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FACTORS AFFECTING SMALL SCALE MUSHROOM FARMING IN WESTERN KENYA:

A CASE STUDY OF MUMIAS DIVISION IN BUTERE-MUMIAS DISTRICT, KENYA

BY

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DECLARATION

This research project is my original work and has not been presented for a degree in any other University.

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DEDICATION

This work is dedicated to God and my family : Hellen M. Onchonga, sons Eric Bosire, Asher Pingo and Joash Asanya, only daughter Miriam Kwamboka.

ACKNOWLEDGEMENTS

This research report is the result of teamwork and it is my duty to thank the members of the team who have worked with me on this project during the last two years.

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ABSTRACT

The purpose of the research was to investigate on the various factors affecting small-scale mushroom farming in Kenya focusing in Mumias Division with a view of establishing mushroom industry. The government is committed to alleviate poverty and create more jobs but the economic growth has been slow especially the contribution from conventional agriculture. Other countries that have taken mushroom farming seriously like China, the enterprise has created a lot of wealth to the people and it's now a formal business. Globally there are about 1.5 million species with only 30 species domesticated as edible and medicinal mushrooms. In Kenya, only oyster type is being grown whose production and spreading has been stagnating. It's against this background the study looked at such factors as characteristics, prevailing marketing strategies, management of the growing conditions, cost-benefit analysis of mushroom and sugarcane and other challenges affecting growers.

The descriptive research design was used, 30 samples were selected using cluster/area sampling design. Data was collected through a questionnaire and observations, analyzed using descriptive statistics with help of SPSS and presented on tables. The research revealed that more women are involved in mushroom farming than men with experience of less than one year. The spawn and mushroom products are expensive for a common person to afford. The determination of humidity and temperature in growing house is a problem due to lack of right instruments. The cost- benefit analysis showed that the returns of sugarcane are higher compared to mushroom, however there is no competition between them on surface area. There is poor record keeping and 19 challenges have been identified which affect the producers.

It was concluded that there were knowledge gaps on appropriate management practices, quality of spawn, marketing strategies, record keeping and methods of preservation. Therefore the following recommendations have been proposed so as to vibrant mushroom farming: Varieties diversification. trainings of farmers on mushroom production skills ,good management practices, proper record keeping ,use of bagasse and sugarcane trash and availability of credit facilities .

DEFINITION OF TERMS

Casing: Method of forcing mushroom mycelia to change from vegetative to a productive state or fruiting stage.

Farming: The practice of cultivating the land or raising stock/products

Factors: The act that brings about the desired result.

Growth: Increase in cultivation (surface area) and production (Yield)

Mushroom: A common name for the fruiting body of fungi- some of which are edible, others are highly poisonous

Mycelium: Tiny threads that grow throughout the substrate and collect nutrients by breaking down the organic materials.

Poverty: Is the inability of people to meet their basic needs which comprise of food, shelter and clothing.

Poverty line: Living below one dollar per day.

Spawn: Mushroom seed.

Substrate: The material used in mushroom growing (medium for growth)

Spores: Reproducing bodies containing one or more cells.

Specialty: Any other cultivated mushrooms apart from white Button Mushroom.

Sampling Frame: Actual list of sampling units or list of elements from which the sample is actually drawn.

Small Scale Business: Is defined as those businesses with revenue less than Kshs10000.

Volva : Is a sack-like structure that covers the base of the stipe

ABBREVIATIONS AND ACRONYMS

ERS: Economic Recovery Strategy

FORMAT: Forum for organic resources Management and Agricultural Technologies.

Ha: Hectares

HOA: Head Of Agriculture

GNP: Gross National Product

MDGS Millennium Development Goals

MSC: Mumias Sugar Company

KMGA: Kenya Mushroom Growers Association

KESREF: Kenya Sugar Research Foundation.

PSDA Promotion of Private Sector in Agriculture

NARC: National Rainbow Coalition

PRSP: Poverty Reduction Strategy Paper

SMS: Spent Mushroom Substrate

SPSS: Statistics package for Social Sciences.

SMES: Small and Medium Enterprises

US: United States

USDA: United States Department of Agriculture

WMS: Welfare Monitoring Survey

VIMPRO: Vihiga Mushroom Project

ZERI: Zero Emission Research Institute

MOA: Ministry of Agriculture

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INTRODUCTION

1.0 CHAPTER OVERVIEW

This section has focused on the background to the study, problem statement, objectives of the study, research questions, significance of the study, limitations, Scope of the study and assumptions.

1.1 Background of the Study

Mushrooms are an important commodity worldwide. However, thorough understanding of consumption trends isunavailable (Martinez, 2003) http://www.haworthpress.com.Mushroom cultivation is also a worldwide practice. Mushrooms are fungi, which are stationary organisms that were classified as vegetables for many years. During the second half of the 20th century they were grouped into a separate kingdom known as Fungi Kingdom, since they are neither true vegetables nor animals, (George and Pamplona ,2004). They are heterotropic, that is, incapable of synthesizing their own organic material and are believed to evolve from algae.

Hippocrates first mentioned mushrooms when he wrote about their medicinal value in 400B.C (Bayer, 2003). The first mention of mushroom cultivation, distinct from chance appeared in the field in 1652 B.C. The species of fungi globally are estimated at 1.5 Million, about 10,000 produce the fruiting bodies we call mushrooms, roughly 300 mushrooms species are edible, and about only 30 have been domesticated (Chang and Miles, 1986)

Mushroom farming is non-agricultural farming that does not require vast land like conventional farming. Indoor cultivation utilizing the vertical space is one advantage in view

of increasing pressure on agricultural land due to expanding civilization and population growth. The pressure on land has made the production per unit area to decline.

The world production of edible and medicinal mushrooms is quite encouraging. Total mushroom production worldwide has increased to more than 18-fold in the last 32 years, from about 350,000 metric tons in 1965 to about 6,160800 metric tons in 1997 (Table 1.1). The bulk of this increase has occurred during the last 15 years (Chang, 1999). During the 1979 production year, the Button mushroom, *Agaricus bisporus*, accounted for over 70 % of world's supply. The People's Republic of China has been the major producer of edible mushrooms, producing about 3,918,300 tons each year or 64% of world's total. China also produces more than 85% of all Oyster (*Pleurotus spp*) grown worldwide (Table 1.2). There could be constraints affecting top world producers but they seem not to have adverse impact on mushroom farming.

Table 1. 1: World Production of cultivated edible Mushrooms in 1986 and 1997 Fresh Weight (x 1000t)

Species	1986		1997		Increase (%)
	Tons	%	Tons	%	
Agaricus bisporus	1227	56.2	1956	31.8	59.4
Lentinula edodes	314	14.4	1564	25.4	398.1
Pleurotus spp	169	7.7	876	14.2	418.3
Auricularia spp	119	5.5	485	7.9	307.6
Volvariella volvacea	178	8.2	181	3.0	1.7
Flammulina velutipes	100	4.6	285	4.6	185.0
Tremella fuciformis	40	1.8	130	2.1	225.0
Hypsizygus marmoreus	-	-	74	1.2	-
Pholiota nameko	25	1.1	56	0.9	124.0
Grifola frondosa	-	-	33	0.5	-
Others	10	0.5	518	8.4	5080.0
Total	**2182**	**100.00**	**6158**	**100.00**	**182.2**

Source: Chang (1999)

Table 1.2: Estimated Production (Fresh wt) of Oyster Mushrooms in 1997.

Country	Population (1000m)	Production (1000lbs)	%
China	760.0	1,675496	86.8
Japan	13.3	29321	1.5
Rest of Asia	88.4	194887	10.1
North America	1.5	3307	0.2
Latin America	0.2	441	-
EU	6.2	13,668	0.7
Rest of Europe	5.8	12787	0.7
Africa	0.2	441	-
Total	**875.6**	**1930,348**	**100.0**

Source: Chang (1999)

United States has shown upward trend of Oyster Mushroom production in five years .The increase in United States production is due to increased consumer demand and the relative high compensation growers receive for the product (Table 1. 3).

Table 1. 3: Estimated annual production (Fresh weight) and production per week per grower of Oyster mushrooms in the United States, 1988-2002.

Year	No. Growers	Annual (x1000 lbs)	Per wk/Grower
1988	47	2210	904
1999	63	3729	1138
2000	68	3573	1010
2001	54	3817	1359
2002	51	4265	1608

Source: United States Department of Agriculture (USDA, 2002)

In Africa the trend of growth of mushroom farming activities are quite low (Table 1. 2). Looking at world population of cultivated edible and medicinal mushrooms there are only two species of mushroom grown in Africa namely *Agaricus bisporus* and *Pleurotus spp* (Appendix II) whose population is 36000 and 200 respectively representing 0.6% of the world Population. Peter (2000) vice Chancellor of University of Namibia says, "Mushroom production in Africa is seldom mentioned on publications and when literature surveys on Africa's agricultural crops is undertaken, mushrooms feature nowhere. All along, mushrooms have been ignored, neglected and marginalized". Gunter Pauli (2003) Director of ZERI Foundation indicates that there is an opportunity for further mushroom cultivation in Africa on both subsistence and commercial scales. This is a clear indication that there are factors affecting mushroom production in Africa, which have been investigated in this research with

a view of establishing mushroom industry like any other crops such as Tea, Coffee and Sugar in the continent of Africa.

In Kenya mushroom farming has been taking a slow trend in growth but there is high potential of developing mushroom industry .In Vihiga District, the chairman of Vimpro, Silingi says,' farmers are set to reap great financial benefits within the next three years through a grand farming project initiated by the Vihiga Mushroom Project"(Standard, December 22, 2004).

The project, which was started by farmers in Vihiga District in October 2002, had initially failed to take off for lack of mushroom seeds (Spawn), poor funding and lack of inputs. Though originally confined to Vihiga District, the project has extended to other parts of Western Province, Nandi District South (in Rift Valley) Kisumu and Nyamira in Nyanza Province. The project has started to grow whereby some farmers from these other areas outside Vihiga have attended mushroom production courses sponsored by the German Technical Co-Operation (GTZ). Silingi indicates that, "Once we become fully established, we will share the technical know-how at a fee with other farmers in the country so as to make mushroom-growing a major agricultural economic activity".

The Vimpro project has expanded and formed KMGA Organization with 16,800 memberships countrywide ((DN, Jan 22, 2006). The mushroom farming has spread to Koibatek, Siaya, Busia and Kisii areas recently. Although there is an indication of expansion the rate still leaves one wondering on how long it will take to cover all the 71 districts in the

country. The concept of mushroom farming is developing at a slow rate which should not be the case since weather is not a limitation.

An attempt to grow Oyster mushroom has been made by FORMAT and Mount Pleasant Consultants based in Kisumu. The East African Standard, in March 2005, carried a report on a demonstration of Oyster mushroom production and processing conducted in Busia and attended by 250 participants. Kariaga, who participated in this project, indicated that she managed to produce 120kg of Oyster from small room making a profit of kshs37, 630 in only three months. This is encouraging and should motivate farmers to engage themselves more to mushroom production. Getting this amount of money in the period stated is an open opportunity for creating wealth in a shorter period than most of the enterprises can offer.

Mumias Division in Butere-Mumias District, Mushroom farming was initiated in 2004 by training fifty (50) farmers through the Ministry of Agriculture according to Theresa Siangani, Agricultural Extension Officer. There were eight (8) villages in the division involved in growing mushroom on small scale and many more have shown an interest on the enterprise but their production is quite insignificant and hardly can be seen even in Mumias market. Therefore there are problems being experienced by farmers which require attention in order to have rapid spread of mushroom farming in the division.

Constraints experienced globally, regionally and nationally basically seem to be similar but the difference is seen in terms of commitment put in place by stakeholders in solving them. The constraints have been cited from various production countries, developed, developing to least developed.

Kumar and Aneja (1999) indicated that in India, the mushroom industry had not picked up the desired momentum (www.tribuneindia.com). Of the various factors that have kept mushroom cultivation on slow track, inadequate knowledge and poor cultivation have been major constraints (www.tribuneindia.com) .Dahiya and Singh (www.tribuneindia.com) have cited other constraints in India such as depressed/low market during glut production, unavailability of spawn, Weak financial status of entreprenuers, post-harvest losses in quality, and lack of processing industries in post-harvest.

In Indonesia (Sumiat, 2001), the problems facing farmers include low yields because farmers always apply the same formula, negative attitude, low quality spawn, contamination of both spawn and substrate media which leads to a loss of about 5% to 20%, lack of capital, difficulties in drying during rainy season because they depend on the sunlight and most of the mushrooms posses short life.

In Kenya, Osoro (Standard, 22 Dec, 2004) indicates that there are about eleven (11) varieties of mushrooms but those commonly found in Kenya include *Pleurotus spp*. He and other researchers are still carrying out research to come up with the best variety that can be recommended for economic production, therefore variety is a constraint in Kenya. Senelwa (DN, Jan 22, 2006) indicated that the constraints facing KMGA include lack of capital, lack of transport for produce collection and delivery to the market, lack of cold rooms for preservations and post-harvest losses.

Theresa Siangani (2005), Agricultural Extension Officer in Mumias Division gives the following as the constraints facing growers, lack of market for the product, poor production

techniques, lack of spawn in the division, low yields example 1kg spawn produces 0.5kg dried mushroom, no credit facilities are available to farmers and contamination during production process.

This research was proposed with a view of investigating major factors affecting mushroom farming so as to step up production which will pave way for the creation of mushroom industry in the country.

1.2 Problem Statement

The mushrooms farming in Kenya especially so in Mumias Division has been stagnating. This is due to non-availability of spawn, lack of capital base (Finance), poor management of growing conditions, and lack of reliable marketing strategy, low returns and other challenges facing the growers.

If mushroom farming was growing rapidly then mushroom industry could have been established by now from the time, the enterprise was introduced in the division. This industry could have created jobs and assist in poverty alleviation. The magnitude of the poverty problem in Kenya is enormous with more than half of the population living below the poverty line (PRSP, 2001). Globally through Millennium Development Goals (MDGS) there is an expectation to have a reduction of the proportion of people living in extreme poverty by half by 2015 (Mokoro 2005). In rural areas, there are malnutrition and disease infections which mushrooms can assist to solve because of their medicinal properties and the fact that they are rich in Vitamins.

It is against this background that this research intended to identify the factors affecting small scale mushroom growers.

1.3 Objectives of the Study

1.3.1 General Objective

To investigate the various factors affecting mushroom farming with a view of improving production.

1.3.2 Specific Objectives

1. To examine the characteristics of edible and medicinal species of mushrooms grown in the area.
2. To determine the prevailing marketing strategies used by growers.
3. To evaluate the management of growing conditions affecting mushroom farming in the area.
4. To determine the cost-benefit analysis of mushrooms and sugarcane of the farmers.
5. To identify other challenges which could be critical in affecting mushroom growers.

1.4 Research Questions

1. To what extent does mushroom characteristics affect mushroom farming?
2. To what extent existing market strategies affect mushroom farming?
3. To what extent does management of growing conditions affect mushroom farming?
4. To what extent does the cost-benefit analysis affect mushroom farming?
5. How do other challenges facing farmers affect mushroom farming?

1.5 Significance of the Study

Source of employment

Mushroom farming can be a source of employment by creating jobs. Since the 1980s, the economy has performed below its potential, with low economic and employment growth and a decline in productivity. The number of people openly unemployed stands over 2 million

(ERS, 2004). Unemployment has soared and productivity has fallen over time. In 1999 baseline Survey carried out in Kenya by the International Centre for Economic Growth, shows that SMEs employed about 2.4 million people or approximately 17% of the total workforce. In Kenya on average, a total of 500,000 persons enter the labour market annually while the economy generates between 250,000 to 330,000 jobs (PRSP, 2001). Senelwa (DN, Jan22, 2006) KMGA has created a total of 16,800 jobs to the rural people.

During the general election of 2002, NARC Government promised the electors 500,000 job creation annually. If mushroom farming is taken up as one of the strategies, it will facilitate the creation of these jobs. Example, in USA, 90% of all new jobs come from small enterprises and in Japan they account for 80% of the total employment. Mushroom project being a small-scale business can make a big contribution toward GNP.

Poverty Alleviation Strategy

One of the goals of MDGS is the reduction in the proportion of people living in extreme poverty by half by 2015.The overall target of reducing poverty prevalence is to less than 30% by 2015 as indicated in PRSP (Okemo, 2001).

Poverty remains a pervasive national problem presenting formidable challenges, which call for urgent action. The poor constitute more than half the population of Kenya, at least one in every two Kenyans is poor (PRSP, 2004). Poverty is multi-dimensional. It includes inadequacy of income, deprivation of basic needs and rights, lack of access to productive assets as well as to social infrastructure and markets.

The 1997 Welfare Monitoring Survey estimated the absolute poverty line at kshs 1,239 per person per month and kshs2, 648 respectively for rural and urban areas. It is estimated that the proportion of the population living in poverty has risen from about 48.8% in 1990 to

55.4% in 2001 and the proportion is estimated to have risen to more than 56% in 2003 (ERS, 2004). In Butere- Mumias, local leaders estimated the number to have risen to about 60% by 2000 as indicated in Consultation Report (Gakunu, 2001). Small-scale mushroom production presents an opportunity for farmers interested in additional enterprise and is a specialty option for farmers without much land (Beetz and kustudia, 2004). The enterprise can generate a lot of income due to short turnovers, which could be even ten times annually as indicated by Kariaga (Standard, December 22, 2004). This is a sure way of freeing from poverty (www.mushworld.com) in Kenya and other countries in the world. It is also the easiest and best way of income-generation according to Muna (DN, Nov.2005).

HIV/AIDS Suppression means.

The disease has aggravated poverty mainly because those dying are the productive young people, leaving behind widows and orphans who become dependent on other members of the family. Those who are afflicted with AIDS also consume resources as they require drugs and special food (PRSP, 2004). Some families are forced to sell their land to take care of these expenses. Women are more susceptible to transmission of HIV/AIDS because of biological factors, illiteracy, ignorance and lack of skills for employment forcing them to be dependant on men for economic support. They are also the managers of family diets.

Research has shown that,'constant diet of mushroom suppresses the HIV Virus' as alluded to Plipuan Vuuren, the project manager of Unum's Marine Coastal Resource Centre (www.allafrica.com). George and Pamplona (2004) mushrooms have medicinal effects which need be known by people. Some mushrooms contribute therapeutically, for example *Agaricus* bisporus is good for antidiabetic, *and Lentinus edodes* is good for immune boosting anticarcinogen and antiviral and can reduce cholesterol.

The government of Kenya is in record for spending a lot of money to import prophylactic devices such as condoms and drugs to control HIV/AIDS. If production of mushroom could be improved and consumption incorporated in the normal diets there could be a big saving.

Control of Water Hyacinth

Mushroom farming can utilize the world's worst water hyacinth weed (*Eichhornia crassipes*) as substrate. Water hyacinth has been found to be good substrate for mushrooms. Therefore if mushroom production can be stepped up, then the water hyacinth infestation will reduce drastically in rivers and lakes.

No limitation by Weather

Mushroom is grown all the year round and does not go with the weather changes because it is grown under a shade according to Kariaga (Standard, December 22, 2004)

Nutrients Suppliers

Mushrooms provide good source of proteins of biologically high quality, Vitamins example B1, B2, B6, Niacin and vit D, good source of minerals especially phosphorus, Potassium, iron, Copper and Zinc (George and Pamplona. 2004, Stamets .1983) indicates that," spent substrate is suitable as feed for chicken, cattle and pigs".

Environment Cleaners

Besides decomposing long chains of plants, which would otherwise be locked up, as piles of wastes into simpler gases and absorbable ions, mushrooms are useful as environment cleaners. The oyster mushroom spent substrate has been used to remove the biocide pentachlorophenol, which are persistent wastes with recalcitrant nature. These are priority wastes because of their toxicity. Once the pentachlorophenols are degraded by spent substrate the wastes are completely mineralized (Chiv et al, 1998).

Nematicidal activity

Spent oyster substrate has proved to be a safe potent nematicide, which can be used on plant parasitic nematodes. Five oyster mushroom spices secrete metabolites toxic to nematodes (Thorn and Baron, 1984). Nematodes infestation on sugarcane in Mumias sugarcane zone is raising a concern. Research carried out by Osoro (2005) indicates that in a great percentage of ratoon crops, the yield is declining due to nematode infestation. Therefore, the cost of using manufactured Nematicide would be reduced greatly once spent Oyster substrates are used in sugarcane.

Good organic Fertilizer

The Spent Mushroom Substrate (SMS) is high in organic matter, making it desirable for use as a soil amendment or soil conditioner. Sometime the material is called spent mushroom compost.

Medicinal Values

Oyster mushrooms naturally produce Lavastatin (Gunde Cimerman et al, 1995) a drug approved for treating blood cholesterol. *Ganoderma lucidum* has been known for its health stimulating properties particularly amongst Chinese and Japanese for many years. Polysaccharides isolated from this mushroom stimulate the immune system. Ganoderic acids have also been isolated, they lower blood cholesterol as well as portraying Anti-coagulant effects (Morigawa et al, 1986). The mushroom also has modulating effect to pressure and lipid levels in the blood (Kabir et al, 1989), an influence on blood glucose (Kimura et al, 1989) and can cure cancer, chronic fatigue syndrome, liver degeneration and blood disorders (Willard, 1990).

1.6 Limitations of the Study

Insufficient funds and lack of time

The funds and time were not adequate to allow the researcher do extensive coverage. The administration of the questionnaires was done by the researcher and Research Assistant hence funds were not enough. Therefore the researcher concentrated in Mumias Division and raised 100% of the total budget of kshs 60, 000 (Appendix VII).

1.7 Scope of the Study

The study took place in Mumias Division of Butere-Mumias District and covered small-scale Mushroom growers. The study targeted those farmers who are growing mushrooms and those who started growing after getting training from the ministry of Agriculture but later on abandoned the enterprise/crop.

1.8 Assumptions

The study had the following assumptions:

There are readily available domestic and external markets for mushrooms.

Farmers make huge profits from mushrooms

There is poor management of growing conditions of mushrooms.

There are a lot of challenges / constraints mushroom growers are facing.

CHAPTER TWO

LITERATURE REVIEW

2.0 CHAPTER OVERVIEW

This section deals with mainly Butere-Mumias District profile and conceptual framework on mushrooms. The sources of information are from both primary and secondary sources of data. The sources consisted of scholarly journals, theses and dissertations, government documents, papers presented at conferences, books, international indices, abstracts, periodicals, and the Africana section of the library of Kenyatta University, gray literature and use of internet. The conceptual framework has been analyzed in relation to past studies done in the area and critical issues concerning the study have been addressed.

2.1 District Profile

2.1.1 Geographical Location, Size and Population Distribution

Butere – Mumias District is one of the eight (8) districts in Western province of Kenya. It was curved out of the old Kakamega District on the 2nd March 1998 (PRSP, 2001-2004). Busia and Bungoma District on the West, Siaya and Vihiga Districts to the South and Kakamega District to the North. (Appendix 1). It lies between longitude 36.50'0E and Latitude 0.15 N of the equator. The District covers an area of 1034.5 Sq. Km with population of 523,464 and population density of 506 (Table 2.1.1).

Table 2.1.1: Area, population and Density.

Division	Area Sq. Km	Population	Density /Sq. Km)
Mumias	326.4	168743	517
Matungu	259.8	08314	417
Butere	209.8	111637	532
Khwisero	143.3	88234	616
South Wanga	95.2	46536	489
Total	**1034.5**	**523464**	**506**

Source: Population Census of 1999

The population was estimated at 625,042 (2005) with population density of 604, an increase of 98 persons per Sq.Km. Mumias division had a population of 168,743(1999) with population density of 517 per Sq. km, but estimated at 195,619 in 2005 with population density of 599, an increase of 82 persons per Sq. km. This is an indication that land resources are decreasing due to population pressure.

2.1.2 Topography and Climate

The district lies in a fairly flat land with no major significant variations of terrain, has good rainfall conducive for arable farming with two seasons and has high temperatures all the year round.

2.1.3 Economic Activities

The district falls within a rich agricultural zone with good soils able to support a variety of crops. The main crops are Sugarcane, maize, beans, sunflower, bananas, sweet potatoes, tea, coffee, finger millet and cover crops among others. Sugarcane is the main cash crop in the district. It is grown in four of the five divisions of the district namely Mumias, Matungu, South Wanga and Butere. Mumias sugar company Limited (MSC), the largest sugar factory in the country, contracts almost all the sugarcane farmers. The District is generally a food deficit area, since most of the available land is under sugarcane production. It's also a milk deficit area and imports 60% of its milk requirement. Apart from MSC, the district has no other manufacturing industries. Hence the need to establish mushroom industry to supplement MSC in the area.

2.1.4 District Poverty Level

The welfare monitoring survey II of 1994, the population of the poor people in Butere-Mumias District was 204, 134. However, the estimates given by the local leaders and other stakeholders indicate that the number had risen to about 60% or 288,434 people by 2000(Consultation Report, 2001-2004). In Kenya, about 56% of the population live below the poverty line.

2.2 Main Review

(i) General Characteristics of Mushrooms

(ii) Prevailing Marketing Strategy

(iii) Management of Growing Conditions

(iv) Cost- Benefit analysis of Mushrooms and Sugarcane

(v) Other Challenges Facing Growers

2.2.1 General Characteristics of Mushrooms.

Mushrooms are fungi. Fungi are stationary organisms that were classified as vegetables for many years and undergo eight phases before they mature (Figure 2.a). During the second half of the 20th century, they were grouped into a separate kingdom called fungi kingdom, since they are neither true vegetables nor animals (George and Pamplona, 2004). They are heterotropic that is, incapable of synthesizing their own organic material. It is believed that they evolved from algae. Mushroom like any other fungi have no

chlorophyll. The body of fungi is called mycelium and individual branches or filaments of the mycelium are hyphae. They reproduce mainly by means of spores. Spores are specialized propagative or reproductive bodies consisting of one or more cells. Their Sexual spores are referred to as basidio spores. Their fruit bodies are colorful and may be edible or poisonous. The organisms feed by absorption and therefore must break down large chains of organic material from plants.

