GSC Biological and Pharmaceutical Sciences
eISSN: 2581-3250 CODEN (USA): GBPSC2
Cross Ref DOI: 10.30574/gscbps
Journal homepage: https://gsconlinepress.com/journals/gscbps/

(RESEARCH ARTICLE)

Check for updates

S.W.O.T. diagnostic analysis of the production of the mushroom Pleurotus in Cote d'Ivoire

Adam Camille KOUAME [1,*], N'Zué Kouadio Christian OKA [2], Marc ADOU [2], Yao Denis N'DRI [2] and N'Guessan Georges AMANI [2]

[1] *Livestock Production Program, National Centre for Agricultural Research (CNRA), Bouaké Regional Office, P.O. Box 633 Bouaké 01, Bouaké, Cote d'Ivoire.*
[2] *Laboratory of Food Biochemistry and Processing of Tropical Products, Nangui ABROGOUA University (UNA), UFR STA; P.O. Box 801 Abidjan 02, Abidjan, Cote d'Ivoire.*

GSC Biological and Pharmaceutical Sciences, 2025, 30(02), 269-280

Publication history: Received on 02 January 2025; revised on 15 February 2025; accepted on 18 February 2025

Article DOI: https://doi.org/10.30574/gscbps.2025.30.2.0058

Abstract

Despite its cultivation in Côte d'Ivoire, the problem of availability of edible mushrooms persists, limiting their use in the human diet. The aim of this research was therefore to address the productivity problems of the mushroom *Pleurotus geesteranus*, which is known for its nutritional benefits. To achieve this, a SWOT analysis of the mushroom production process at the FESAAP farm was carried out to identify the factors hindering production and to propose solutions. The SWOT analysis identified a number of issues including management, understanding of production and effective cultivation methods. It also highlighted strengths such as proximity to customers and low production costs. The external environment study also identified opportunities such as a non-competitive local market and a diverse customer base. However, lack of technical support, lack of bank finance and unavailability of inputs were identified as threats to the sustainability of the business. Implementing corrective measures, such as drawing up an organizational chart and building trust between workers and management, will help to significantly increase production.

Keywords: Edible mushroom; Oyster mushroom; SWOT; