

A STUDY OF THE PROFITABILITY OF MUSHROOM CULTIVATION IN THE GREATER ACCRA REGION OF GHANA

BY

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**A DISSERTATION SUBMITTED TO THE DEPARTMENT OF
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DEDICATION

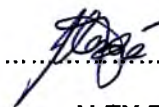
Dedicated to my parents, Mr. And Mrs. R.M. Opong for their support, encouragement and guidance.



DECLARATION

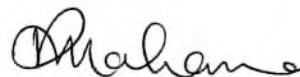
I, ALEX FREMPONG, author of this project report do hereby declare that the work presented in this Dissertation “A Study of the Profitability of Mushroom Cultivation in the Greater Accra Region of Ghana” was done entirely by me in the Department of Agricultural Economy and Farm Management, University of Ghana.

This work has never been presented in whole or in part for any other degree of the University or elsewhere.



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ABSTRACT

This study examines the extent to which farmers trained by the Food Research Institute have taken up mushroom farming and also determines the profitability of mushroom production. Specifically, the study describes trends in the levels of mushroom production since 1995, the rate of adoption and dis-adoption of mushroom farming by trainees, the profitability of mushroom cultivation and identifies constraints to mushroom farming from the perspective of farmers. Trend description involves annual output of respondents in the Greater Accra region from 1995 to 1999. The profitability of mushroom cultivation was determined by the use of the Benefit-Cost Ratio, Net Present Value and the Internal Rate of Return criteria. The constraints to mushroom cultivation from the perspective of the farmers were listed and ranked in decreasing order of importance. Results from the study reveal that there is an increasing trend in production by the individual farmers in the Greater Accra region, and that majority of the Food Research Institute's trainees took up mushroom production. The estimates of the profitability indicators suggest that mushroom cultivation is profitable. The average values of the B/C ratio, NPV and IRR are 1.35, ₵ 6,2900.00 and 48.24% respectively. The three most important constraints found militating against mushroom cultivation are: poor marketing, lack of funding and scarcity of water, in that order. Some of the means by which constraints to marketing of agroproducts in general could be removed are: Intensification of market survey and dissemination of market information to producers and also increase in the proportion of Ghana's merchandise exports that are processed. The problem of funding could be solved by the farmers forming savings and loans associations. Investment in rainwater harvesting and storage facilities is a possible means of solving the water problem. It is recommended that a similar research be carried out in areas outside the Greater Accra region of Ghana to assess profitability of the industry nationwide.

CONTENTS

	Page
DEDICATION	I
DECLARATION.....	II
ACKNOWLEDGEMENT.....	III
ABSTRACT	IV
CONTENTS.....	V
LIST OF TABLES.....	VIII
LIST OF FIGURES.....	IX

CHAPTER ONE

1.0 INTRODUCTION	1
1.1 Background.....	1
1.2 Problem statement.....	2
1.3 Objectives of the study.....	3
1.4 Justification of the study.....	4

CHAPTER TWO

2.0 LITERATURE REVIEW.....	5
2.1 World Trend in Mushroom Production.....	5

2.2 Mushroom As a Crop.....	8
2.3 Cultivation Methods and Costs of Production.....	10
2.4 Profitability of Mushroom Production.....	12
2.5 The system of Mushroom Farming Adopted by Farmers in Ghana.....	13

CHAPTER THREE

3.0 METHODOLOGY.....	16
3.1 Analytical Framework.....	16
3.2 Data Collection.....	22



CHAPTER FOUR

4.0 RESULTS AND DISCUSSION.....	23
4.1 Results of Analysis.....	23
4.1.1 Production Trends.....	23
4.1.2 Adoption of Mushroom Farming.....	25
4.1.3 Investment Analysis.....	28
4.2 Constraints in Mushroom Production.....	32

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS.....	35
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	Page
LIST OF REFERENCES.....	37
 APPENDIX 1	
QUESTIONNAIRE ON FOOD RESEARCH INSTITUTE'S	
TRAINING PROGRAMME.....	41
 APPENDIX 2	
MAIN QUESTIONNAIRE (COST ITEMS,CONSTRAINTS	
AND PRODUCTION LEVELS).....	42
 APPENDIX 3	
RETURNS OF SAMPLED RESPONDENTS.....	47
 APPENDIX 4	
PRODUCTION COSTS OF SAMPLE.....	51
 APPENDIX 5	
ESTIMATION OF PROFITABILITY INDICATORS.....	57



LIST OF TABLES

	Page
2.1 World Production of Mushrooms (1986 and 1991).....	6
4.1 Annual Outputs of Mushrooms by Respondents.....	23
4.2 Estimated Regional Output of Mushrooms (1995-1999).....	24
4.3 Rates of Adoption and Dis-adoption of Mushroom Farming.....	27
4.4 Range and Average Values of B-C Ratio, NPV(¢) and IRR (%).....	31
4.5 A Ranking of Constraints in Mushroom Farming.....	32



LIST OF FIGURES

	Page
4.1 Greater Accra Regional Output of Mushroom (1995 –1999).....	26
4.2 Trends in Number of Trainees Produced by the Food Research Institute.....	29
4.3 Trends in Number of Sampled Trainees Starting Farming.....	30



CHAPTER ONE

1.0

INTRODUCTION



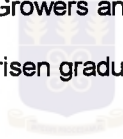
1.1 Background

Mushroom grows in the wild and is seasonal, so mushroom cultivation is necessary to ensure supply on the market all year round. Cultivation of mushroom began in France in the 17th century during the Napoleonic era. It became a thriving industry, mainly occupying the abandoned tunnels of quarries in the neighbourhood of Paris (Brouk, 1975). Most cultivated mushrooms (Agaricus species) belong to the classes of fungi known as Basidiomycetes and Ascomycetes. The straw mushroom (Volvariella volvacea) is cultivated successfully in tropical countries such as Ghana and Thailand (Addae-Kagyah, 1993). Apart from button mushroom (Agaricus bisporus) other species such as oyster mushroom (Pleurotus ostreatus) could be cultivated, taking advantage of the abundance of wastes such as sawdust, rice straw and bran. Agricultural and industrialization activities, particularly in the food sector in Ghana, result in an abundance of waste materials most of which contain large amounts of cellulose, hemicellulose and lignin, which support the growth of mushroom if the right conditions are provided (Senyah and Robinson, 1998).

Mushroom has medicinal value and is also used in dyeing natural fabrics. It is also used to bioremediate polluted soils. Above all, mushroom has a major benefit of having a high nutritional value as a result of its high content of quality vitamins (B1, B2 and C) and minerals such as phosphorus, sodium and potassium and a lesser amount of calcium (Oei, 1996). Increased cultivation and consumption of mushroom can therefore

help raise the nutritional status of Ghanaians by providing an extra source of protein, valuable minerals and vitamins. It is in the light of this that the Ministry of Food and Agriculture organises short courses for farmers at Asuansi, Adidome and Wenchi Farm Institutes. Also, the Agricultural Department of the University College of Education, Ashanti Mampong campus, runs a course in mushroom cultivation for its students.

As a result of the attractive nature of benefits that could be reaped from mushroom cultivation, the Ghana Export Promotion Council in collaboration with the Food Research Institute in 1990 established the National Mushroom Development Project (N.M.D.P.) based in Accra (G.E.P.C., 1992). The goal of this project is to make Ghana a major exporter of mushrooms. Efforts in this direction has led to a growing interest in mushroom cultivation in Ghana as an income earning activity as well as a source of foreign exchange. An interview with some executives of the Mushroom Growers and Exporters Association of Ghana reveals that membership of the Association has risen gradually from fifty since its inception in 1994 to about a hundred in 1999.



1.2 Problem Statement

There are reports of increase in world production of mushrooms since the 1980s and it is unclear if that applies to Ghana in general and the Greater Accra region in particular. A total of seven hundred and forty one farmers have been trained in mushroom farming since 1995. Although there was an evaluation of the National Mushroom Development Project in 1995 which estimated a net present value of ₵10.60 billion at 35% discount rate, a benefit-cost ratio of 2.51 and a rate of return of 154%, there has not been an assessment of the impact of the project on uptake of mushroom farming by trained farmers. The uptake of mushroom farming

will depend largely on the profitability of the mushroom enterprise. The National Mushroom Development Project report in 1991 made mention of a number of constraints that militate against the project and although mushroom farmers in the Greater Accra region operate under different conditions they are all confronted by constraints which when addressed will ensure that mushrooms contribute substantially to the development of agriculture and the achievement of Ghana's Vision 2020 objective. The questions that emerge from this background are:

- (a) Is the Greater Accra region of Ghana keeping pace with the world in mushroom production ?
- (b) To what extent have trained farmers taken up mushroom farming ?
- (c) Are returns from investment attractive enough to lead to expansion in mushroom production ?
- (d) What constrains mushroom production in the Greater Accra region of Ghana ?