In most cases many people get problems when feeding on unidentified type of mushrooms. In some cases it is relatively easy to recognize inedible or toxic mushrooms based on their characteristics. For example, the Stinkhorn mushroom (Clathrus rubber) has a smell of rotten meat, which clearly indicates that it is not fit for human consumption (George and Pamplona, 2004). Each type of mushroom has distinct characteristics (Appendix 11, IX) which could be pleasant or unpleasant to the consumers. These characteristics include:

(i) Colour of Pileus(Cap)

(ii) Co lour of Lamellae(Gills)

(iii) Co lour of Stipe (Stem)

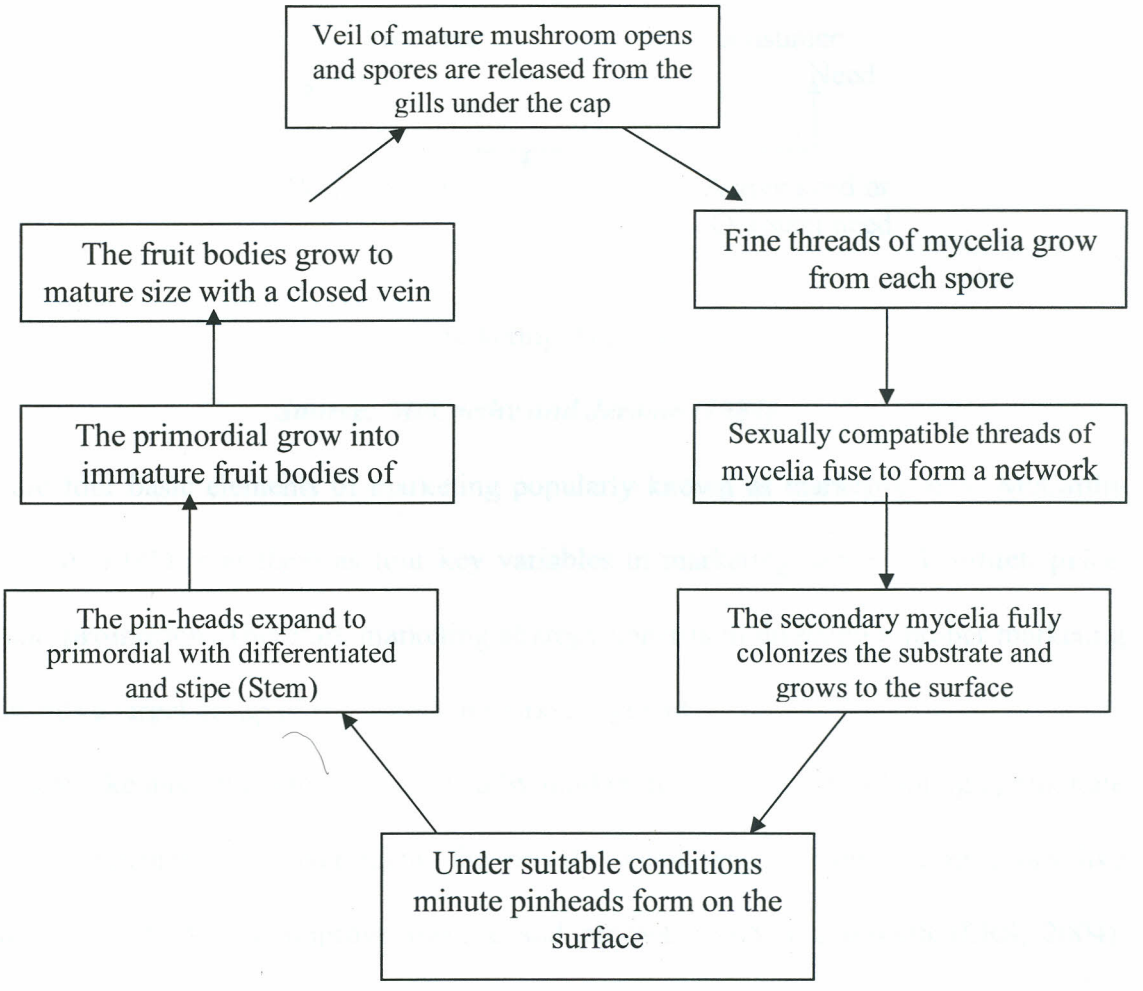
(iv) Smell of mushrooms

(v) Presence of Annulus (Ring)

(vi) Presence of Volva

Therefore these characteristics can affect mushroom farming to larger extend.

Figure 2.a: Life Cycle of a common Mushroom



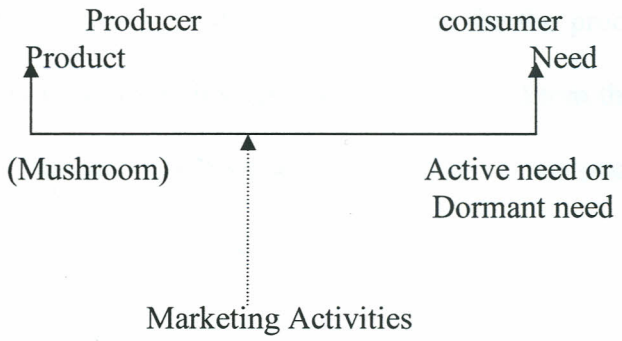
Source; Kariaga, 2005

2.2.2 Marketing Strategy

Marketing is the most important consideration of all. Alice and Kustudia (2004) said,''If you cannot sell your mushrooms at a price that ensures a reasonable profit margin, you do not invest in the enterprise.'' This is a very important statement.

Marketing as a major activity in business has been defined by Kotler (1986) as,"A human activities directed at satisfying needs and wants through exchange process.'' The process is shown in figure 2.b

Figure 2.b: Exchange Process



Source: McCarthy and Jerome (1981)

There are four basic elements of marketing popularly known as marketing mix. McCarthy and Jerome (1981) refer them as four key variables in marketing namely, **Product, price, place** and **promotion**. Therefore marketing strategy consists in directing a proper marketing mix towards a target group of customers or market segment.

Mushrooms like any other crop are affected by marketing activities. By adopting appropriate marketing strategies, the government, the private sector, and farmers organizations like Vimpro and KMGA, can improve income and promote economic growth (ERS, 2004). Therefore these elements do affect directly or indirectly mushrooms farming.

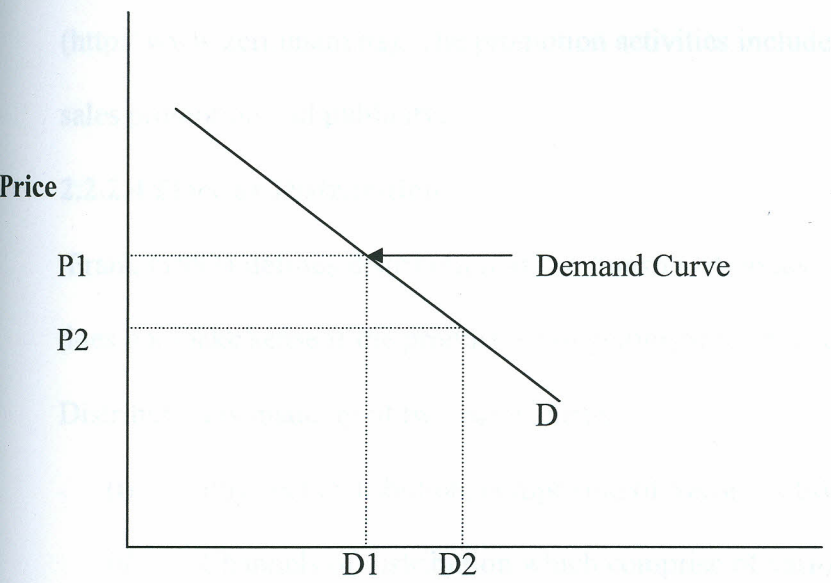
2.2.2.1 Product (mushrooms)

Giles (1994),indicates that, '' Packaging materials, design, color, size illustrations, brand name and associated symbols may affect to a very considerable extent a potential buyer's perception of a product ''. Packaging of a product plays a vital role in stimulating memory and helping recognition. This has wider behavioral implications in terms of establishing customer preference. The quality of mushrooms can be affected by packaging materials since the caps and stipes (stems) are delicate. The elite group of marketing segment is concerned with product quality.

2.2.2.2 Price

The amount of money that consumers must pay in exchange for the product. The level at which a firm sets its prices will affect both sales and productivity. From the basic economic law of supply and demand (Saleemi, 1987) shows that,' the lower the price, the greater the quantity of demand,'' as indicated in figure 2.c.

Figure 2.c: Price and Demand Curve.



Source: Economics Simplified (Saleemi, 1987p.16)

The price of cultivated mushroom is usually higher than what the poor can afford. Malindi (2004) indicate that the price of locally produced mushrooms can cost as higher as kshs80.00 per 30gms dried mushrooms. This may give an impression that mushrooms constitute a luxury food item, hence a social factor affecting mushrooms farming. It is important to realize that in developed economics psychological aspects of pricing take on a greater

significance. Low price, for example, may be irrationally associated with poor quality and can affect mushroom.

2.2.2.3 Promotion

Lack of awareness is affecting mushroom farming. There is little public awareness on the enormity of wealth that could be generated from mushroom and mushroom products. Research on tropical mushrooms is almost non –existent due to lack of information. Most of governments in Africa have not yet established mushroom Research Centre or Institutes (http://www.zeri.unam.na). The promotion activities include advertisements, personal selling, sales promotion and publicity.

2.2.2.4 Place or Distribution

Frank (1993) defines distribution as the transfer of goods from a producer to a consumer. It does not make sense if the product is not getting to the consumer at the right time and place. Distribution is made up of two components:

(i) Physical distribution, comprising of transportation, warehouse and storage

(ii) Channels of distribution which comprise of various routes used to get the produce to the consumer

2.2.2.5 Prevailing Market Strategy

One is expected to explore as many marketing strategies as they appeal to you (Beetz and Kusudia, (2004). Some strategies include:

(i) Direct marketing

This involves selling mushrooms directly to end-users. Naturally this receives a better price than through wholesalers. Mushrooms can be sold to local farmers markets, to restaurants, or to supermarkets, which might be located in many places. When competing for local markets,

excellent service, top quality and consistent in supply rather than the lowest price, might win the sell (Beetz and Kustudia, 2004).

Local grocery stores are another potential buyer of fresh mushrooms. An Arkansas grower found that a local grocery chains were interested in shiitake mushrooms only if she could assure them of a year- round supply. Therefore she decided to add indoor production in order to meet this requirement. This can be the situation in most of the producing countries including Kenya in that there is no fresh mushroom supply constantly.

(ii)Wholesale markets

Selling fresh mushrooms to wholesaler will mean a lower price than if you market directly. However, for farmers who choose not to involve themselves in direct sales, there are established wholesalers for mushrooms. Wholesalers advertise in produce industry periodicals like the packer. One of the wholesalers, Paul Goland of Hardscrabble Enterprises (www.ncat.org) says that, ''there is a steady and growing market for quality dried shiitake, even though the wholesale market has been depressed by Chinese imports.'' This wholesaler buys mushrooms from farmers who ship directly from West Virginia and can as well buy from Kenya.

(iii)Adding value to fresh mushrooms

Adding value to fresh mushrooms usually mean either developing a processed product, such as a sauce, or drying surplus mushrooms for sale in the off-season, when prices are higher. A value added mushroom product can be sold either directly to the consumers or wholesalers.

The Persimmon Hill Berry Farm in Missouri (www.ncat.org) offers an example of how a small entrepreneur can create and market a value –added mushroom product. Persimmon Hill developed a recipe for a shiitake mushroom sauce and invested in a commercial kitchen to

produce it. In Kenya there is need to have the grown mushroom processed into various forms to attract many consumers.

(iv)Computer Technology (internet)

Market can be found through internet search such as mushworld@yahoo.com whose main objective is to alleviate poverty through mushroom farming.

2.2.3 Management Of Growing Conditions For Oyster mushrooms

Mushrooms like any other crop require specific conditions to thrive. If these conditions are lacking the cultivation and production of mushrooms is exercise in futility. Therefore the critical growing conditions for oyster mushrooms (*Pleurotus spp*), which can limit production have been outlined. Weingarten (2004), http://www.mycowest.org says,' How to regulate the growing environment and other growing parameters for optimum growth is very important).''

2.2.3.1 Why Oyster mushrooms is preferred for Beginners.

They are easier and inexpensive gourmet mushrooms to grow and are good choice for beginners (Beetz and Kustudia, 2004). They can be grown using woody materials such as papers, pulp, sludge and sawdust. All the cereal straws, corn, corncobs, sugarcane Bagasse, coffee residues, banana fronds, cottonseed hulls, soy pulp and other materials too numerous to mention and difficult to imagine possible to grow on them (Dietzler, 1997), http: www.greenmuseum.org. However, Shah et al (2004) indicates that sawdust is the best substrate for high yields.

2.2.3.2 Mushroom House

The size of the Mushroom house depends on the expected production level. Moisture retention is critical in mushroom growing, so it is advisable to have double brick walls,

preferably plastered inside. Plastic or foam sheets can also be used on the walls .The roof should be thatched with grass, straw, tiled etc. while ensuring that the space between the roof and the wall is completely sealed (Kariaga, 2005). There should be a door and a window (s). The floor can be watered and sand may be poured on it and watered to keep the room moist. The shelves should be made of double rows allowing for watering and picking space. The lowest rack/shelve should be at least 15cm above the ground. The shelve should not be more than 1m wide.

