/10	Individuals/Supermarkets
Brunchie	Button only	5	Individuals/Supermarkets
Landing Restaurant	Oyster/ Button	5/8	Individuals/Supermarkets
Dynasty Restaurant	Oyster/ Button	5/10	Individuals only

7.5 PROMOTION

Not much has been done regarding awareness creation of the nutritional values of mushrooms. Quite a number appear not to be aware of the existence of the oyster mushroom
Most shops visited in Accra were outlets for imported mushrooms as can been seen in Table I. This is because the growers of mushrooms sell direct to consumers and cannot produce enough for the shops as well. In Table II, most of the hotels and restaurants get their supply of oyster mushrooms from individual growers and imported button canned or frozen mushrooms from shops.

7.6 MARKET DEMAND

As already stated, the demand for mushrooms are vast. Although awareness of this product a few consumers only know especially the oyster, the demand cannot match the supply as growers have a number of constraints namely:

a. Financial
b. Logistics and
c. Bag production

7.7 MARKET PROJECTION

Almost all the Hotels/Restaurants visited use mushrooms in the preparation of their dishes (Table 2). For health reasons, we also have people who are vegetarians and also live on mushroom as their source of protein.

Most shops visited had the imported mushroom on their shelves with only displaying the oyster mushroom, which is grown in Ghana all the year round. This is an indication of the demand for mushrooms.

It is estimated that if the mushroom market is developed, it will create employment for quite a number of people and also reduce the importation of the other species from the European markets. Unfortunately there are no reliable figures to show the quantity of imported mushrooms that come into the country or what is produced in the country but a survey conducted in Accra indicates that the mushroom growers are unable to sustain the market as their production levels depends on the number of mushroom bags available for the farmers to purchase.

The Food Research Institute together with other mushroom bag producers should produce enough bags to march the demand. This is because the market potential for mushrooms spawn not only in Ghana but also in regions South of Sahara with distinct dry season. It is also envisaged that people's attitude could be transformed towards the recognition of oyster mushrooms as edible and thereby creating more demand through education.

8. PROFITABILITY ANALYSIS

APPENDIX I: FIXED CAPITAL COST
SCHEDULE A: LAND & INFRASTRUCTURE

	Capacity (ft)	Cedis ('000)	In US$
Land and Factory Building Space	1 acre	20,000	2,857
Inoculation/Incubation Room	20x60	30,000	4,286
Bagging Shed	15x20	3,000	429
Composting Area	40x60	2,000	286
Storage Room	12x15	6,000	857
Laboratory	12x12	5,000	714
Office	12x12	5,000	714
Contingency, 10 %		7100	1014
Total		**78,100**	**11,157**

SCHEDULE B: PLANT & EQUIPMENTS

	Quantity	Unit Cost (C'000)	Total cost (C"000)	In US$
Autoclave	1	11,900	11,900	1700
Top Loading Balance	1	2,100	2,100	300
Laminar Flow Cabinet	1	1,000	1,000	143
pH Meter	1	1,500	1,500	214
Washing Tanks	2	800	1,600	229
Refrigerator	1	4,000	4,000	571
Laboratory Oven	1	17,500	17,500	2500
Incubator	1	11,900	11,900	1700
Gas cylinder	4	500	2,000	286
Gas burner	4	300	1,200	171
Cylinder Regulators	4	150	600	86
Inoculation needles	100	5	500	71
Glassware	-	-	1,000	143
Oil-Barrel Drums	4	300	1,200	171
Contingency, 10 %			5,800	829
Handling, Installation, 10 %			6380	911
Total			**70,180**	**10,026**

SCHEDULED C: OFFICE EQUIPMENT & FURNITRURE

		Unit Cost (¢)	Total Cost (¢)	Total Cost ($)
Computer, complete with printer	1	14,000	14,000	2000
4 Chairs, 2 tables, shelves etc		1,400	1,400	200
Air Conditioner	2	5,000	10,000	1428.57
Contingency, 10%		2040	2540	362.86
Total		**22,440**	**27,940**	**3,991**

TOTAL FIXED CAPITAL COST

	Cost In (¢)	Cost In US $
Land & Infrastructure	78,099,000	11,157
Plant & Equipments	66,430,000	9,490
Office Equipment & Furniture	27,937,000	3,991
TOTAL	**172,466,000**	**24,638**

APPENDIX II:

SCHEDULE A: OPERATING COST

1. DIRECT LABOUR

	Number	Unit (¢)	Total (¢)	Total ($)
Manager	1	525,000	525,000	75
Production Supervisor	1	437,500	437,500	62.50
Technical Officer	3	350,000	1,050,000	150
Semi Skilled Labour	4	288,750	1,155,000	165
Social Security fund, 12.5%		200,156	395,938	56.56
Total			**3,563,438**	**509.06**

2. RAW MATERIAL REQUIREMENT

	Quantity	Unit Price (¢)	Total (¢)	Total ($)
Sorghum	100 kg	200,000	200,000	29

Cotton Waste	2 bales	120,000	240,000	34
Saw Dust	15,600 kg	66.67	1,040,052	149
Rice Bran	47 bags	15,000	702,000	100
Mushroom Spawn	100 bottles	3,000	300,000	43
Water	3,900 gal.	39.2	152,880	22
Empty Spawn Bottles	2,000	200	400,000	57
News Print	117 pcs	1000	117,000	17
LPG	2,205 kg	2,203.90	4,859,600	694
Rubber Band	47 sachets	12,000	564,000	81
PVC Pipe	130 pcs	18,000	2,340,000	334
High Density Polyethene Bag	26,000 pcs	100	2,600,000	371
Quick Lime	52 sachets	1000	52,000	7
Glucose	0.5 kg	20,000	20,000	3
Agar	15 g	65,000	65,000	9
Total			**13,652,532**	**1,950**

3. ELECTRICAL ENERGY REQUIREMENT

Total Plant Rating, kW	15
Operating Period/day, hr	8
Number of Productive days/month	20
Energy Consumption/month	2400
Energy Cost, kWh	0.09
Total	**216**

TOTAL DIRECT OPERATING COST	**Cost In ¢**	**Cost In US $**
Direct Labour	3,563,000	509
Raw Materials	13,965,000	1,995
Hiring of trucks (Transportation)	279,300	40
Electricity	1,512,000	216
Total	**19,319,300**	**2,760**

SCHEDULE B: ADMINISTRATIVE COST

1. INDIRECT LABOUR

	Number	Salary (¢)	Total (¢)	Total ($)
Secretary/Accounts Clerk	1	350,000	350,000	50
Security Man	2	288,750	577500	82.5
Social Security fund, 12.5%		79843.75	115937.5	16.56
Total		**718,594**	**1,043,438**	**149.06**

2. DEPRECIATION, REPAIR & MAINTENANCE AND INSURANCE

DEPRECIATION

	AMOUNT ($)	RATE (%)	VALUE ($)
Infrastructure	11157	5	557.85
Plant & Equipments	9,490	10	949.00
Office Equipment & Furniture	3991	5	199.57
Total			**1706**

REPAIR AND MAINTENANCE

	AMOUNT ($)	RATE (%)	VALUE ($)
Infrastructure	11157	3	334.71
Plant & Equipments	9,490	5	474.5
Office Equipment & Furniture	3991.43	5	199.57
Total			**1009**

	INSURANCE		
	AMOUNT ($)	RATE (%)	VALUE ($)
Infrastructure	11157	1	111.57
Plant & Equipments	9,490	2	189.8
Office Equipment & Furniture	3991.43	1	39.91
Total			**341**

3. OTHER INDIRECT COSTS

	Cost (¢)	Cost ($)
Stationery	300,000	42.86
Audit & Legal fees	500,000	71.43
Post & Postages	150,000	21.43
Communication	200,000	28.57
Operating Overheads, 2%	23,000	3.29
Contingency, 10%	117,300	16.76
Total	**1,290,300**	**184.33**

TOTAL ADMINISTRATIVE (INDIRECT OPERATING) COST	**In US $**
Indirect Labour	149
Repair and Maintenance	1,009
Insurance	343
Other Indirect Cost	184.00
Add 30% Institutional Overheads	505.48
Total	**2,190**

APPENDIX III

WORKING CAPITAL (3 MONTHS)

	In US $
Operating Cost	8,280
Administrative Cost	6,570
Total	**14,850**

APPENDIX IV

PRE-OPERATIONAL COST

	COST (¢)	COST ($)
Financial feasibility fee	2,000,000	285.71
Transportation	1,000,000	142.86
Design Fee	2,000,000	285.71
Registration of Company	200,000	28.57
Communication	500,000	71.43
Miscellaneous	570000	81.43
TOTAL	**6,270,000**	**896**