1.3 Objectives of the study

The purpose of the study is to assess the extent to which the Mushrooms Project has encouraged mushroom farming. The specific objectives are:

1. To describe the trends in the levels of mushroom production since 1995.
2. To determine the rate of adoption and dis-adoption of mushroom farming by trainees.
3. To determine the profitability of mushroom cultivation.
4. To identify constraints to mushroom farming from the perspective of farmers.

1.4 Justification of the study

Although the Food Research Institute continues to expend resources on the training of mushrooms farmers, it has not done any profitability analysis to determine whether the efforts of the Institute by way of their training are being rewarded. More often than not, farmers, especially illiterate farmers only consider as important, the actual amount of additional income they expect to receive and ignore the measures of project worth (Gittinger, 1982) and hence end up engaging themselves in unprofitable ventures. With the active promotion of mushroom cultivation, therefore, there is the need to know if the investment is worthwhile to ensure that the individual farmers reap enough profit for consumption and re-investment. The government of Ghana is making every effort to boost investment in the country and the agricultural sector in particular deserves much attention. The findings or results of this study can be used as a basis to advice potential investors.



CHAPTER TWO

2.0 LITERATURE REVIEW

In this chapter, the world trend in mushroom production is reviewed and the contributions of the various producer countries as well as the various mushroom types to world production are compared. Literature on mushroom as a crop and the various cultivation methods employed worldwide as well as the costs associated with production are reviewed next. It then touches on the system of mushroom farming adopted by farmers in Ghana. Finally, issues relating to the profitability of mushroom production are reviewed.

2.1 World Trend in Mushroom Production

The Food and Agriculture Organisation of the United Nations report world production of mushroom at 1.4 million tons between 1983 and 1984. Chang and Miles (1984) report of over ten countries cultivating "shiitake" mushroom. Annual production of fresh "shiitake" mushroom total about 192,000 tons, which is equivalent to 27,000 tons of dried mushrooms worth about 540 million dollars.

The production trends of different types of mushroom between 1986 and 1991 are presented in Table 2.1.

Table 2.1 World Production of Mushrooms (1986 and 1991)

Mushroom Type	Production in 1986		Production in 1991		Percentage Increase over 1986 figure (Fresh equivalent weight)
	Output in metric tons (Fresh equivalent weight)	Percentage Share	Output in metric tons (Fresh equivalent weight)	Percentage Share	
Button	1,227	56.2	1,590	37.2	31.0
Shiitake	314	14.4	526	12.3	64.0
Straw	178	8.2	252	5.9	42.0
Oyster	169	7.7	917	21.5	44.2
Wood ear	119	5.5	465	10.9	291.0
Others	175	8.0	522	12.2	198.2

Note : There is no recent publication on the world production of mushrooms hence the current world production trend is not known, although, there is an increasing production trend in Ghana.

A comparison of production between 1986 and 1991 reveals that production of all cultivated mushroom species increased during the period by 95.8%. Mainland China was a leading producer of oyster mushroom in 1986 producing 100,000 tons which accounted for 59% of world production. Another major producer in 1986 was the United States of America which recorded 285,000 tons of fresh equivalent weight of Agaricia mushrooms. The only African country which produced a significant amount of mushroom that year was South Africa .

Several studies have demonstrated production increases since the 1980s (Chang, 1983 and 1993; Boehr, 1992; Schmidt, 1993; Chang and Miles, 1991). The number of cultivated species is also increasing (Oei, 1996b) but Agaricus bisporus is the most important and

advanced mushroom from the standpoint of total production and research (Chang, 1990; Pai, 1991).

Canada and the Netherlands are some of the leading importers of mushroom. In Canada dried mushrooms are the most common consumer packs to be found on the store shelves, usually in Chinese, Italian, or other ethnic food stores. In 1994, Canada imported dried mushrooms from China, valued at 5 million US dollars (S.C., 1994). The Netherlands imported 18,000, 14,000 and 20,000 tons of mushrooms in 1993, 1994 and 1995 respectively from Intra-Eu, Extra-Eu, developing and other countries respectively. The leading supplying countries of mushrooms to Netherlands are Poland, China and Germany. The role of developing countries in the world mushroom market is substantial, as they supply about a quarter of the total volume of imports by the Netherlands (C.B.I., 1997).

Revenue generated from mushroom production, like any other crop depends basically on price and the yield (which is the amount of mushroom produced per unit amount of substrate). The price of mushroom depends on regional preference and hence varies from country to country as well as from species to species. For instance, oyster mushroom is very cheap in China whilst it is very expensive in Europe. The price of mushrooms also depends on whether they are sold fresh or preserved. In Taiwan, farmers in an attempt to manage and sell products of mushroom themselves, face problems of unstable and usually lower sale prices. Two mushroom projects, one called Royal project, came in to rectify the situation by advising farmers to adopt a rotation technique to control the cropping time so that the supply of mushroom products to the market would be consistent with demand throughout the year and result in a stable price. They also made an attempt to reduce the problem of quality through grading and improved packaging. (Natalaya *et al.*, 1981).

The market potential for mushroom is vast, not only in Ghana, but also in regions south of the Sahara with distinct dry season (G.E.P.C., 1991). In principle, mushroom and mushroom products are quite suitable for export to earn foreign exchange. It is for this reason that the Ghana Export Promotion Council recommended the establishment of a National Mushroom Development Project in 1990, to undertake the promotion and development of mushroom production by Ghanaians as a non-traditional export commodity in line with the government's policy under the Economic Recovery Programme. In this project it was estimated that by 1993 Ghana could earn as much as 64,000 U.S.A dollars from mushroom export. However, this target has not been achieved yet (G.E.P.C., 1991).

2.2 Mushroom As a Crop

Mushroom is a macrofungus with a distinct fruiting body which can be either epigeous or hypogeous and large enough to be seen with the naked eye and to be picked by hand (Chang and Miles, 1989). Mushroom has a number of uses some of which are medicinal. It activates intestinal peristalsis and prevents chronic constipation and it also has high protein content in the range of 20 to 45 percent in the dry weight (FAO, 1994). Mushroom converts lignocellulosic materials into more edible and protein enriched substances which can be used as good manure for vegetables or as supplements in animal feed (Zadrazil and Beg, 1986).

In botanical sense, mushrooms can be defined as fungi which lack chlorophyll and so cannot photosynthesise. However, mushroom can produce a wide range of enzymes that degrade the complex substrates on which they grow following which they absorb the soluble substances for their own nutrition. This absorptive nutrition is a characteristic of fungus. Mushroom can also be poetically described as a plant "without leaves, without buds, without

flowers: yet they form fruit". As a food substance, as a tonic, as a medicine: the entire creation is precious (Chang, 1990a). Mushroom varieties can be roughly divided into four categories as follows :

- (1) those which are fleshy and edible fall into the edible mushroom category, for example, Agaricus bisporus.
- (2) those considered to have medicinal applications, are referred to as medicinal mushrooms, for example, Ganoderma lucidum:
- (3) those which are proven to be, or suspected of being poisonous are named poisonous mushrooms, for example, Amanita phalloites:
- (4) a miscellaneous category which includes a large number of mushrooms whose properties remain less well defined.

The edible fungi, Volvariella volcacea, are cultivated successfully in tropical countries such as Ghana and Thailand and an experiment to explore the possibility of cultivating this mushroom in south Africa has began (Addae-Kagyah, 1993). Recently, a wide range of edible fungi has been isolated and grown in pure culture, and the number of wild species which can be successful cultivated are increasing rapidly (Jong and Davis, 1987). About 2,000 species from more than 30 genera are regarded as prime edible mushrooms but only about 80 of them are grown experimentally, 60 cultivated commercially and only 4 to 5 are produced on an industrial scale (Chang, 1990b).



2.3 Cultivation Methods and Costs of Production

The technique for the cultivation of mushrooms can be primitive, as in rural farming of Volvariella and Pleurotus mushrooms. It can also be highly industrialized, as Agaricus and Lentinus production in urban areas, in which advance technology and equipment are used. The cost of cultivation therefore depends on the scale of production as well as the technology and equipments chosen (Chang and Miles, 1989).

The cultivation method of mushroom can be divided into six stages: (Nutalaya, Pataragetvit and Srimanee, 1981)

1. Preparation of the inoculum
2. Preparation of the bed legs
3. Inoculation
4. Log laying in the shelter
5. Raising the legs
6. Cropping and harvesting the fruiting bodies.