2.2.3.3 Cropping Containers/Kits

Common containers are bags and slanted walls. The bags are inexpensive, portable and disposable. Any plastic bag is suitable. Bags with 30-50kg weights are recommended for ease of handling and economic production. The 3-5kg capacity bags are good for beginners. Spawn rate of 100-150gms per bag of 30-50kg is adequate (Kariaga, 2005). The small sized bags save on losses in case of contamination, and only a small volume is affected as the bag is removed without a great impact on the production level.

The transparent plastic is ideal as the mycelium growth is easily monitored, to enable contamination to be noticed. Black plastic bags on the other hand have the advantage of keeping the mycelium in total darkness during spawn run.

2.2.3.4 Preparation of fruiting substrates

Oyster mushrooms can be fruited on a variety of materials, for example hardwood logs, straw, sawdust, corncobs, shredded newspaper, etc. avoid sawdust and chips from softwood trees such as pine, as these inhibits the growth of oyster mushroom mycelium (http://www.mykoweb.com). The straw is chopped and moistened overnight (Kariaga, 2005). Submerging in water at 70°c for two hours pasteurizes it. The purpose of pasteurization is to leach out soluble compounds that might attract competing molds, and to kill insect pests.

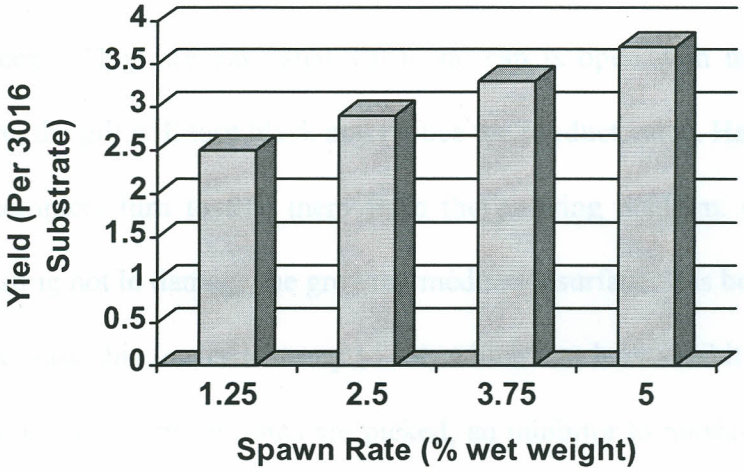
2.2.3.5 Spawning and Spawn Run

High quality spawn (seed) is essential for high yields (Kariaga, 2005). The more the grain spawn used to inoculate a fruiting culture, the faster it will be colonized, the less likely it will become contaminated. Pasteurized cultures can become contaminated with molds and bacteria.

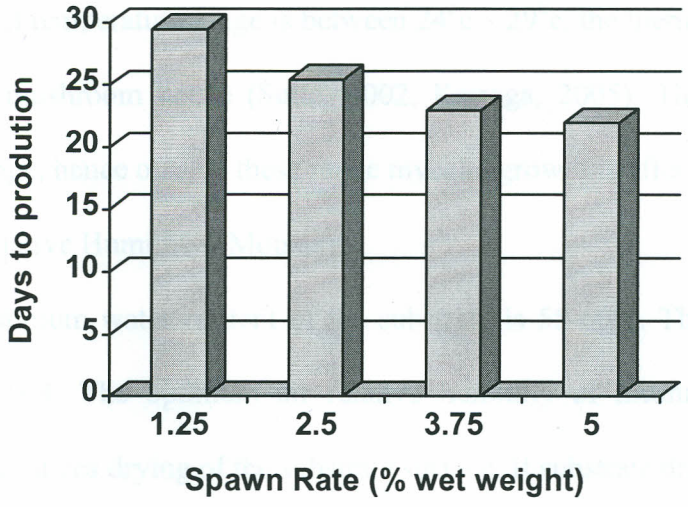
Spawn is mixed uniformly at recommended rate .The spawn rate of 100-150gm per 30-50kg bag can be used ,however the best rate is 5% of wet weight of the substrate (Royse, 2004).At this rate the yields are increased and maturity period reduced (Figure 2.d) . Ahmed (1986), said that *Pleurotus oestreatus* complete spawn run in 17-20 days. During this time the bags are placed in total darkness so that the mycelia colonize the substratum. After spawn run the bags are opened or holes made all over the bags to allow the mycelia to go through.

Figure 2.d: Influence of four spawn rates (1.25, 2.5, 3.75 and 5 % of substrate-wet weight) on Pleurotus cornucopiae mushroom yield (A) and days to production (B)

A: Mushroom Yields



B: Days to Production



Source: Royse, 2004

2.2.3.6: Harvesting

Under favorable conditions, mushrooms will begin to appear in 7-14 days (Suite, 2002), mushroom usually double in size every day. They are harvested over 2-4 days in a 7-10 cycle called flushes or breaks (Kariaga, 2005) maximum harvest of first flush should be around the 5^{th} week. They are harvested when the cap is open with mature size. If harvested over mature, the gill will turn black and reduce the product value. Harvest by twisting them slowly one complete turn to free them from the growing medium. Care should be taken during harvesting not to damage the growing medium's surface. It is better not to cut the mushrooms off, because this leaves a stump to rot, which can later inhibit the fruiting of the next crop. When all mature mushrooms are picked, an inhibitor to mushroom development is removed and then the next flush moves to maturity. The first two flushes account for the majority of the total yield, with the subsequent flushes tapering off to relatively low levels of production.

2.3.3.7 Critical Factors Sustaining the Mushroom Crop

(i) Temperature

Best temperature range is between $24^{o}c - 29^{o}c$, the thermometer can be used to check this in mushroom house (Suite, 2002, Kariaga, 2005). The mycelia can grow within this range, hence outside these range mycelia growth is affected.

(ii) Relative Humidity / Moisture

Optimum water content of the substrate is 55-60%. The ratio of substrate and water is 1.3:1.4. The optimum air relative humidity of mushroom house is 90 – 95%. This minimizes drying of the substrate surface. If substrate dries, production goes down.

(iii)Air Circulation

At the time of pinning, sufficient fresh air (oxygen) is introduced to lower carbon dioxide Produced by mycelia to below 700ppm. This will encourage both mycelia growth and fruit body development. Hence ventilation should be adequate in the growing house.

(iv)pH Value

Mushroom can grow in the substrate with pH of 6-11 and the optimum value is 8.0. Therefore the substrate should not be acidic, it can affect growth of mushroom (http://www.unicernbag.com)

2.2.3.8 Diseases and insect Pests

(i) Bacteria

The most common bacterial problem encountered by growers is *Pseudomonas tolaasii* .Symptoms include, reduced yields, orange discoloration, brittleness, infected mushroom have reduced self-life. As a control measure the Relative humidity is lowered to 80% from 85% and sprinkling the surface of the bags between flushes with 0.2 bleach solution may help maintain control.

(ii)Fungi

Most of fungi grow and develop on the substrate and are very rarely parasitic. The substrates need be pasteurized and conditioned. Fungal infestations may be more of a problem when substrates are supplemented with nitrogen rich nutrients and substrate temperature raised above 35^0c. For control use fungicide, reduce temperature and control supplement.

(iii) Insect pest

Insect infecting mushroom tissues cause the greatest lose to growers. They deform oyster tissue which could resemble, "cauliflower'. Control includes adherence to strict hygiene practices and the use of *Bacillus thuringienis* when incorporated into the substrate at spawning has shown excellent effectiveness against sciarid flies.

2.2.4 Cost-Benefit Analysis Of Mushrooms And Sugarcane

Mushroom enterprise is a business undertaking. It's important for one to understand the returns expected compared to other agricultural enterprises. Therefore returns have been analyzed for small-scale growers in terms of cash flow statements and gross margins.

2.2.4.1 Mushroom Returns

The returns has been analyzed using cash flow statement (Table 2.2.4.1)

Table 2.2.4.1: Mushroom Enterprise Cash flow Statement for year ended 31st December, 2005

Description	Jan-Mar	May-Jul	Sep-Nov
Cash Sales (Kshs) (4kg dry@2000.00	8,000.00	8,000.00	8,000.00
Credit sales	-	-	-
Total Sales inflow	**8,000.00**	**8,000.00**	**8,000.00**
Cost of production (Kshs)			
Spawn (4kg @500.00)	2,000.00	2,000.00	2,000.00
Maize stovers	-	-	-
Transport and Chopping	100.00	100.00	100.00
Polythene bags (40 @3.0	120.00	120.00	120.00
Cotton wool/Spirit	230.00	230.00	230.00
Packaging dry mushrooms	50.00	50.00	50.00
Depreciation (House@25)	1250.00	-	-
Total cost (Kshs)	**3,750.00**	**2,500.00**	**2,500.00**
Net Cash (Sales less cost of prod.)	**4,250.00**	**5,500.00**	**5500.00**
Accumulative cash/Income	**4,250.00**	**9,750.00**	**15250.00**
Mean per kg	**1,062.50**	**1,218.75**	**1,270.8**

Source: Theresa Siang'ani Records (2005)

Note: Production unit size (House) is 2mx3m

Cost of house construction was ksh5000.00

2.2.4.2 Sugarcane Returns

About 90% of sugarcane comes from small scale farmers whose land size is between 0.01ha- and 0.5ha (Table 2.2.4.3). The farmers do not enjoy economies of scale in their production and the returns per tonne in both Plant crop and Ratoon crop (Appendix 111, IV) are low in Mumias (Mutanda, 2001) compared to other factories(Table 2.2.4.2). This shows that farmers get profits from sugarcane farming. Hence is a viable business worth undertaking and can suppress other income generating activities if their returns are low compared to sugarcane. The returns of mushrooms are higher compared to sugarcane (Table 2.2.4.4). This could have encouraged producers to step up their production but this is not the case.

'Table 2.2.4.2: Costs and Benefits of Cane Production in Kenya (Kshs/Ha) 2004.

	Mumias		Nzoia		West Kenya	
1. Costs	**Plant**	**Ratoon**	**Plant**	**Ratoon**	**Plant**	**Ratoon**
Land Preparation	9125	-	9191	-	7750	-
Seed cane	19000	-	15767	-	22018	-
Fertilizers	8478	8478	8526	8526	11304	12380
Inter-cultivation	-	2100	-	2000	-	1000
Lab our	16188	9688	13400	8650	7260	4560
Interest on farm inputs	15079	6203	15097	6686	14763	6200
Harvesting	19500	15600	154000	12320	8000	6400
Transportation	44200	35360	44200	35360	44200	33920
Levies	1890	1512	1890	1512	2160	1728
Total costs	**133460**	**78941**	**123471**	**75054**	**115655**	**66188**
Total costs per ton	**1335**	**987**	**1235**	**936**	**1157**	**827**
2.Revenue						
Yield (Tch)	100	80	100	80	100	80
Gross Revenue	189000	144000	189000	151200	216000	172800
Net Revenue	55540	72259	65529	76146	100345	1066612
Net revenue per ton	**555**	**903**	**655**	**952**	**1003**	**1333**
3.Break-EvenYield(Tch)	**71**	**42**	**65**	**40**	**54**	**31**
4.Return per ksh.invested	**0.42**	**0.92**	**0.53**	**1.01**	**0.87**	**1.61**

Source: KESREF Report (2004)

Table 2.2.4.3: Returns of cane proceeds by farmer plot sizes (4 year summary from 1/7/97 to 30/6/2001) in Mumias.

I	II		III		IV	V	VI	VII	VII
Plot Size Range	No. Of farmers		Area		Tonnage	Yield TCH	Net Income/Ha (Kshs)	Net Income/ Farmer (Kshs)	Net/Gross %
	No.s	%	No.s	%					
0.01-0.50	11669	24.18	5133.5	11.14	526972	102.65	82,357.93	36231.42	47.63
0.51-1.0	24323	50.41	19819.9	43.0	1836693	92.67	76662.0	62468.99	49.31
1.01-1.50	8126	16.64	10349.5	22.46	975193	94.23	81715.25	104074.82	51.85
1.51-2.0	2224	4.81	3987.5	8.65	368954	92.53	82764.93	148392.61	53.39
2.01-2.50	834	1.73	1995.6	4.33	189412	94.91	86169.07	206185.85	55.32
2.51-3.0	367	0.76	1116.2	2.42	109788	98.36	98275.01	298895.29	59.74
3.01-4.00	321	0.66	1237.9	2.69	112969	91.26	96494.23	372119.04	63.16
4.01-5.0	177	0.37	935.8	2.03	86910	92.87	105092.93	555626.93	66.78
5.01-6.00	92	0.19	564.3	1.23	47364	83.93	95301.55	584550.73	67.62
6.01-7.0	76	0.16	559.10	1.21	46432	83.05	103104.22	758494.34	73.46
7.01-8.0	42	0.09	389.10	0.84	35317	90.76	111154.9	1029770.77	72.18
Total/Mean	**48251**	**100.0**	**46088.4**	**100.0**	**4336004**	**94.08**	**81465.09**	**78176.19**	**51.61**
2.01-8.0	**1909**	**3.96**	**6798.00**	**14.75**	**628192**	**92.41**	**93651.23**	**342625.89**	**60.24**

Source: Mutanda P. Head of Agriculture (2001)

Table 2.2.4.4: Returns (Kshs/Unit)

Crop	Factory	Crop Cycle		Mean
		Plant	Ratoon	
Sugarcane(Ton)	Mumias	555.0	903.0	**729.0**
	Nzoia	655.0	952.0	**803.5**
	West Kenya	1003.0	1333.0	**1168.0**
Mushrooms(kg)	One Grower	-	-	**1270.8**

Source: Table 2.2.4.1 and Table 2.2.4.2

2.2.5 Other Challenges Facing Small-Scale Mushroom Farmers

Various studies done have identified some challenges facing small-scale enterprise sector. A small business that is independently owned and operated is faced with many challenges (Oluoch, CBA621). These problems are mainly due to ignorance and lack of adequate information. However, some are beyond their control. The major challenges are as follows:

2.2.5.1 Financial Limitation

As a result of their size, small enterprises have limited tangible and intangible resources to meet their financial needs. This problem is worsened by under-capitalization due to poor planning, lack of initial start-up capital, poor management reflected in capital tied up in stock, poor profit margins and cash flows, delays in the release of debt financing and poor security. These financial limitations seriously hamper small-scale mushroom enterprises farming.