APPENDIX V

LOAN AND REPAYMENT SCHEDULE

PRINCIPAL	**40,384**
INTEREST RATE	40%
REPAYMENT PERIOD	5 YEARS
COMMIMENT FEE, 1%	404
MORATORIUM ON PRINCIPAL	1 YEAR

ITEM/PAYMENT DATE	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
OUTSTANDING AMOUNT	40,788	40,788	30,591	20,394	10,197
LOAN REPAYMENT	0	10197	10197	10197	10197
INTEREST PAYABLE	-	16,315	12,236	8,158	4,079
CLOSING BALANCE	40,788	30,591	20,394	10,197	0

APPENDIX VI
PRODUCTION PLAN & REVENUE ESTIMATION

SCHEDULE A: PRODUCTION PLAN FOR MUSHROOM SPAWN

Item/Year	**1**	**2**	**3**	**4**	**5**
Installed capacity per day, spawn bottles	100	100	100	100	100
Number of production days per year	240	240	240	240	240
Installed capacity per year, spawn bottles	24,000	24,000	24,000	24,000	24,000
Plant capacity utilisation, %	95	96	97	98	99
Total Production Output	22,800	23,040	23,280	23,520	23,760

SCHEDULE B: PRODUCTION PLAN FOR COMPOST BAG

Item/Year	**1**	**2**	**3**	**4**	**5**
Installed capacity per day, compost bag	1300	1300	1300	1300	1300
Number of production days per year	240	240	240	240	240
Installed capacity per year, compost bag	312,000	312,000	312,000	312,000	312,000
Plant capacity utilisation, %	95	97	99	99	99
Total Production Output	296,400	302,640	308,880	308,880	308,880

SCHEDULE C: REVENUE ESTIMATION FOR MUSHROOM SPAWN

EX-FACTORY PRICE PER BOTTLE					
Spawn per bottle ($)	0.5	0.5	0.51	0.51	0.52
Revenue ($)	11,400	11,520	11,873	11,995	12,355

SCHEDULE D: REVENUE ESTIMATION FOR COMPOST BAG

EX-FACTORY PRICE PER BAG					
Compost per bag ($)	0.19	0.19	0.2	0.21	0.21

Revenue ($)	56,316	57,502	61,776	64,865	64,865

PROJECTED INCOME STATEMENT

ITEM/YEAR	**1**	**2**	**3**	**4**	**5**
TOTAL REVENUE	67,716	69,022	73,649	76,860	77,220
Direct Operating Cost	8,280	8,280	8,280	8,280	8,280
Gross Profit Margin	59,436	60,742	65,369	68,580	68,940
Indirect Operating Cost	6,570	6,570	6,570	6,193	6,193
Marketing Expenditure	1354	1380	1473	1537	1544
Depreciation	1,706	1,706	1,706	1,714	1,714
Profit before Interest/Tax	49,806	51,085	55,620	59,136	59,489
Interest on Loan	-	16,315	12,236	8,158	4,001
Corporate Tax, 32.5%	-	16,603	18,076	19,219	19,334
Net Profit	**49,806**	**18,167**	**25,307**	**31,759**	**36,154**

APPENDIX VIII

PROJECTED CASH FLOW STATEMENT

ITEM/YEAR	**0**	**1**	**2**	**3**	**4**	**5**
Cash inflow						
FUNDS FROM OPERATION						
Net Profit	0	49,806	18,167	25,307	31,597	36,154
Depreciation	0	1,706	1,706	1,706	1,706	1,706
Salvage Value	0	0	0	0	0	0
Working Capital	0	0	0	0	0	0
TOTAL CASH INFLOW	**0**	**51,512**	**19,873**	**27,013**	**33,303**	**37,860**
Cash Outflow						
Fixed Assets						
Land & Infrastructure	11,157	0	0	0	0	0
Plant & Equipments	9,490	0	0	0	0	0

Office Equipment & Furniture	3,991	0	0	0	0	0
Total	**24,638**	0	0	0	0	0
Intangible Assets	**896**	0	0	0	0	0
Current Assets	**14,850**	0	0	0	0	0
Principal Repayment	**0**	0	10,197	10,197	10,197	10,197
TOTAL CASH OUTFLOW	**40,384**	**0**	**10,197**	**10,197**	**10,197**	**10,197**
CUMMULATIVE NET CASH FLOW	**-40,384**	**-11,128**	**18,942**	**35,758**	**58,864**	**86,527**
PRESENT WORTH	**403**					
INTERNAL RATE OF RETURN	**69%**					