The cost of mushroom production can be estimated when the method of cultivation to be adopted is identified. To determine the profitability of a mushroom growing project, the following must be taken into account (Oei, 1996):

1. Investment in substrate production facilities
2. Operating cost of substrate production
3. Investment in growing rooms
4. Growing cycle period
5. Operating costs of mushroom growing
6. Profitability of total operation

7. Price

8. Yields

Investment in substrate production facilities is one of the factors to be considered in determining the cost of mushroom production. The magnitude of the investment depends on the type of technology chosen as well as the equipment and its capacity. Each of the facilities is used within a certain period of time and hence depreciation must be taken care of. The cost of acquiring property has to be added to the investment cost (Oei,1991). Another vital source of cost is the operating cost of substrate production and hence farmers need to keep good records on it. Many factors influence this cost and some of the factors are ingredients of substrate, substrate containers, depreciation of equipment used in the production of the substrate, spawn and labour employed. Frequency and the amount of production of substrate also influence the cost. The cost of substrate ingredients depends on the exact formulation (i.e. what goes into the substrate). The cost of a unit amount of substrate varies from farmer to farmer depending on the formulation. The exact cost of substrate formulation can be easily defined if the exact formulation is defined.

Mushroom can be cultivated in an open or closed space. In commercial mushroom farms, there is the need to invest in special growing rooms. According to Oei (1996), growing rooms may be few square metres or up to a size as large as two hundred and fifty or more square metres. The larger the size of a growing room, the cheaper it is to control the climate of the room since a single climate control unit is installed in each room. On the other hand, if there are many small sized growing rooms the cost increases because each of these will require a separate climate control system. Growing rooms contribute substantially to the high initial investment cost. The scale of production of mushroom determines the size of the

growing room to invest in. Small-scale out-growers or farmers who grow in specific seasons only normally erect simple structures whilst large-scale production requires investing in larger structures which are either made of bricks or of other materials which are used to put up permanent structures. The following cost items constitute the cost of investment for commercial or larger scale production: buildings, installation of electricity or steam, climate control, permits and consultancy and shelves. Temperature control is essential because temperature affects the growth as well as the quantity and quality of fruiting bodies produced (Leong, 1982). According to Cheng and Hans (1977), research has revealed that physical factors such as temperature, humidity, pH, aeration and light, may affect substrate efficiency.

2.4 Profitability of Mushroom Production

An evaluation and feasibility report prepared on the National Mushroom Development Project in June 1995 indicated that the project had both high social and financial benefits to the nation and therefore it was recommended that the project be expanded accordingly (G.E.P.C., 1995).

The report indicated a Net Present Value of 10.83 billion cedis at a discount rate of 35% and a benefit-cost ratio of 2.61 in its Social (Economic) Analysis. Analysing the financial viability of the project, at a discount rate of 35%, a Net Present Value of 10.60 billion cedis and a Benefit-Cost Ratio of 2.5 were recorded. The Ghana Export Promotion Council had earlier on, in 1991 issued a report on a pilot mushroom project it initiated in 1990, that the project was feasible and financially sound. A proforma operating statement of the project indicated that it could operate as a profitable venture. This project made a loss of ₵4.2 million in the first year

of its operation. A gross operation profit of ₵15.3 million was however realised in the second year increasing to ₵29.7 million in the third, fourth and the fifth years.

Srimanee (1981) reported that in the mountainous areas in the north of Thailand, mushroom cultivation showed a high return in a small space with less care and much shorter time than temperate fruit crops and coffee.

There is an increasing trend of the production of mushrooms worldwide and different technologies are being developed to enhance mushroom production and hence there is the need to assess the industry's profitability. Since no profitability analysis, apart from that of the National Mushroom Development Project has been done in Ghana, this research will be a useful venture.

2.5 The System of Mushroom Farming Adopted by Farmers in Ghana

Mushroom farmers in Ghana, have adopted a system of farming, which is the bag method. This method is suitable for the oyster mushroom, (which is the main variety grown in Ghana), as well as the other varieties like the straw mushroom. With the introduction of the bag method, mushroom can be grown either in open space or in an enclosed area such as a storeroom. Some of the farmers invest in costly permanent structures whilst others cultivate under shade trees.

Farmers either buy or prepare their own compost bags, depending on whether or not they have the technical know-how in compost bag production. After acquiring the “spawned” or “seeded” fully grown mushroom compost bags, the bags are arranged on wooden shelves in the growing room or space and these basic steps are followed to produce good quality mushroom.



The neck of the bag is cut with a razor blade. The cut compost bags are placed either horizontally or vertically on the wooden shelves and then covered with a perforated material, for example, perforated plastic sheets. The bags are kept humid and cool by spraying them with a mist of water and sprinkling water on them, if the bags are few. In case a sprayer is not available the bags are laid on soaked jute sacks and the floor and the walls against which the shelves lean, are kept wet. Direct air current is avoided since it results in evaporation of moisture within a short time. Watering is done at least twice a day depending on the atmospheric humidity. During the harmattan (dry season) the rate of watering increases, depending on the severity of the harmattan.

After five to ten days, depending on the variety of the mushroom, the first flush is observed on the surface of the compost. The mushroom is fully mature when the edge of the cap unfolds and thins out. Harvesting is done by hand. The stalks are grasped at the base and pulled gently, after which the bases are cut off to ensure any compost attached is removed. All left over tiny mushrooms are removed since they will not develop further into bigger mushrooms. Depending on the variety of mushroom, harvesting can be done continuously for about 2 to 3 months at intervals of between 7 to 16 days. In the case of bags which yield more than 4 to 5 times within the period, the rotten surface of the compost is removed by scraping. After the first picking of mushroom, the bag could be closed and inverted and then slits made on the bottom for more mushroom to come out again in 5 to 7 days. Slits can also be made on the sides for more mushroom to grow. After the 2 to 3 month production period the compost bags become exhausted and are disposed of. Each compost bag can yield a total of 200 to 250 grams within the production period of 2 to 3 months.

The Food Research Institute trains a number of farmers in mushroom farming every year and some of these farmers also train others living around their farms. As a result, the number of participants in the Food Research Institute's training programme declines over time. Individuals interested in mushroom farming prefer to train at a lower cost and hence avoid travelling from far away (outside the Greater Accra region) to Accra to train at a fee.

Mushroom production in Ghana does not necessarily require a high amount of capital to start with, since mushroom can even be grown in cane baskets and in the kitchen (Sawyerr, 1992).

CHAPTER THREE

3.0

METHODOLOGY

To achieve the aims of the study, the appropriate analytical methods must be employed. This chapter discusses various methods of analysis used to analyse the data and the theory behind each of the methods. First, it shows how the outputs produced per year by individual respondents and the regional outputs are computed. Next, it shows a graphical presentation of the adoption of mushroom farming by respondents after training at the Food Research Institute. It then shows how the profitability indicators, including the net present value, the internal rate of return and the benefit – cost ratio are computed. Finally, a tabular presentation of the constraints to mushroom farming and its ranking in decreasing order of importance.



3.1 Analytical Framework

The first objective of the study is to describe the trends in the levels of production. The trend of production by individual farmers as well as that of the region is determined. Annual output figures of individual farmers from 1995 to 1999 were compiled. Knowing the total output of the respondent farmers for each year, the output produced by the region is estimated based on the number of active mushroom farmers in the region.

The quantity of output per year (for each farmer) is calculated as the sum of outputs recorded per batch.

$$Q_T = \sum_{i=1}^n q_i$$

Where Q_T = The quantity of output per year.

q = The quantity of output per batch

n = The number of batches in a year

The regional output level is estimated by first determining the total output of the various years produced by the randomly selected respondents, and with the knowledge of the number of active mushroom farmers in Greater Accra region, the regional output is calculated by multiplying the average output of respondents by the number of active farmers in the region.

The second objective is to determine the number of the trainees of the Food Research Institute who adopted mushroom farming and the number who dis-adopted. A list of respondents who have stopped cultivation due to some constraints was compiled. A comparison of the percentage of respondents who ever started cultivation after their training and the percentage who started but stopped after some time is made. Respondents were therefore asked to indicate when they had their training at the Food Research Institute, when they started mushroom cultivation and when they stopped, if they are no longer farming mushroom.

The third objective is to determine the profitability of mushroom cultivation. The following must be taken into account when determining the profitability of a mushroom growing project.

- i) Investment in substrate production facility.
- ii) Operating cost of substrate production.
- iii) Investments in growing rooms.
- iv) Operating costs of mushroom growing.
- v) Profitability of total operation.
- vi) Price.
- vii) Yields. (Oei, 1996).

The profitability of mushroom cultivation is determined by the use of the Benefit-Cost ratio, Net Present Value, and the Internal Rate of Return criteria.

The Benefit-Cost ratio indicates the returns to every cedi invested. It is calculated as the present worth of the benefit stream divided by the present worth of the cost stream (Gittinger, 1982).

$$\text{Benefit-Cost Ratio} = \frac{\sum_{t=1}^n \frac{B_t}{(1+i)^t}}{\sum_{t=1}^n \frac{C_t}{(1+i)^t}}$$

Where n = The project's life.

t = year (1, 2, ..., n).