2.2.5.2 Weaknesses in entrepreneur or managerial functions

Usually in small enterprises, one person performs enetrepreneurial and managerial functions.

The owner manager (grower) makes strategic and tactical decisions and also takes care of functional area that is marketing, production, finance, personnel etc. weaknesses in these areas may be traced to a number of factors such as:

(i)The entrepreneur may have started out with just one skill but may not have experience in business management.

(ii)The smallness of operation does not justify in-house team specialists

(iii)The enterprise has fewer financial resources and poor networking capabilities for example, it is believed that Asian businesses succeed because of their fantastic network.

2.2.5.3Inaccessible to information

Lack of information is one of the causes of problems and difficult faced by growers. It's also a major constraint with regard not only to markets, finance, technology and sources of other inputs. Access to information is blocked by the following factors:

(i) The entrepreneurs limited education.

(ii) Its restricted circle of conducts and networks. Hence relies on immediate business contacts like family, relatives, suppliers, customers and sales persons.

(iii) Lack of financial resources to buy information

2.2.5.4 Limited Knowledge of production and Technology

Small enterprises generally rely on the technical knowledge of entrepreneur or the partner. Workers usually acquire skills on the job and they don't have money to hire highly qualified workers. The following worsens these situations:

(i) Lack of access to technical training and upgrading.

(ii) Lack of access to technological information and sources of technical assistance.

(iii)Lack of resources to invest in improved appropriate technology.

2.2.5.5 Unsupportive Policies and Regulations

While small enterprises are flexible, they can be particularly vulnerable to unsupportive policies and regulations because they don't have resources and reserves to fall on. They also don't have the managerial and technical capacity to deal with variable and economic and business policies, for example fluctuating fiscal and monetary regulations, complex licensing and authorization procedures. In Kenya, the situation has been worsened by the ambiguous legislation, corruption, inefficiencies and general policies that are biased against small enterprises.

2.2.5.6 Liability Challenge

A single mushroom may produce 4 million spores per hour. Workers' exposure to airborne spores is a concern on most farmers. Inhaled spores can cause an allergic reaction in some workers, therefore people fear to be liable. A greater concern is the risk of being sued by a consumer who becomes ill and accuses you for selling contaminated products. Agricultural waste products used for substrate sometimes contain pesticides, medicinal residues and other chemicals that can be concentrated during recycling. They may also contain toxic microorganisms such as aflatoxins

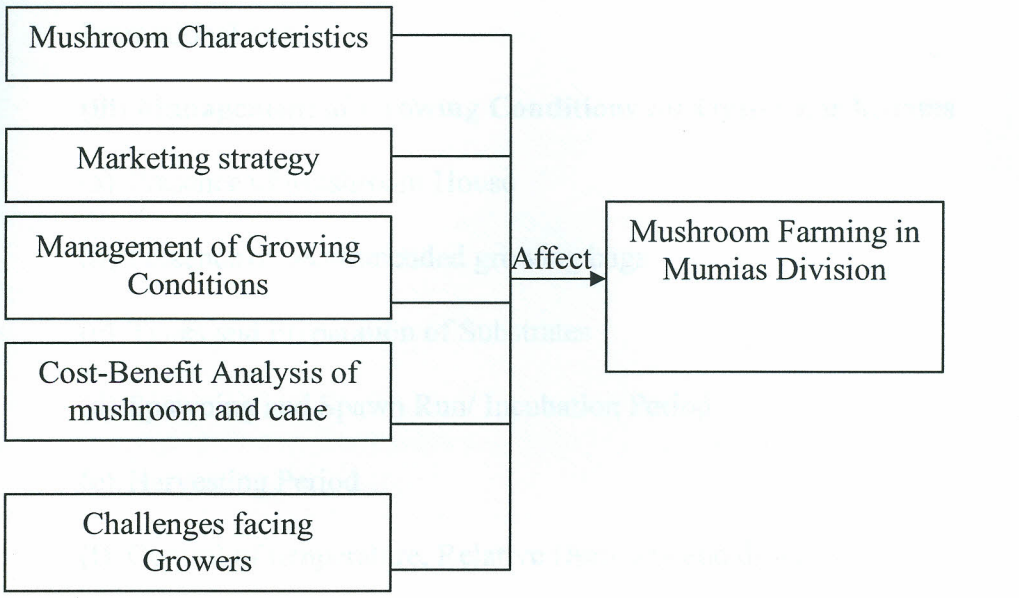
2.3 Summary and Gaps to be Filled by the Study

The recommendations which have been made in the report will assist the mushroom growers to improve in marketing of the products through good marketing strategies, increase productivity through efficient and effective production technologies and develop specific interventions for various challenges. The ministry of agriculture will be brought on board to assist the growers

2.4 Conceptual Framework.

The study has been based on developed conceptual framework (Figure 2.e) similar to the model of Kombo and Tromp (2006). Each of the factors outlined affects small-scale mushroom farming in Mumias Division.

Figure 2.e: Conceptual Framework



Source: Researcher (2006)

The independent variables and dependent variable have been conceptualized in this study by reference to the following indicators:

Independent variables

(i) Mushroom Characteristics

(a) Colour of the mushrooms in terms of its Pileus and Stipes

(b)Presence of annulus and Volva

(c)Smell of mushrooms

(ii) Marketing Strategy

Using combination of marketing mix variables such Product, Price, Place and Promotional mix.

(iii) Management of Growing Conditions for Oyster mushrooms

(a) Presence of Mushroom House

(b) Presence of recommended growing bags

(c) Types and Preparation of Substrates

(d) Spawning and Spawn Run/ Incubation Period

(e) Harvesting Period

(f) Control of temperature, Relative Humidity and diseases

(iv)Cost-Benefit analysis of Mushrooms and Sugarcane

(a)Production cost and Returns of Mushrooms

(b)Production cost and Returns of Sugarcane

(v) Other Challenges Facing the Growers

(a)Financial limitation

(b) Weakness in entrepreneurs or Managerial Function

(c) Inaccessible to information

(d) Limited knowledge of Production and Technology

(e) Unsupportive Policies and regulations

Dependent Variable

The Mushroom is the dependent variable. The indicators of whether there is increase or decrease in mushroom activities depends on the above independent variables.

CHAPTER THREE

RESEARCH METHODOLOGY.

3.0 CHAPTER OVERVIEW

This section has covered research design, population and sample, sampling design, data collection, reliability and validity of measuring instrument, data analysis and lastly expected outcome.

3.1 Research Design

The type of design used was descriptive research. This design fitted well in the research because it helped the researcher to describe phenomena or situations and events (Margaret, 1995). The description of the state of affairs as it exists at present has been done (Kothari, 2004).

3.2Target Population and Sample.

3.2.1 Target population.

In this research, target population comprised of all farmers growing mushrooms in small scale within Mumias Division who were 200.This included some farmers trained by the ministry of agriculture, current growers and those who started and left the project.

3.2.2 Sampling frame

Since sampling Frame was not available, it was developed based on villages and groups that are growing mushrooms in the division. The villages are Maraba, Mwitoti, Ebumayi, Shiakhabo, Luninu, Ehifuyo and Makhwale Group.

3.2.3 Sample Size

The sample size consisted of 30 farmers (Appendix VIII) .This number was considered as the respondents for the study. For each village, there were some representatives.

3.3 Sampling Design and Procedures

The sampling design used was cluster/area sampling (Kathori, 2004). The study involved geographic subdivisions. The method was suitable due to low costs and where there was no satisfactory sampling frame for the whole population. Therefore the sampling frame was developed. For each village, four farmers were selected except some villages five were selected. Some farmers who had abandoned the mushroom farming business and had moved to other areas were followed there to provide information.

3.4 Data Collection Procedures

This involved both primary and secondary data.

3.4.1 Primary data collection methods.

This type of data was collected from original sources which was the respondents. Several methods or combined methods were used. This improved reliability and validity of the data collected. The methods comprised of the following:

3.4.1.1 Questionnaire

The questions consisted of structured and semi- structured, typed with sufficient space left for the respondent to fill in (Appendix V). Some questionnaires were self administered or researcher administered. This was the main instrument of data collection in this research.

3.4.1.2 Observations

The researcher made physical observations on actual operations

3.4.1.3 Interviews

In some cases interviews were conducted by the researcher.

The two data collection methods and an instrument selected were relevant to the study since some farmers were literate and others illiterate. All sampled respondents were reached in two weeks period (Appendix VI).

3.4.2 Secondary data collection methods

The datas were obtained from available research results, textbooks, mushroom journals, Internets and other publications.

3.5 Issues of Reliability and Validity of Measuring Instrument.

The reliability is concerned with whether the results of a study are repeatable or checking of consistency (Alan, 2001). Validity is meant the success of the scale in measuring what it sets out to measure (Moser and Kilton, 1971), or it relates to the question of whether a measure is measuring what it was supposed to measure. The questionnaire was the main data collection instrument hence to ensure that it was reliable and valid, test-retest was done. The questionnaire was administered to ten (10) different respondents and feedback scrutinized for the purpose of adjusting the questionnaire.

3.6 Data Analysis and Presentation

The data was edited both in the field and in the office (Central) for correctness and completeness. Coding was done by assigning numbers to Questionnaires for identification purposes and then classified into categories. The researcher analyzed the data using descriptive statistics with the help of SPSS. The results are presented in tables and the researcher has done interpretation, made conclusions and finally drawn recommendations.

3.7 Expected Outcome

It's expected the number of mushroom growers to increase greatly after the research report is released for use in the division.

The cost of production shall reduce due to the employment of new technologies in production, utilization of sugarcane trashes and free bagasse from the factory as substrate.

It's also expected that the quality of mushroom products shall be improved.

CHAPTER FOUR

DISCUSSION OF FINDINGS

4.0 CHAPTER OVERVIEW

This chapter presents the data analysis, their interpretations and the main findings of the research. The first section reports the respondent's background in terms of gender, age and experience in mushroom farming. The second presentation covers the analysis and discussion of the findings for the factors affecting the enterprise which includes mushroom characteristics, prevailing marketing strategies, management of growing conditions, cost-benefit analysis of mushroom and sugarcane and finally other challenges facing farmers.

4.1 Information on Respondents

A total of 30 candidates had been identified to form the research sample. This figure represents 15% of the total target population of about 200 mushroom growers. These farmers were selected specifically to get a representative sample size for the purpose of this research. In total 30 respondents participated in answering the questionnaire and handed them over through Research Assistant.

4.1.1 Gender

In the research 16 females representing 53.3% and 14 males with 46.7% took part in the research. This translates into a ratio of 8:7 which indicate that both men and women were fairly represented. It shows that the majority of mushroom growers are women (Table 4.1.1)

Table 4.1.1: Distribution of Respondents by Gender

Gender	Frequency	Percent (%)	Cumulative %
Female	16	53.3	53.3
Male	14	46.7	100.00
Total	**30**	**100.0**	

Source: Researcher (2006)

4.1.2: Age

The result revealed that young people between 18-25 years representing 5% are engaged in mushroom farming and 26-33years representing 5% while from over 34 years are the majority farmers (Table 4.1.2)

Table 4.1.2: Age Distribution of the Growers

Age (Years)	Frequency	Percent (%)	Cumulative %
18-25	5	16.7	16.7
26-33	5	16.7	33.4
34-41	10	33.3	66.7
>42	10	33.3	100.0
Total	**30**	**100.0**	

Source: Researcher (2006)

4.1.3 Experience in Mushroom Farming

The result revealed that 23 (76.7%) farmers had experience of less than one year while 2-4 years were 6 with 20% and 1 with over 5 years (3.3%) experience (Table 4.1.3). In 2004, 50 farmers were trained by MOA but only 6 representing 12% are in production the rest dropped out of the project. This finding is in agreement with Kioko (2006) who reported that in Vimpro, 125 groups started mushroom farming and currently they are 30 representing 76% drop.