B_t = Benefit in each year.

C_t = Cost in each year

i = interest (discount) rate

Every profitable project must have a Benefit-Cost ratio of 1 or greater when discounted at a suitable discount rate, most often the opportunity cost of capital.

The net present value is simply the present value of the incremental net benefit or incremental cash flow stream. It is the result of discounting costs and benefits in different periods and expressing them all in a common value at any one point of time (Squire and Van der Tak, 1995).

$$\text{Net Present Value} = \sum_{t=1}^n \frac{B_t}{(1+i)^t} - \sum_{t=1}^n \frac{C_t}{(1+i)^t}$$

For a mushroom project to be profitable the net present value should be a positive figure.

The internal rate of return is the maximum interest that a project could pay for the resources used if the project is to recover its investment and operating costs and still break even. It is the "rate of return on capital outstanding per period while it is invested in the project" (Merrett and Sykes, 1963). The internal rate of return is computed as the discount rate that makes the net present value of the incremental net benefit stream or incremental cash flow equal zero.

$$\sum_{t=1}^n \frac{B_t}{(1+i)^t} - \sum_{t=1}^n \frac{C_t}{(1+i)^t} = 0$$



The rule for interpolating the value of the internal rate of return lying between discount rates too high on the one side and too low on the other side is given as:

$$IRR = DR_L + (DR_H - DR_L) \left[\frac{PV_L}{PV_L + PV_H} \right]$$

Where, DR_L = Lower discount rate.

DR_H = Higher discount rate.

PV_L = Present value of incremental net benefit stream (cash flow) at the lower discount rate.

PV_H = Present value of incremental net benefit stream (cash flow) at the higher discount rate.

IRR = Internal Rate of Return.

NPV = Net Present Value.

B-C ratio = Benefit / Cost Ratio.

$(PV_L + PV_H)$ = Sum of the present values of the incremental benefit streams (cash flows) at the two discount rates, signs ignored.

The NPV, B-C ratio and the IRR are calculated for each farmer and conclusions are drawn on the sample averages.

The total cost incurred during the economic life of the project comprises investment cost and operating and maintenance cost. For each particular year the total cost incurred is the sum of the investment costs and operation and maintenance costs if only investment is made that year.

Benefits are the output from mushroom cultivation expressed in monetary terms. Through personal interviews about 78.0% of respondents indicated bank loans as their main source of funding. A discount rate of 38.0% is used in discounting. This rate is chosen because it was the average value of the annual lending rates published by the research department of Bank of Ghana over a period of five years (1995 to 1999).

<u>Lending rates</u>		
<u>Year</u>	<u>Range (%)</u>	<u>Average (%)</u>
1995	28.00-47.00	37.50
1996	30.00-47.00	38.50
1997	35.00-49.00	42.00
1998	30.00-42.00	36.00
1999	31.00-42.00	36.50



Source : Research Department of Bank of Ghana

Average of the averages : 38.1%.

In the determination of the profitability of mushroom cultivation, therefore, respondents are required to recall their costs and benefits over the period 1995 to 1999.

The fourth objective is to identify constraints to mushroom farming from the perspective of farmers. The National Mushroom Development Project in its feasibility report of 1995 indicate some problems and constraints that the project face which retard the progress of the project. This study aimed at identifying the problems the farmers are now facing. The

constraints were ranked according to the percentage of respondents who mentioned a particular constraint.

3.2 Data Collection

Thirty-five respondents were randomly selected from the Greater Accra region and structured questionnaires are administered to them. Primary data from the questionnaire are supplemented with personal observations. A sample of this questionnaire can be found in Appendix 2.

The data on the number of farmers trained in mushroom farming from 1995 to 1999 at the Food Research Institute was provided by the project manager of the institute.



CHAPTER FOUR

4.0 RESULTS AND DISCUSSIONS

4.1 Results of Analysis

Although, thirty-five farmers were sampled, twenty of them were chosen for the description of the trends in the levels of production, determination of profitability of the industry and constraints to mushroom production. As a result of the inconsistencies in the figures presented on the questionnaires of fifteen respondents, such questionnaires could not be used in the description of trends in the levels of production, determination of profitability of the industry and constraints to mushroom production. This then is a limitation of the study. All the thirty-five respondents could provide reliable information on the adoption and the dis-adoption of mushroom farming after training with the Food Research Institute.

4.1.1 Production Trends

To describe the trends in the levels of production over a five year period (1995 to 1999) the total outputs produced by the respondents in the various years under study are presented in Table 4.1.

Table 4.1: Annual Output of Mushroom by Respondents (1995-1999)

Year	Total Output (kg)	Average Output (kg)	Standard Deviation (kg)
1995	8,592	429.60	495.14
1996	19,566	978.30	1,651.02

Year	Total Output (kg)	Average Output (kg)	Standard Deviation (kg)
1997	26,356	1,317.80	2,361.77
1998	39,905	1,995.25	4,431.25
1999	23,508	1,175.40	659.19

Source : Survey data.

There was a general increase in production from 1995 to 1998 and there was a sudden sharp decline in the total output of 1999, even below the level of 1997.

Respondents attribute the increase in levels of production of individual farmers to guidance and encouragement from the Mushroom Growers and Exporters Association of Ghana. Promises from importers also motivated them to expand production. They however blamed the low output level of 1999 on climatic factors, specifically, high temperatures recorded during 1999.

The number of active mushroom farmers in the Greater Accra region was estimated to be twenty-five (25). The annual output of the Greater Accra region from 1995 to 1999 is presented in Table 4.2. This is based on the annual average production of the sampled farmers and the number of active farmers in the region.

Table 4.2 : Estimated Regional Output of Mushrooms (1995 – 1999)

Year	Sample Average (kg)	Regional Total (kg)
1995	8,592	10,740.00
1996	19,566	24,457.50

Year	Sample Averages (kg)	Regional Total (kg)
1997	26,356	32,945.00
1998	39,905	49,881.25
1999	23,508	29,385.00

Source: Survey Data.

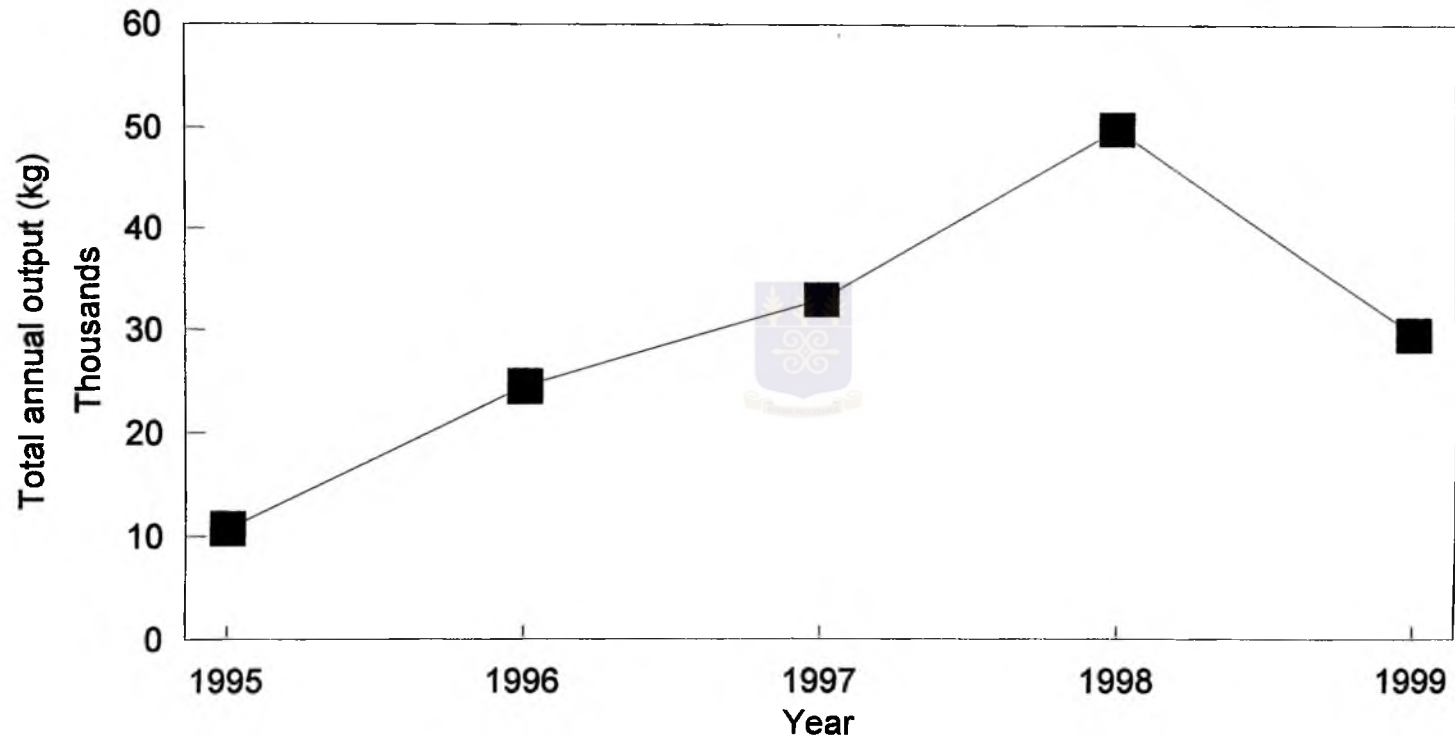
Figure 4.1 is a graphical presentation of the total output of mushroom production of the Greater Accra region (1995 – 1999).

4.1.2 Adoption of Mushroom Farming

From the results of the analysis of the Food Research Institute's training, it has been observed that virtually every trainee in mushroom farming adopted and a few stopped cultivation after a period of time due to one or more constraints. Table 4.3 is a summary of the analysis, showing the number of sampled trainees who trained in a particular year, the percentage which adopted and the percentage which dis-adopted.



Figure 4.1
Greater Accra regional output of Mushroom (1995-1999)



Source: Survey data

Table 4.3: Rates of Adoption and Dis-adoption of Mushroom Farming

Year Trained	Number of Trainees in the Sample	Year Trainees Started Cultivation	Number of Sampled Trainees	Percentage that Adopted Farming	Number of Trainees who Dis-adopted Later	Percentage of Trainees who Dis-adopted Later
1995	13	1995 1996	10 3	100.00	1	7.69
1996	8	1996 1997	5 2	87.50	1	14.28
1997	5	1997	5	100.00	0	0.00
1998	6	1998 1999	4 2	100.00	3	50.00
1999	3	1999	3	100.00	1	33.33

Source: Survey data.

With the exception of 1996 when 12.5% of the sampled farmers failed to start mushroom farming after training, all sampled farmers in the various years under study adopted

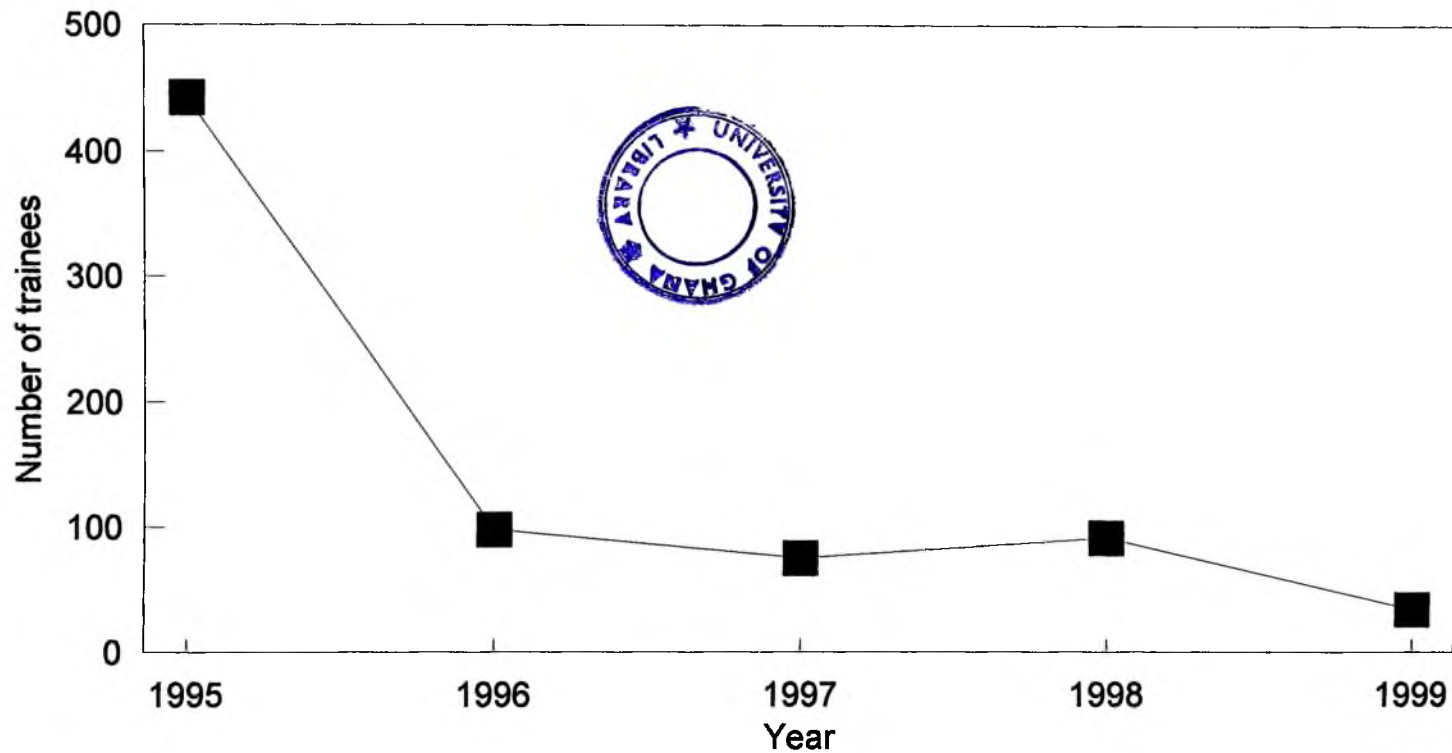
the training. This is an indication that the training by the Food Research Institute is useful. For a number of reasons, some of which are lack of market and of funding, some sampled farmers were compelled to stop mushroom farming after a period of cultivation. None of the sampled farmers who trained in 1997 stopped. The high percentage of trainees which stopped, in 1998 and 1999 could be due to the relatively low yields recorded in 1999 due to an unfavourable weather (high temperature). Some new entrants must have been discouraged by this misfortune.

Figures 4.2 and 4.3 show the trends in the number of trainees of the Food Research Institute and percentage of sampled farmers going into cultivation after training from 1995 to 1999 respectively. Although Figure 4.2 shows a downward trend in the number trainees, this is not an indication of a reduction in the number of people trained nationwide. This is because trained farmers train other farmers in their locality so that they do not need to travel to Accra to train. Initially the dependence on the Food Research Institute office in Accra for training was high but this has declined over time. This trend therefore is not an indication of loss of interest in mushroom farming by the trained farmers.

4.1.3 Investment Analysis

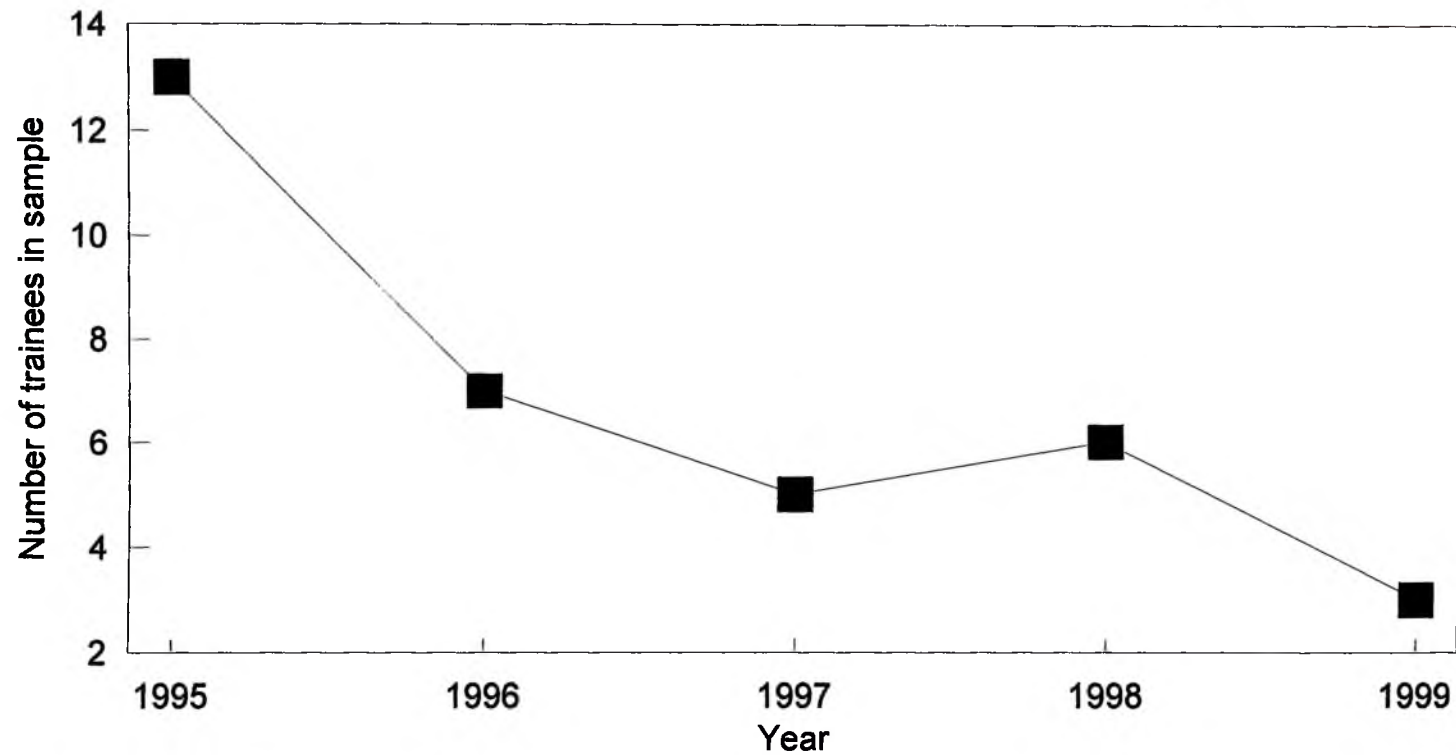
In the profitability analysis at individual level, the net present value (in ₵ million) ranged between 0.12 and 75.70 with an average of 6.29. One respondent recorded an extremely low value of -4.55 (₵ million) and another a value as high as 75.70 (₵ million). The values of benefit-cost ratio ranged between 0.68 and 2.51 with an average of 1.35. The respondent who recorded the negative net present value had a value of 0.68 as the benefit-cost ratio and the other respondent who recorded the 75.70 (in ₵ million) net present value recorded a 2.51