Table 4.1.3: Distribution of Growers by experience

Experience (Years)	Frequency	Percent (%)	Cumulative%
<1	23	76.7	76.7
2-4	6	20.0	96.7
>5	1	3.3	100.0
Total	**30**	**100.0**	

Source: Researcher (2006)

4.2: Characteristics of Mushrooms

All the 30 respondents are growing oyster mushrooms. Asked why they cited the following reasons:

(i) Its easy to grow on variety of substrates

(ii) Spawn is easily available

(iii) They have never been introduced to any other type of mushroom apart from Oyster. This result is in agreement with Dietzer (1997) who reported that oyster is common and can grow on many substrates sometime difficult to imagine possible. Also with Alice and Kusudia (2004) who reported that oyster mushrooms are easier and inexpensive gourmet mushroom to grow and are good choice for beginners. Most of these farmers are new in mushroom farming, less than one year. The result is also in

conformity with the findings of Kioko (2006) who reported that many mushroom producers in Kenya grow Oyster.

4.2.1 Colour and Smell

All the farmers indicated that the colour of this type of mushroom is grey and has nice smell like that of a chicken meat. Chicken meat in western province if meat was to be ranked would top the list. This implies that this type of mushroom is fit for human consumption. This result agree with the findings of George and Pamplona(2004) who reported that stinkhorn mushroom which has a smell of rotten meat as being unfit for human consumption.

4.2.2: Source of spawn

The research established that a total of 28 growers representing 93.3%, purchase the spawn and 2 growers with 6.7% make their own (Table 4.2.2). Due to inadequate facilities for spawn production for the two farmers who make their own, the spawn quality is poor. The two sell the same to other farmers in the division .The yields of farmers have remained low in the division and other farmers have even left mushroom farming. The results are in agreement with Kariaga (2005) who reported that high quality spawn is essential for high yield. Therefore low quality spawn lead to low yield of mushroom products. The farmers have frequently purchased spawn from various merchants such as Vimpro at kshs750 per kg, Osoro from Baraton University at kshs 350/kg, Neutron-Deli Shinyalu Mushroom Group in Kakamega at kshs 500/Kg, Reuban Ogutu in Mumias at kshs250 and Wambua from Nairobi at kshs 500. Although there are many sources of spawn but the selling price seems to be high.

Table 4.2.2: Sources of spawn for farmers

Source of spawn	Frequency	Percent (%)	Cumulative %
Purchase	28	93.3	93.3
Own Making	2	6.7	100.0
Total	**30**	**100.0**	

Source: Researcher (2006)

4.2.3 Spawn Rate

The result showed that 3 growers representing 10% use 100-150gms per 30-50kg bag, 3 with 10% use 5% of wet weight of substrate while 22 others representing 73.3% do not have specified rates (Table 4.2.3). Spawn running for the grown mushroom take more than 30days as observed by the researcher due to using incorrect rates of spawn by majority of the farmers. This result differs with the findings of Ahmed (1986) who reported that *Pleurotus oestreatus* completed spawn running in 17-20 days, and also Royse (2004) who reported that the best rate is 5% of wet weight of the substrate.

Table 4.2.3: Distribution of Spawn Rates used by farmers

Rate	Frequency	Percent (%)	Cumulative %
100-150gms/30-50kg Bag	3	10.0	10.0
5% of wet weight of substrate	3	10.0	20.0
Others	22	73.3	93.3
Missing 7	2	6.7	100.0
Total	**30**	**100.0**	

Source: Researcher (2006)

4.3 Prevailing Marketing Strategies used by Farmers

4.3.1 Markets availability

A total of 17 growers representing 56.7% sale their mushroom products in the local markets especially at open air markets while 13 growers sale to hotels and restaurant (Table4.3.1).This implies that there is market for mushroom products. This result is in agreement with Beetz and Kusudia (2004) who reported that mushrooms can be sold to local farmers, to restaurants or supermarkets, which might be located in many places.

Table 4.3.1: Markets for mushroom product

Type of market	Frequency	Percent (%)	Cumulative %
Local market	17	56.7	56.7
Foreign market	0	0	100.0
Others	13	43.3	
Total	**30**	**100.0**	

Source: Researcher (2006)

4.3.2 Participating in selling activities

Total of 16 growers representing 53.3 % are themselves involved in selling the product while 14 representing 46.7 % use middlemen in selling mushrooms (Table 4.3.2). This implies that direct marketing would earn farmers more money than indirect marketing. The results agree with the findings of Beetz and Kusudia (2004) who reported that selling mushroom directly to end-users receives a better price than through wholesalers.

Table 4.3.2 Involvement in Selling

Participation	Frequency	Percent (%)	Cumulative %
Involved in selling	16	53.3	53.3
Not involved	14	46.7	100.0
Total	**30**	**100.0**	

Source: Researcher (2006)

4.3.3: Sellers of mushrooms

The research revealed that 23 growers representing 76.7 % under others use their groups in selling, some produce insignificant amount of quantities which they consume at home. Two growers representing 6.7% sale through retailers, one sale to groceries (3.3%) and 4 growers with 13.3% never indicated how their products are disposed (Table 4.3.3)

Table 4.3.3: Sellers of mushrooms

Type of seller	Frequency	Percent (%)	Cumulative %
Retailers	2	6.7	6.7
Groceries	1	3.3	10.0
Others	23	76.7	86.7
Missing	4	13.3	100.00
Total	**30**	**100.0**	

Source: Researcher (2006)

4.3.4: Packaging Materials for Mushroom Products

A total of 29 growers representing 96.7 % packet their product in polythene bags while one with 3.3%use bottles as material for packaging (Table 4.3.4). Packaging is a good marketing strategy the farmers are using. These results are in line with Giles (1994) who reported that

packaging materials, design, colour and associated symbols can affect potential buyer's perception of a product. It helps in stimulating memory and recognition.

Table 4.3.4: Type of Packaging Materials

Type of material	Frequency	Percent (%)	Cumulative %
Polythene Bags	29	96.7	96.7
Bottles	1	3.3	100.00
Others	0	0	
Total	**30**	**100.0**	

Source: Researcher (2006)

4.3.5 Selling price per Unit

A total of 21 growers representing 70% sale dried mushrooms in small quantities of 50gms at kshs 100.00 while 9 growers representing 30% sale in large quantities of 1 kg at kshs2000.0 of dried mushrooms. This result revealed that the yields are low for most of the farmers and that is why majority of farmers are packaging in 50gms (Table 4.3.5). The selling price is higher than what the poor can afford. This finding is in agreement with Maulindi (2004) who reported that the yields are low and packaging is done in terms of 30gms of dried mushrooms and sold at kshs80.00 per packet. This also confirms the basic economic law of supply and demand of saleemi (1987) that the lower the price, the greater the quantity demanded.

Table 4.3.5: Selling Price

Price per unit (KHz)	Frequency	Percent(% 0	Cumulative %
1kg at 2000.0	9	30.0	30.0
50gms at 100.0	21	70.0	100.0
Others	0	0	
Total	**30**	**100.0**	

Source: Researcher (2006)

4.3.6 Processing of Mushrooms for Storage

The result revealed that 25 growers representing 83.3% process their mushrooms while 5 with 16.7% do not process but sale them to consumers in fresh form (Table 4.3.6). Processing here mean sun-drying in this context using dryers, so as to increase shelf-life of mushrooms. Mushrooms are perishable product which can hardly store for 4 days without getting spoiled. By drying of mushroom means value addition. The result is in line with the findings of Beetz and Kusudia (2004) who reported that adding value to fresh mushrooms mean either developing a processed product such as a sauce, or drying surplus mushrooms for sale in the off-seasons, when prices are higher. A value added mushroom product can be sold either directly to consumers or wholesalers. In India lack of processing industries in post – harvest has kept mushroom cultivation on slow track (Kumar and Aneja, 1999)

Table 4.3.6: Processing of Mushrooms

Processing	Frequency	Percent (%)	Cumulative %
Processing	25	83.3	83.3
No processing	5	16.7	100.0
Total	**30**	**100.0**	

Source: Researcher (2006)

4.4 Management of Growing Conditions

The management involves construction of growing house, ventilation, substrates, pest's control, monitoring of temperature and relative humidity.

4.4.1Growing House construction.

All the 30 respondents indicated that they have constructed growing house, this represents 100%. The ventilation status varied a lot whereas 11 growers with 36.7% had good ventilation,16 representing 63.3% was fair while 3 with 10% was poor (Table 4.4.1). The result is in agreement with the findings of Kariaga (2005) who reported that mushroom house and good Ventilation are required for oyster production.

Table 4.4.1: Ventilation Status of Mushroom House

Ventilation Status	Frequency	Percent (%)	Cumulative %
Poor	3	10.0	10.0
Fair	16	53.3	63.3
Good	11	36.7	100.0
Total	**30**	**100.0**	

Source: Researcher (2006)

4.4.2 Substrate Media

The research established that 11growers representing 36.7% use maize Stover's, 6 with 20% use bagasse while 13 representing 43.3% use mixtures of substrates (Table 4.4.2). This result differ with the findings of Shah etal (2004) who reported that sawdust is the best substrate for higher yields but agree with the findings of Dietzler (1997) who reported that oyster can grow on numerous materials which are difficult to imagine possible. Farmers in kisii have complained that the mushrooms grown from bagasse are small in size and are difficult to sale (Kioko, 2006). All the growers indicated that they do pasteurization of the substrates to kill pathogens so as to avoid contamination of spawn which can lead to crop failure. This finding is also in line with Kariaga (2004) who reported that pasteurization is vital and should take 2hrs at 70 degrees, this avoids contamination. In Indonesia (Sumiat, 2001), contamination of spawn and substrate has led to a loss of about 5-20%.

Table 4.4.2: Type of Substrate

Substrate	Frequency	Percent (%)	cumulative %
Maize Stover's	11	36.7	36.7
Sugarcane Bagasse	6	20.0	56.0
Others	13	43.3	100.0
Total	**30**	**100.0**	

Source: Researcher (2006)

4.4.3 Determination of Temperature and Relative Humidity in Growing House

The result of this research showed that all respondents estimate both temperature and relative humidity by body feelings. They do not have thermometers and are not aware of Radiometers. This results differ with the findings of Suite (2002) who reported that temperature should be measured using Thermometer. Without checking these critical growing conditions for mushrooms growing, might lead to low yields. Weingarten (2004) indicated that regulation of the growing environment and other parameters for optimum growth is very important.

4.4.4 Insect Pests and Diseases

In total 28 growers representing 93.3% have experienced problems with insect pests and diseases while 2 representing 6.7% have not had a problem with pests (Table 4.4.4). The control method is mainly cultural practices for all of them except one farmer who uses fungicides. The presence of pests can cause greatest losses to the farmers. The findings are in conformity with the findings of Royce (2004) who reported that insects infecting mushroom tissues cause the greatest losses to growers.

Table 4.4.4: Pests Problem

Pest	Frequency	Percent (%)	Cumulative %
Presence of pest	28	93.3	93.3
No pest	2	6.7	100.0
Total	**30**	**100.0**	

Source: Researcher (2006)

4.5: Cost –Benefit Analysis of Mushrooms and Sugarcane

The cost of production and revenues were investigated for both Mushrooms and sugarcane. The result showed that 16 farmers representing 53.3% had no records while 14 with 46.7% had records which are improperly kept.

4.5.1 Cost-Benefit Analysis for mushrooms

The research established that 14 growers (46.7%) had records and their mean cost of production was kshs1045.0 while revenue was kshs2552.90 giving a net profit of kshs 1507.90 per growing cycle. The estimated annual income for four cycles was (1507.90x4) kshs6031.60 from a house measuring 2mx3m on average. Despite the fact that records are poorly kept the yields are low (Table 4.5.1) which can discourage farmers. These results agree with the findings of sumiat (2001) who reported that low yields are among the major factors affecting farmers in Indonesia. In this research the income could not be accurately assessed due to poor record keeping. Most of the records show one cycle. The comparison between the production of Kariaga and Mumias farmers in terms of ratio is 0.04:1 meaning they are making very small profit out of the business and yet others are reaping huge profits.

Table 4.5.1: Cost- Benefit Analysis of Mushrooms Per Cycle

Number	Cost of Production (Kshs) A	Revenue(kshs) B	Net(Profit or Loss) kshs C	Projection Per annum(Kshs) D = (CX4)
1	1000.0	1800.0	800.0	3200.0
2	450.0	1000.0	650.0	2600.0
3	500.0	1200.0	700.0	2800.0
4	6000.0	15000.0	9000.0	36000.0
5	800.0	1500.0	700.0	2800.0
6	600.0	1000.0	400.0	1600.0
7	900.0	3000.0	2100.0	8400.0
8	800.0	1600.0	800.0	3200.0
9	300.0	900.0	600.0	2400.0
10	480.0	1350.0	870.0	3480.0
11	500.0	1600.0	1100.0	4400.0
12	620.0	1890.0	1270.0	5080.0
13	680.0	1900.0	1220.0	4880.0
14	1000.0	2000.0	1000.0	4000.0
Total	**14630**	**35740.0**	**21110.0**	**84840.0**
Mean	**1045.0**	**2552.90**	**1507.90**	**6031.60**

Source: Researcher (2006)

4.5.2. Cost-Benefit Analysis of Sugarcane

A total of 12 growers representing 40% had some records, although not well kept for their sugarcane while 18 (60%) were growing other crops. The result revealed that mean income from one hectare of sugarcane was kshs71, 025 while earning per month was kshs3551.30 and per day was kshs118.40 (Table 4.5.2).This confirms KESREF Report (2004) that there is good net revenue per ton of sugarcane.

Table 4.5.2: Cost-Benefit of Sugarcane per Cycle

No.	Land(Ha)	Cost of prod (kshs)		Revenue (kshs)		Net Income (kshs)		Mean (kshs)	Returns Per Ha	In M
		Plant	Ratoon	Plant	Ratoon	Plant	Ratoon			
1	.01-.5	19000	10000	32000	58000	13000	48000	30500	61000	30
2	^	20000	15000	60000	42000	40000	27000	33500	67000	33
3	^	63800	74100	125000	164000	61200	89900	75550	151100	75
4	^	35000	28790	70000	80000	35000	51210	43105	86210	43
5	^	17000	14000	60000	42000	43000	28000	35500	71000	35
6	^	20000	18000	60000	41000	40000	23000	31500	63000	31
7	^	23000	18000	60000	42000	37000	24000	30500	61000	30
8	^	50000	75000	90000	120000	40000	45000	42500	85000	42
9	^	20000	15000	60000	42000	40000	27000	33500	67000	33
10	.51-1.0	49500	20000	70000	100000	20500	80000	50250	50250	25
11	1.01-1.5	51000	40000	89000	143000	38000	103000	70500	47000	23
12	1.51-2.0	37000	18000	130000	96000	93000	78000	85500	42750	21
Total	**12**	**395800**	**345890**	**906000**	**970000**	**500700**	**624110**	**562405**	**852310**	**42**
Mean	**0.75**	**32983.3**	**28824**	**75500**	**80833.3**	**41725**	**52009.2**	**4686.1**	**71025.8**	**35**

Source: Researcher (2006)

4.6. Other Challenges Facing Mushroom Growers.

The research established 19 problems facing the growers. The major ones were five namely Lack of spawn with 21.1%, lack of knowledge with 9.8%, Pests with 9.8%, lack of storage facilities with 9.8%, and low yields with 9.8% respectively (Table 4.6). These results agree with the findings of Kumar and Aneja (1999), Sumiat (2001) and Senelwa (DN, Jan 22,2006) who have reported that lack of spawn, lack of knowledge, low yields, pests and lack of storage facilities are the major challenges facing farmers.

Table 4.6: Distribution of Challenges Facing Growers.

No.	Challenge	Frequency	Percent (%)
1	Lack of spawn	26	21.1
2	Lack of knowledge	12	9.8
3	Mushroom Pests	12	9.8
4	Lack of storage facilities	12	9.8
5	Low yields	12	9.8
6	Lack of funds	9	7.3
7	Labour intensive	8	6.5
8	Problem in transportation	7	5.7
9	Difficult in Construction of growing house	7	5.7
10	Drying of substrate because of water	4	3.3
11	Contamination of spawn and substrate	3	2.4
12	Low profits	3	2.4
13	High production costs	2	1.6
14	Determining temperature & R. humidity is had	1	0.8
15	Failure of spawn to germinate	1	0.8
16	Lack of information and communication	1	0.8
17	Inadequate packaging materials	1	0.8
18	Inadequate substrates	1	0.8
19	High price of spawn	1	0.8
Total	**19**	**123**	**100.0**

Source: Researcher (2006)

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 CHAPTER OVERVIEW

This chapter has been divided into three sections. The first section consists of a summary of the main findings which have been outlined. The second section presents some conclusions that have been drawn as a result of the discussion of the findings. The last section presents recommendations which if adopted will see the enterprise grow rapidly.

5.1 SUMMARY OF THE MAIN FINDINGS

All the farmers interviewed through the questionnaire (100%) are growing one type of mushroom called Oyster. This implies that the rest of the farmers in the division are also producing oyster mushrooms.

The majority of the farmers (93.3%) purchase their spawns. The prices range from kshs250 to kshs750 per 1kg of spawn. Few farmers (10%) use the correct spawn rate at spawning time which is 5% wet weight of substrate and the rest (73.3%) use incorrect rates during spawning. The spawn is not also readily available to farmers, a complain which was registered by 21.1% of respondents.

The yields that have been realized from oyster production in the division are generally low. A yield of less than 1kg fresh mushrooms per a small bag containing substrate which weighs about 2kg is often realized by majority of the growers.

The mushroom products are sold in both small quantities of 50gms in dried form (70%) and large quantities of 1kg (30%). The selling prices are kshs100 per 50gm and kshs2000 per 1kg respectively. These high prices have affected the consumption of the products because they are too high compared to meat prices in the division.

All the farmers (100%) determine temperature and relative humidity in growing house by body feelings hence not correctly done. They have never used thermometers and Radiometers which are the conventional instruments in determining these two critical growing conditions.

The bagasse and sugarcane trash are agricultural wastes which are plenty and readily available in Mumias division but not well utilized. About 20% of the farmers use bagasse, maize Stover's (36.7%) and the rest (43.3%) use mixtures.

In total 14 farmers (46.7%) had records which were poorly kept while 16 (53.3%) had no records at all. This makes ascertaining the break-even point for yields and selling prices difficult.

The returns of mushrooms per growing cycle using 2mx3m growing house is kshs 6031.60 while for sugarcane is kshs 61000 from an area of 0.01-0.50ha. Most of sugarcane farmers are small scale producers.

Most of the farmers lacked basic knowledge of mushroom production. In total 23 (76.7%) of the respondents had an experience of less than one year and 2-4 years were 6 (20%) farmers and only one(3.3%) with more than 5 years .

In total 28 farmers (93.3%) had their production units affected by insect pests and diseases and controlling methods employed is only cultural practices. This is a preventive measure but they do not know any pesticide they can use in case of outbreak of a disease or insect pest.

The storage facilities are lacking in the division. The farmers are not able to store fresh mushrooms even for two days since they do not have fridges or cold rooms.

The farmers are not accessible to credit facilities. Due to lack of funds to purchase all the required inputs for mushroom production, most farmers have been producing less than their families consumption requirements, no excess for sale.

The mushroom production is labour intensive. Most of the growers tend to be risk averse hence produce minimal levels.

5.2 CONCLUSION

Mushroom production and marketing has not yet been established in the division. Many of the farmers/ groups lack adequate strategic measures on how to go about the business. Quite a number of the farmers in the division have gone into production without the basic skills and knowledge on mushroom production for commercial purposes. This has led to poor produce and low yields, which has discouraged growers to continue production. Almost in all growing areas /villages in the division there are no adequate trained staffs who can easily monitor and evaluate farmers production for effective management of the enterprise. Therefore farmers have not been prepared well for mushroom production through full training.

The cost of production is still high due to spawn prices. There is variation in price of spawn which are still very high for some farmers, hence they have not been able to purchase spawns due to the high prices associated with it. No control measures for the preparation and

production of spawns, leading to poor quality spawns which reduce production levels and mushroom quality. Many of the spawn producing farmers/groups lack the required facilities such as laboratory in preparation which has led to poor quality spawns, hence poor quality mushroom products. Therefore spawn being sold in the division is of low quality.

There are poor management practices being used which have contributed to some farmers to drop out of production, a case of 50 trained farmers by the Ministry of Agriculture (2004) only one is still in mushroom production with over 5 years experience and the rest pulled out. The current ones are relatively new with less than one year experience in mushroom farming and have not been trained adequately .Therefore many farmers are likely to drop out of production if new techniques in production are not employed.

Majority of the farmers do not keep records, making accounting for cost and setting of product prices difficult. Therefore the pricing of mushroom product is not realistically done. The price of mushroom product is exorbitant which favors few consumers .This in turn limits levels/quantity of consumption.

There is ineffective product promotion. Promotion methods e.g. advertising, fair pricing, free demonstration in seminars, barazas on mushroom recipes have not been used effectively to increase local consumption of mushroom products. Therefore promotional mix strategy has not been fully exploited for mushroom business.

Many people are not aware of nutritional and medicinal values of mushrooms so they do not eat them as often as they would if they knew. This is in particular to promote the product in the local market e.g. Mumias and Butere towns.

5.3 RECOMMENDATIONS

There is need to diversify mushroom varieties in the area, not to rely on oyster mushrooms alone. Further research into mushroom varieties is recommended so as to introduce the best variety in Kenya such as *Lentinula edodes* (Shiitake) *Agaricus bisporus* (Button) and *Ganoderma incidum* (Reishi).

To monitor spawn production quality, to control spawn prices and ensuring the correct rates are used, the ministry of agriculture should get involved .Currently the agricultural extension staffs are concentrating on conventional agricultural agronomic practices giving no attention to mushroom farming. Hence the government should train both farmers and staffs on mushroom production skills. Facilities in spawn production such as laboratory should be set up in Mumias town by the government and quality standards be monitored by Kenya Plant Health Inspectorate Services (KEPHIS).

To improve in yields, there is need to carry out intensive trainings on modern mushroom production techniques, use high quality spawn at correct rates and management of critical growing condition should be done by the Ministry of Agriculture via extension services.

To reduce selling price of mushroom products to make it affordable to majority of the consumers, the government should provide credit facilities (small loans) to producers so that more producers come on board to step up production to glut level. The cost will come down naturally due to supply and demand theory. Also Non-Governmental organizations should be encouraged to come forward to help these farmers.

To control humidity and temperature in growing house, the government should supply thermometers and radiometers to each grower as incentives. This will help in monitoring of these conditions properly.

In the division there are a lot of agricultural wastes which are underutilized such as sugarcane trashes and bagasse. The two can be used as substrates in order to reduce the cost of production. Therefore it's recommended that further research on these substrates be done to determine their suitability for mushroom production. Also Mumias Sugar Company should be approached by local leaders so as to allow mushroom growers access bagasse free of charge and also to assist in substrate pasteurization using steam from the boilers. This possibility of using steam for pasteurization need be studied.

To improve on record keeping, the farmers should be taught on good record keeping practices for production and marketing. This will help farmers to account fully the cost of production and determine profit and also avoid over or under estimation of production.

To improve on returns which are low currently, the optimum number of bags spawn run in the growing house should be determined. This requires a further research on the house size of 2m x 3m. Also producers should form a cooperative society to streamline the production and marketing process.

To control pests and diseases in the growing houses, there is need to pasteurize the substrates well to avoid contamination and embrace both cultural practice and use of pesticides. Therefore farmers should be trained well on hygiene practices and save pesticide use.

To improve on storage facilities for fresh mushrooms, there is need for the government to construct cold rooms at strategic places such as Mumias and Butere towns which farmers can access at a reasonable fee.

To improve on start up capital, the farmers should be taught on how they can access small scale farming loans from lending financial organizations such as AFC, Micro-Finance Organization or CDF.

To improve on labour, farmers should be encouraged to use family labour especially when the schools have closed and children are at home as vocational jobs.

Further research is recommended to have extensive coverage for all producers in Kenya and possibly do SWOT Analysis for each established groups like vimpro.

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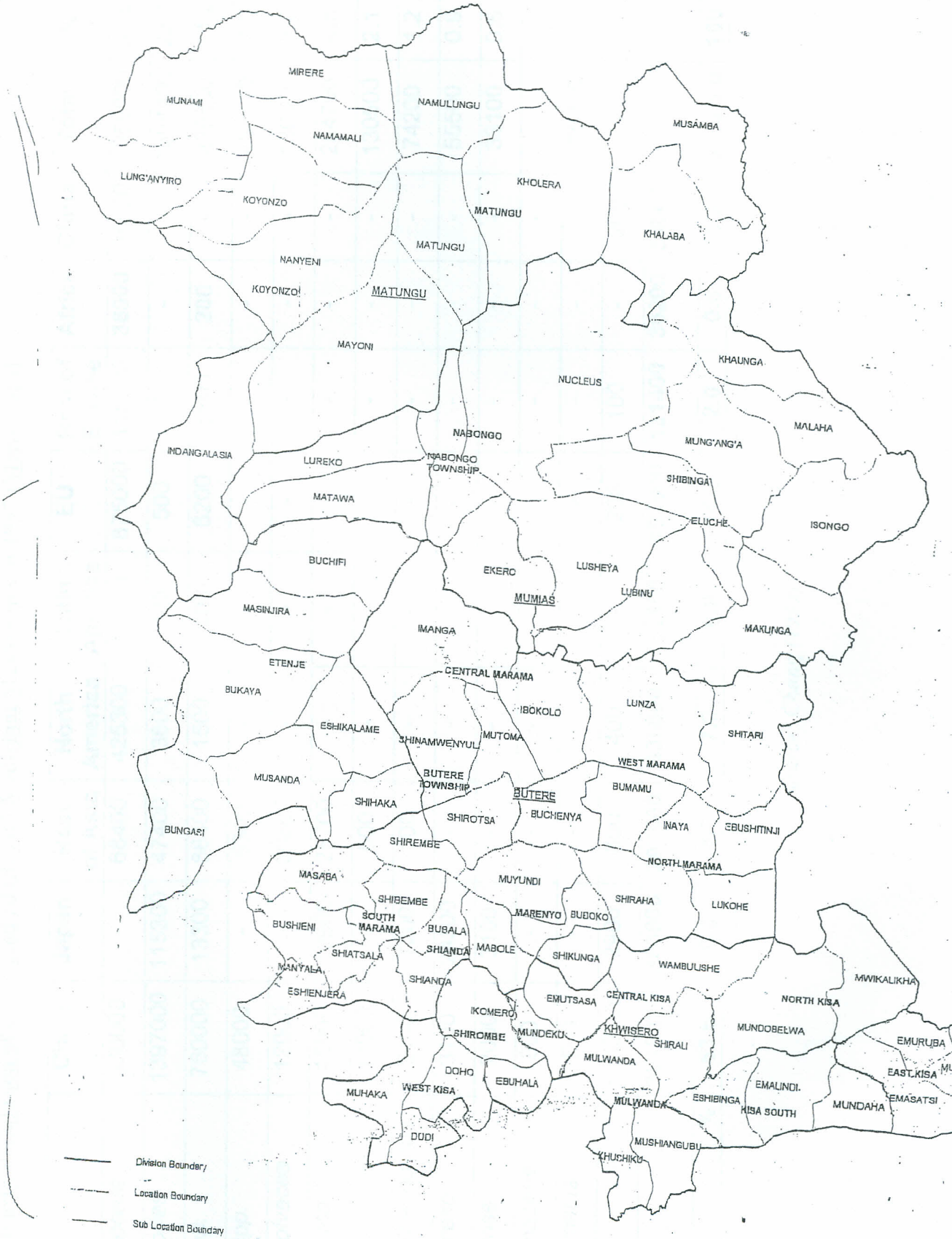
Appendix 1:District Map-Butrere-Mumias District