Figure 4.2
Trends in number of trainees produced by Food Research Institute



Source: The Food Research Institute

Figure 4.3
Trends in number of sampled trainees starting farming



Source: Survey data

benefit-cost ratio. The values of the internal rate of return ranged between 21.63% and 98.33% with an average of 48.24%. The -4.55 (in ₵ million) net present value recorded a 21.63% internal rate of return. The above is summarised in Table 4.4.

Table 4.4 Range and Average Values of B-C Ratio, NPV (₵ m) and IRR (%).

	Range	Average
B -C ratio	0.68 - 2.51	1.35
NPV(₵m)	0.12 - 75.70	6.29
IRR (%)	21.63 - 98.33	48.24



The average value of the benefit-cost ratio is higher than one (1) and ninety percent (90%) of respondents recorded benefit-cost ratios above one (1) indicating that investment in mushroom farming is profitable. The respondent whose benefit-cost ratio was less than one (1) operated at a loss and this was as a result of the extremely high investment that was made on housing structure (cropping house). As at the end of 1999 the structure was being underutilised at less than a third of the total capacity. The annual total cost therefore outweighs the revenue. The respondent who recorded a benefit-cost ratio of 2.51 operates on a comparatively very large scale, with full capacity utilisation.

The average value of the net present value is positive and ninety percent (90%) of respondents recorded positive values. This is an indication that the venture is profitable. The discount rate or the cost of capital is 38% and the average value of the internal rate of return is higher than this discount rate and seventy percent (70%) of respondents had recorded values of internal rate of return higher than 38%. This then confirms the fact that mushroom cultivation is profitable.

4.2 Constraints in Mushroom Production

In all, eleven (11) constraints were mentioned by farmers as factors which militate against mushroom production. Table 4.5 shows the constraints and their relative importance.

Table 4.5 A Ranking of Constraints in Mushroom Farming

Constraint	The number of respondents who mentioned a constraint	The percentage of respondents who mentioned a constraints	Ranking
Marketing	16	80	1
Lack of funding	10	50	2
Irregular supply of water	6	30	3
Unfavourable climatic factors	6	30	3
Irregular supply of compost bags	5	25	5
Pest infestation	5	25	5
Lack of storage facility (Perishability)	3	15	7
High cost of compost bags	3	15	7
Difficulty in land acquisition	2	10	9
Negative perception of cultivated mushrooms	2	10	9
Disposal of used polythene bags	1	5	11

Source: Survey data.

Lack of markets, lack of funding and climatic factors or irregular water supply were the three most important constraints in that order. According to the respondent farmers, the problem of marketing has been in existence since the inception of mushroom cultivation in Ghana, although some respondents believe the Mushroom Growers and Exporters Association of Ghana has improved the situation through the establishment of domestic network of major buyers such as supermarkets and restaurants. The problem of marketing is attributed to two main factors, the first one being lack of awareness among consumers on the cultivation of mushroom. The local market is more used to the seasonal wild varieties and most consumers are not aware of the cultivated varieties. Secondly, individual farmers are unable to meet the orders placed by the export market, single handedly. The demand for mushrooms on the local market is lower than the supply and hence losses are incurred through rotting of unsold produce.

Exhibition of produce at Trade Fairs can be of help. The orders placed by exporters are so high that it requires that the produce of individual farmers are collected to be able to meet the demand for export. Even locally, the collection and distribution to the marketing outlets will enhance marketing. This practice has been encouraged by the Mushroom Growers and Exporters Association of Ghana which has a collection point (Richcoll shop) behind the University of Ghana hospital. It has been reported since 1997 that demand for non-traditional agricultural exports (e.g., fruits and vegetables) including mushrooms is effectively unlimited since Ghana has such a small share of the world market of such products (MOFA, 1997). This gives an indication that the scope for expansion of exports is quite considerable.

Mushroom farming, like any other project, requires capital to cater for investment, operating and maintenance expenses. Most of the farmers do not qualify to contract loans

from the financial institutions in Ghana because of the collaterals the financial institutions demand. If individually, farmers do not qualify to acquire loans, they can come together, through the Mushroom Growers and Exporters Association of Ghana to contract loans in the name of the Association, which will then be held responsible in case of default of repayment.

Respondent farmers whose cropping houses are located at places such as Teshie, Nungua and Madina really face water problems and hence their operating costs are normally high due to the high cost of water during periods of water shortage. Mushroom cultivation is favoured by low temperature but Ghana, like most tropical countries experience several months of high temperature a year. Mushrooms therefore require intensive care in the periods of high temperature.

The annual output of mushroom production by respondents as well as that of the region from 1995 to 1999 was increasing and virtually all trainees of the Food Research Institute adopted mushroom farming which has proved to be profitable through the profitability analysis. If constraints are reduced to the minimum or eradicated, the industry will benefit the economy of Ghana.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

Estimates of benefit-cost ratios, net present values and internal rates of return suggest that mushroom cultivation is generally profitable. With an increasing trend in production and majority of Food Research Institute's trainees going into cultivation after training, it is evident that if the constraints that militate against mushroom cultivation in Ghana are properly addressed, the goal of the National Mushroom Development Project to make Ghana a major exporter of mushroom will be achieved.

It is recommended that the Mushroom Growers and Exporters Association of Ghana improves co-ordination for assembly of produce and also take it upon itself to develop the local and the international markets to solve the problem of marketing to ensure that farmers earn enough profit for consumption and re-investment. Ghana has not been able to achieve increased market access for non-traditional as well as traditional produce in regional and international markets. Marketing of mushrooms in the regional and international markets can be enhanced by visiting the import countries to understand the needs of the market and even help to create the demand for the produce. The Market Promotion Programme formulated by the Ministry of Food and Agriculture under Ghana's Accelerated Agricultural Growth and Development Programme if implemented effectively, will achieve its aim of assisting the private sector and Non-Governmental Organizations to develop, maintain and expand markets for Ghanaian agricultural produce in the regional and international markets through approved market access promotion activities. Marketing of non-traditional crops will then be improved.

Acquisition and dissemination of market information to producers of mushrooms in Ghana are very essential. Government can contribute to this cause by funding marketing research and marketing information services.

The problem of funding could be solved by farmers coming together under a credit scheme like the Block Farm Scheme, initiated by the Agricultural Development Bank (in 1986), to secure loans to fund their operations. Government can improve farmers' access to credit from financial institutions servicing the agricultural sector by mobilizing domestic and external sources of on-line credit to increase the institutions' loanable funds. The minimum reserve ratio required of such financial institutions when lowered can also encourage the institutions to lend to farmers. Tax relief to these financial institutions could also encourage the institutions to lend more to farmers.

In the siting of farms, it is advisable that farmers take into consideration the availability of water, especially, pipe-borne water. Although water is an abundant resource in Ghana, seasonal shortages do occur quite often. The government of Ghana could help resolve this problem by supporting the district assemblies to assist in the provision of water harvesting and storage facilities in water deficient areas of the country. As part of investment, individual farmers could also invest in low cost water impounding and storage facilities such as ponds and "polytanks" to ensure the availability of quality water for farming all year round.

Finally, it is recommended that further research on mushroom farming be conducted outside the Greater Accra region.

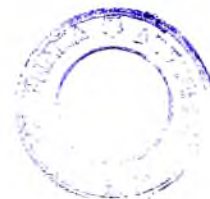
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APPENDIX 1

QUESTIONNAIRE ON FOOD RESEARCH INSTITUTE'S TRAINING PROGRAMME

- 1) When were you trained by the FRI?

.....

Year

- 2) Did you go into mushroom cultivation after your training?

Yes () No ()

- 3) If yes, when did you start cultivating mushrooms?

.....

Year

- 4) If no, give reason(s).....

- 5) Are you still cultivating mushrooms?

Yes () No ()

- 6) If no, when did you stop?.....

- 7) If no, why did you stop?.....

APPENDIX 2

MAIN QUESTIONNAIRE (Cost Items, Constraints and Production Levels)

Year: 1999

Questionnaire Number.....

Name of respondent:

Location of farm (distance away from Accra):

(1) (a) Do you have other occupation(s)?

Yes () No ()

(b) If "Yes" list and rank them (1st, 2nd, 3rd, 4th etc.)

Occupation	Ranking
(i)	
(ii)	
(iii)	
(iv)	
(v)	

(2) (a) What was the size of your farm when you started mushroom cultivation (in

kg/batch) ?

(b) Indicate the number of batches per year.....

(3) (a) What equipment do you use?

(b)

Equipment	Number of equipment	Year of Purchase	Cost per unit	Total Cost

(c) (i) what equipment(s) do you hire?.....

(ii) What is the cost per year?.....

(d) (i) How many housing structures do you use?

(ii) When did you purchase it / them ?.....

(iii) What was the price per unit at purchase?.....

(iv) For how long do you use it / them before replacing it / them?.....

(e) (i) How many workers have you employed permanently?.....

(ii) When did you employ this labour?.....

(iii) What was the cost of labour (salary) at the time of employment ?.....

(f) List other fixed assets and provide information (i)-(iv) as listed under 3 (d).

(4) (a) Do you use any climate control unit?

Yes () No ()

(b) If "Yes" write the name of the climate control unit and annual cost of operation.

Name	Annual cost of operation

(5) Complete the table below

Item	Quantity used/batch	Price/unit of item	Annual Cost
i. Electricity			
ii. Water			
iii. Casual labour			
iv. Compost bags			
v. Pest control			
vi. Packaging			
vii. Interest on capital			
viii. Transportation of produce to market			
ix. List other items			

(6) What is the size of your farm this year? (1999).

(a) Indicate the number of batches this year.....

(b) Average output/batch (in kg).....

(7) What is the price per kilogram of mushroom?.....

(8) (a) Where do you sell your produce?

Local market ()

International market ()

Both ()

(b) Indicate the proportion sold in each market.

(i) Local market.....

(ii) International market.....

(c) If local market only, list the markets/supermarkets etc.

(i)

(ii)

(iii)

(iv)

(9) List the problems you encounter in mushroom production

(i) (v).....

(ii) (vi).....

(iii) (vii).....

(iv) (viii).....

Complete the table below

YEAR	INVESTMENT COST/YR.	OPERATING COST/YR.	REVENUE/YR.
1995			
1996			
1997			

YEAR	INVESTMENT COST/YR.	OPERATING COST/YR.	REVENUE/YR.
1998			
1999			



APPENDIX 3**RETURNS OF SAMPLED RESPONDENTS**

Farmer number	Year	Yield (kilograms)	Price/kilogram (¢)	Revenue (¢000)
01	1995	625.0	3,500.00	2,200.00
	1996	850.0	4,000.00	3,400.00
	1997	1,115.0	4,500.00	5,000.00
	1998	445.0	4,500.00	2,000.00
	1999	2,000.0	5,000.00	10,000.00
02	1995	400.0	3,000.00	1,200.00
	1996	933.0	3,000.00	2,940.00
	1997	900.0	3,600.00	3,240.00
	1998	1,020.0	4,000.00	4,131.00
	1999	800.0	6,500.00	5,000.00
03	1995	130.0	3,500.00	455.00
	1996	510.0	4,000.00	2,040.00
	1997	800.0	4,000.00	3,136.00
	1998	1,500.0	4,500.00	6,547.50
	1999	1,800.0	5,000.00	9,000.00
04	1995	200.0	3,500.00	700.00
	1996	300.0	4,000.00	1,200.00
	1997	400.0	4,500.00	1,800.00
	1998	700.0	4,500.00	3,150.00
	1999	1,200.0	5,000.00	6,001.00
05	1995	500.0	3,500.00	1,750.00
	1996	750.0	3,600.00	2,690.00
	1997	915.0	4,000.00	3,660.00
	1998	960.0	4,500.00	4,320.00
	1999	1,500.0	5,000.00	7,500.00
06	1995	350.0	3,500.00	1,225.00
	1996	400.0	4,000.00	1,600.00
	1997	525.0	4,000.00	2,100.00
	1998	670.0	4,500.00	3,015.00
	1999	1,800.0	5,000.00	9,000.00
07	1995	230.0	3,500.00	805.00
	1996	285.0	5,000.00	1,430.00
	1997	350.0	5,000.00	1,750.00
	1998	400.0	5,000.00	2,000.00
	1999	420.0	6,000.00	2,520.00

Farmer number	Year	Yield(kilograms)	Price/kilogram (¢)	Revenue(¢'000)
08	1995	2,400.0	3,500.00	8,400.00
	1996	3,750.0	3,500.00	13,125.00
	1997	3,260.0	4,000.00	13,040.00
	1998	3,770.0	4,500.00	16,965.00
	1999	750.0	5,000.00	3,750.00
09	1995	450.0	3,500.00	1,575.00
	1996	600.0	4,000.00	2,400.00
	1997	600.0	4,000.00	2,400.00
	1998	915.0	4,000.00	3,660.00
	1999	950.0	5,000.00	4,750.00
10	1995	180.0	3,500.00	630.00
	1996	216.0	5,000.00	1,080.00
	1997	214.0	4,000.00	856.00
	1998	300.0	4,500.00	1,350.00
	1999	320.0	5,000.00	1,600.00
11	1995	550.0	3,500.00	1,925.00
	1996	750.0	4,000.00	3,000.00
	1997	1,200.0	4,000.00	4,800.00
	1998	1,950.0	4,000.00	7,800.00
	1999	2,001.0	5,000.00	10,005.00
12	1995	285.0	3,500.00	997.50
	1996	250.0	4,000.00	1,000.00
	1997	1,525.0	4,000.00	6,100.00
	1998	1,777.0	4,500.00	7,996.50
	1999	1,500.0	5,000.00	7,500.00

Farmer number	Year	Yield (kilograms)	Price/ kilogram (₵)	Revenue (₵'000)
13	1995	120.0	3,500.00	420.00
	1996	150.0	4,000.00	600.00
	1997	160.0	3,000.00	480.00
	1998	973.0	4,500.00	4,378.50
	1999	600.0	5,000.00	3,000.00
14	1995	350.0	3,500.0	1,225.00
	1996	400.0	4,000.00	7,000.00
	1997	620.0	4,000.00	2,480.00
	1998	850.0	4,500.00	3,825.00
	1999	1,500.0	5,500.00	8,250.00
15	1995	600.0	3,500.00	2,100.00
	1996	750.0	4,000.00	3,000.00
	1997	900.0	4,500.00	4,050.00
	1998	1,000.0	4,500.00	4,500.00
	1999	1,755.0	5,000.00	8,775.00
16	1995	130.0	3,500.00	455.00
	1996	190.0	4,000.00	760.00
	1997	375.0	4,000.00	1,500.00
	1998	450.0	5,000.00	2,250.00
	1999	600.0	5,000.00	3,000.00



Farmer number	Year	Yield (kilograms)	Price / kilogram (¢)	Revenue (¢'000)
17	1995	112.0	3,000.00	336.00
	1996	7,182.0	3,000.00	21,546.00
	1997	10,928.0	4,000.00	43,712.00
	1998	20,520.0	4,000.00	82,080.00
	1999	2,400.0	4,000.00	9,600.00
18	1995	450.0	3,500.00	1,575.00
	1996	600.0	4,000.00	2,400.00
	1997	680.0	3,500.00	2,390.00
	1998	680.0	4,000.00	2,730.00
	1999	750.0	5,000.00	3,750.00
19	1995	80.0	3,500.00	280.00
	1996	100.0	3,000.00	300.00
	1997	139.0	6,000.00	834.00
	1998	225.0	4,500.00	1,015.00
	1999	22.0	5,000.00	110.00
20	1995	450.0	3,500.00	1,575.00
	1996	600.0	4,000.00	2,400.00
	1997	750.0	4,500.00	3,375.00
	1998	800.0	4,500.00	3,600.00
	1999	840.0	6,000.00	5,040.00
Sample mean		1,179.2	4,227.00	5,105.06
Sample standard deviation		2,398.4	720.00	126,554,180.00