Appendix II: World Population of Cultivated edible and Medicinal Mushrooms in 1997 (Metric tons)

	China	Japan	Rest of Asia	North America	Latin America	EU	Rest of Europe	Africa	China	Total	%
Agaricus bisporus	330000	-	68400	425300	51600	875000	115200	**36000**	54400	1955000	31.8
Lentinus edodes	1397000	115300	47400	3600	300	500	300	-	-	1564400	25.4
Pleurotus spp.	760000	13300	88400	1500	200	6200	5800	**200**	-	875600	14.2
Auricularia spp.	48000	-	5300	-	-	-	-	-	-	485300	7.9
Volvsriella volvacea	12000	-	60800	-	-	-	-	-	-	180800	3.0
Flammulina spp.	15000	10900	25700	-	-	-	-	-	-	284700	4.6
Tremella spp.	13000	-	500	-	-	-	-	-	-	130500	2.1
Hypsizygus marmoreus	2100	7200	100	-	-	-	-	-	-	74200	1.2
Pholioto nameko	3100	24500	-	-	-	-	-	-	-	55500	0.9
Grifola frondosa	2000	3100	-	-	-	-	-	-	-	33100	0.5
Hericium erinaceus	800	-	-	-	-	-	-	-	-	-	-
Coprinus comatus	500	-	-	-	-	-	-	-	-	520800	8.4
Others	514900a	2900	800	400	-	200	100	-	200	-	-
Total	**3918300**	**368000**	**297400**	**430800**	**52100**	**881900**	**121400**	**36200**	**54600**	**-**	**-**
%	**63.6**	**6.0**	**4.8**	**7.0**	**0.8**	**14.3**	**2.0**	**0.6**	**0.9**	**6160800**	**100**

Source: Chang (1999).

Appendix 111: Plant Crop Returns per Ton in Mumias

A. Cane price	**1730.00**	**2015.00**	**2015. 00**	**100.00**
B. Plants				**%**
Description	**Kshs/Tonne**		**Proportion of total cost**	
	1997	**2000/01**	**2001/02**	
1. Transport (Av.Zone2)	366.00	436.00	436. 00	27.01
2. Seedcane	200.30	288.10	260.70	16.15
3. Farmers costs	200.01	22.74	252.74	15.65
4. Accrued interest	181.70	190.80	170.60	10.57
5. Harvesting	157.76	178.90	178 .90	11.08
6. Fertilizer	129.00	127.00	127. 00	7.87
7. Land Preparation	109.60	160.00	127.80	7.92
8. P.I.T	34.60	40.30	40. 30	2.50
9. Cess	17.30	20.15	20. 15	1.25
Total costs	1 396.27	1694.39	1614.19	100.00
Gross Margin Kshs	**333.27**	**320.61**	**400.10**	**Mean351.30**
Yield	138.00	70.00	83.00	47

Source Mutanda P. HOA (2001)

Appendix IV: Ratoon Crop Returns Per ton in Mumias

1. Transport	366.00	436.00	436. 00		36.97
2. Farmer's own costs	206.08	268.75	268. 75		22.79
3. Fertilizer	180.00	191.50	191. 50		16.24
4. Harvesting	157.76	178.9	178.90		15.17
5. Accrued Interest	63.20	40.30	40.30		3.70
6. P.I.T	34.60	40.30			3.42
7. Cess	17.30	20.15	20.15		1.71
Total costs	1025.04	1191.40	1179.30		100.00
Gross Margin	**704.96**	**823.60**	**835.70**	**Mean 788.1**	
Yield (TCH)	**106**	**56**	**66**		

Source: Mutanda P. HOA (2001)

Appendix V: Mushroom Survey Questionnaire

Dear Respondent_____

The purpose of this survey is to investigate on the factors affecting mushroom farming in Mumias Division. The data arising from this survey will not be used for any other purpose than improving the production of mushrooms. Please respond accordingly.

Questionnaire	column	Code
1. What is your gender (Please tick)		
Male [ ] Female [ ]		1,2
2. How old are you?		
18-25 years [ ]		1
26-33 years [ ]		2
34-41 years [ ]		3
Over 42 years [ ]		4
3. What type of mushroom do you grow? (Please tick one)		
Oyster [ ]		1
Button [ ]		2
Others (Specify)		3
4. For how long have you been growing this type? (Please tick one)		
Less than a year [ ]		1
2-4 years [ ]		2
More than 5 years [ ]		3
5. What is the colour of the mushroom you are growing? (Please tick one)		
White { }		1

Yellow { } 2

Red { } 3

Brown { } 4

Others (Specify) ---------- 5

6. Do your consumers like the co lour specified in Q5 above (Please tick one)

Yes { } 1

No [} 2

7. How is the smell? (Please tick one)

Good { } 1

Fair { } 2

Bad { } 3

8. What is the source of your spawn? (Please tick)

Merchant (purchase) [ ] 1

Own making [ ] 2

Others (Please Specify)..... 3

9. Where do you sale your mushroom product (s)?

Local market [ ] 1

Foreign market [ ] 2

Others (Specify)..... 3

10. Are you involved in selling?

Yes [ ] 1

No [ ] 2

11. If the response is NO in 10 above who does the selling for you? (Please tick one)

Retailers [ ] 1

Wholesalers [ ] 2

Groceries [ ] 3

Others (Specify) 4

12 Do you package your mushrooms? (Tick one)

Yes [ ] 1

No [ ] 2

13 If the response is yes in Q12 above which packaging material do you use (Please tick one)

Polythene bags [ ] 1

Bottles [ ] 2

Others (Specify) 3

14. State the selling price per unit of mushroom?

1kgm dried mushrooms kshs2000.00 [ ] 1

50gm ^ kshs100.00 [ ] 2

Others (Please specify) [ ] ---------- 3

15. Do you process mushrooms for storage? E.g. drying, making powder etc.

Yes [ ] 1

No [ ] 2

16 Have you constructed mushroom house? (Tick one)

Yes [ ] 1

No [ ] 2

Comment on the response above.....

17. If the response is Yes in Q16, how can you rate ventilation? (Tick one)

Poor [ ] 1

Fair [ ] 2

Good [ ] 3

18. Which type of substrate do you use? (Please tick one)

Sawdust [ ] 1

Maize Stover's [ ] 2

Sugarcane Bagasse [ ] 3

Others (Specify 4

18. Do you pasteurize the substrate? (Please tick one)

Yes [ ] 1

No [ ] 2

19. What is your spawn rate? (Please tick)

100-150gmper 30-50kg bag [ ] 1

5% of wet weight of the substrate [ ] 2

Others (Please specify) [ ] ---------- 3

20. How do you determine mushroom house temperature? (Tick one)

Use of thermometer [ ] 1

By hand feeling [ ] 2

Others (Specify) [ ]---------- 3

21. How do you determine Relative humidity in mushroom house? (Tick one)

Use of radiometer [ ] 1

Use of pyranometer [ ] 2

Others (Specify) [ ]---------- 3

Comment on the response .....

22. Have you experienced problems with diseases and insect pests?

Yes [ ] 1

No [ ] 2

23 If the response is Yes in Q22 above, how did you control?

Use of fungicides [ ] 1

Use of insecticides [ ] 2

Use of cultural practices [ ] 3

Others (Specify) [ ]----------4

24 What is your income /returns (Kshs) from mushrooms in one year? (Please tick one)

0-5000 { } 1

5001-10000 { } 2

> 10001 { } 3

25 How much did you spend in producing mushroom in order to earn the above income? (Please state) Kshs----------

26. What size of land is under sugarcane farming (Please tick one)

0.01-0.5 ha { } 1

0.51-1.0 ha { } 2

1.01-1.50ha { } 3

1.51-2.0 ha { } 4

> 2.1 ha { } 5

---

27 On average give the returns (in Kshs) per hectare for the following crop cycles:

Plant Crop Kshs---------- Ratoon Crop kshs----------

28. What was the cost of production (kshs) in Q 27 above (Please State?)

Plant Crop Kshs---------- Ratoon Crop Kshs----------

29State other challenges/constraints you have encountered in growing mushrooms

(i)----------

(ii)---------- ----------

(iii)----------

(iv)----------

(v)----------

(vi)----------

Thank you for taking time to give information for the survey.

Researcher----------Signature----------Date----------

Appendix VI: Time Schedule

(a) Plan of Activities.

Activity	Duration (Weeks)
Pilot	1
Adjustment of Questionnaire	1
Data Collection	2
Data Editing and Coding	1
Data analysis	2
Report Writing	2
Report presentation and submission	1
Total	10

(b): Schedule of Activities.

Activity/Month	August 2006				September 2006				October 2006			
	1	2	3	4	1	2	3	4	1	2	3	4
Pilot study				√								
Adjustment					√							
Data Collection						√						
Data coding							√					
Data analysis								√				
Report writing									√			
Report presentation an										√		
Report Submission											√	√

Appendix VII: Budget

Item no	Description	Quantity Required	Unity Price (Kshs)	Total cost (Kshs)
1	Computer services	1	20,000	20,000.00
2	Stationary	4 Reams	400	1,600.00
3	Camera	1	2,500	2,500.00
4	Travel lings	200Lts	74	14,800.00
5	Photocopying	800 papers	2.5	2,000.00
6	Allowances for Research Assistant	5000	-	5,000.00
7	Biometrician	1	-	2,000.00
8	Miscellaneous	-		12,100
Total	-	-	-	**60000**

Appendix VIII: List of Respondents

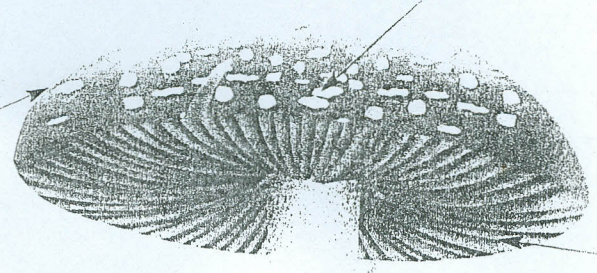
1. Protus Chimwene
2. Wilson Okusimba
3. Azina Wesonga
4. Ibrahim O.watitwa
5. Dickson mwambayi
6. Joseph M.Omwangwe
7. Suleiman Washiali
8. Rehama I.Salim
9. Asman A. Wamukoya
10. Denis O. Wambira
11. Anasitanda Chitechi
12. Tom Otina
13. Lonnah Omukuti
14. Robai Otanga
15. Robert Etabale
16. Theresa Siangani
17. Dinah Atemba
18. Grace Nyanje
19. Everlyne Khasoa
20. Reuban Ogutu
21. Deborah Maina
22. Deliphine Omulamula
23. Anne N. Geoffrey
24. Pamela Mboya
25. Philister Omulamula
26. Benard Okute
27. Stanley Otala
28. Agnes Aburiri
29. Ruth were
30. Roman Masimba

Anatomy of a Mushroom

Mushrooms are the **edible portions** of certain higher **fungi**, which emerge from the underground **mycelium** during certain times of the year. Botanically they constitute the **fruit** of the fungus.

The biological function of mushrooms is the release of **spores** formed in their **hymenium.**

Scales: These are remains of the volva left on the pileus, as is the case with the toxic mushroom *Amanita muscaria.*



Pileus (cap): The pileus is the fleshly portion of the mushroom. Its lower part constitutes the **hymenium.**

Hymenium: This is the reproductive site for millions of spores that spread from each mushroom. It may be formed of lamellae (gills), tubes, folds or spines. The hymenia of the *most* poisonous mushrooms are formed of **lamellae** (gills).

Annulus (ring): This structure is not present in all mushrooms. However, the ***most*** **poisonous** species *always* have an **annulus.**

Stipe: (stem)

Mycelium: This is the vegetative portion of the fungus (the mushroom is the reproductive portion). It is formed by a network of fine filaments, called **hyphae**, which grow underground in concentric circles. It is estimated that ten cubic centimeters of forest soil can contain up to one thousand meters of mycelium filaments from various fungi.

Volva: This is a sac-like structure that covers the base of the stipe of some mushrooms. **All of the most poisonous mushrooms have a volva.** The volva can easily go unnoticed if the mushroom is not harvested carefully.