APPENDIX 4
PRODUCTION COSTS OF SAMPLE

Farmer number	Year	Investment cost (¢'000)	Operating cost (¢'000)
01	1995	1,500.0	1,000.00
	1996	1,500.0	1,200.00
	1997	2,000.0	1,800.00
	1998	2,000.0	1,800.00
	1999	6,000.0	2,000.00
02	1995	837.0	1,840.13
	1996	-	2,044.59
	1997	-	2,555.74
	1998	-	3,651.06
	1999	150.0	3,923.30
03	1995	-	291.20
	1996	-	1,305.60
	1997	-	1,913.67
	1998	4,300.0	4,076.3
	1999	-	6,114.20
04	1995	-	511.00
	1996	-	876.00
	1997	600.0	1,314.00
	1998	750.0	1,132.00
	1999	-	4,416.00



Farmer number	Year	Investment cost (¢'000)	Operating cost (¢'000)
05	1995	-	892.50
	1996	817.5	763.60
	1997	-	1,018.24
	1998	-	2,145.52
	1999	-	5,272.80
06	1995	-	808.50
	1996	-	1,056.00
	1997	1,615.0	1,656.00
	1998	150.0	2,760.00
	1999	400.0	4,977.00
07	1995	400.0	710.00
	1996	-	1,100.00
	1997	-	1,330.00
	1998	-	1,566.55
	1999	-	1,843.00
08	1995	-	5,544.00
	1996	1,0851.0	7,934.00
	1997	-	9,400.00
	1998	-	11,493.00
	1999	-	2,546.00

Farmer number	Year	Investment cost (₵'000)	Operating cost (₵'000)
09	1995	2,112.3	721.00
	1996	-	1,500.00
	1997	-	11,926.67
	1998	-	3,080.70
	1999	-	3,423.01
10	1995	-	403.20
	1996	720.0	749.10
	1997	-	606.00
	1998	-	889.34
	1999	-	9,475.00
11	1995	2600.0	951.00
	1996	-	2,692.78
	1997	-	3,002.00
	1998	-	4,992.60
	1999	-	5,933.20
12	1995	3,000.0	2,500.00
	1996	3,000.0	2,500.00
	1997	-	2,700.00
	1998	-	3,900.00
	1999	-	4,500.00

Farmer number	Year	Investment cost (¢'000)	Operating cost (¢'000)
13	1995	-	1,974.00
	1996	-	282.00
	1997	-	717.83
	1998	38.0	2,250.75
	1999	1,730.0	773.92
14	1995	-	759.50
	1996	180.0	2,267.50
	1997	1,769.3	1,807.50
	1998	-	2,512.12
	1999	2,862.9	4,567.50
15	1995	-	1,260.00
	1996	-	1,800.00
	1997	-	2,430.00
	1998	-	2,700.00
	1999	1702.2	4,010.59
16	1995	-	3,139.00
	1996	157.0	6,66.87
	1997	-	1,137.34
	1998	-	1,377.60
	1999	-	1,864.00

Farmmer number	Year	Investment cost (¢'000)	Operating cost (¢'000)
17	1995	4,980.5	2,750.00
	1996	-	15,132.00
	1997	-	17,013.47
	1998	-	9,341.01
	1999	-	7,930.00
18	1995	1,300.0	894.00
	1996	300.0	1,700.00
	1997	-	1,474.20
	1998	-	1,626.90
	1999	-	1,941.00
19	1995	-	182.00
	1996	435.3	38.56
	1997	-	668.00
	1998	-	696.00
	1999	-	80.25
20	1995	-	1,260.00
	1996	-	1,920.00
	1997	-	2,700.00
	1998	-	2,880.00
	1999	1800.00	3,000.00

Farmer number	Year	Investment cost (¢'000)	Operating cost (¢'000)
Sample mean		3,127.9	2,679.34
Sample standard deviation		3,445.9	2,927.64

APPENDIX 5

ESTIMATION OF PROFITABILITY INDICATORS

Worksheet 1 (Respondent No. 9)

<u>Investment Cost</u>	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>	<u>Year 4</u>	<u>Year 5</u>
	(¢'000)	(¢'000)	(¢'000)	(¢'000)	(¢'000)
Cropping house	2,000.000				
Buckets	4.800				
Scale	40.000				
Bowls	7.000				
Knives	3.507				
Water hose	<u>57.000</u>				
Sub-Total	2,112.307				
<u>Annual Operating Cost</u>					
Water	52.00	160.00	178.00	310.00	318.00
Casual labour	90.00	118.00	335.00	702.00	852.00
Compost bags	400.00	1,040.00	1,216.67	1,858.00	2,043.00
Packaging	6.00	12.00	20.00	30.00	30.00
Mats	11.00	8.00	15.00	32.00	30.00
Interest payments	162.00	162.00	162.00	150.00	150.00
Sub-total	721.00	1,500.00	1,926.67	3,080.70	3,423.01
Total Cost	2,833.307	1,500.000	1,926.670	3,080.700	3,423.010



Revenues 1,575.000 2,400.000 2,400.000 3,600.000 4,750.000

Given that :

IC = Investment Cost

DR = Discount Rate

OC = Annual Operating Cost

CF = Cash Flow

TC = Total Cost

PV = Present Value

B = Benefits (Revenue)

Year	IC (₵'000)	OC (₵'000)	TC (₵'000)	B (₵'000)	DR (38%)	PV _{TC} (₵'000)	PV _B (₵'000)	CF (₵'000)
1	2,112.3	721.00	2,833.30	1,575.00	0.725	2,054.14	1,141.88	(1,258.30)
2		1,500.00	1,500.00	2,400.00	0.525	787.50	1,260.00	900.00
3		1,926.67	1,926.67	2,400.00	0.381	734.06	914.40	473.33
4		3,080.70	3,080.70	3,600.00	0.276	850.27	1,010.16	579.30
5		3,423.01	3,423.01	4,750.00	0.199	681.17	945.25	1,326.99
Total						5,107.14	5,271.69	

$$NPV = PV_B - PV_{TC} = (5,271.69 - 5,107.14) \times \text{₵}1,000.00 = \text{₵}164,540.0$$

$$B / C = PV_B / PV_{TC} = 5,271.69 \div 5,107.14 = 1.03$$

$$PV \text{ of CF at } 49\% = 1.115$$

PV of CF at 50% = - 9.716

$$IRR = 49 + (50 - 49) \left[\frac{1.115}{1.115 + 9.716} \right] = 49.1\%$$

Worksheet 2 (Respondent No. 11)

<u>Investment Cost</u>	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>	<u>Year 4</u>	<u>Year 5</u>
	(¢'000)	(¢'000)	(¢'000)	(¢'000)	(¢'000)
Cropping house	2,455				
Wheelbarrow	60				
Buckets	15				
Scale	45				
Bowls	18				
Knives	<u>7</u>				
Sub-Total	2,600				

Annual Operating Cost

Water	68.00	209.00	236.00	350.00	359.00
Casual labour	48.00	720.00	700.00	835.00	900.00
Compost bags	820.00	1,712.78	1,776.70	3,499.00	4,355.20
Packaging	12.00	32.00	37.50	43.00	47.50
Mats	3.00	19.00	20.00	25.00	31.50
Interest payment	-	-	240.00	240.00	240.00



Sub – Total	951.00	2,692.78	3,002.00	4,992.60	5,933.20
Total Cost	3,551.00	2,692.78	3,002.00	4,992.60	5,933.20
Revenues	1,925.00	3,000.00	4,800.00	7,800.00	10,005.00

Year	IC (₵'000)	OC (₵'000)	TC (₵'000)	B (₵'000)	DR (38%)	PV _{TC} (₵'000)	PV _B (₵'000)	CF (₵'000)
1	2,600	951.00	3,551.00	1,925.00	0.725	2,574.47	1,395.63	(1,626.00)
2		2,692.78	2,692.78	3,000.00	0.525	1,413.71	1,575.00	307.22
3		3,002.00	3,002.00	4,800.00	0.381	1,143.76	1,828.80	1,798.00
4		4,992.60	4,992.60	7,800.00	0.276	1,377.95	2,152.80	2,807.40
5		5,933.20	5,933.20	10,005.00	0.199	1,180.70	2,152.80	4,071.80
Total						7,690.59	8,943.22	

$$NPV = PV_B - PV_{TC} = (8,943.22 - 7,690.59) \times \text{₵ } 1,000.00 = \text{₵ } 1,252.630.00$$

$$B / C = PV_B / PV_{TC} = 8,943.22 \div 7,690.59 = \underline{1.16}$$

PV at 78% DR = 0.38

PV at 79% DR = - 4.01

$$IRR = 78 + (79 - 78) \left[\frac{10.38}{10.38 + 4.01} \right] = \underline{78.72\%}$$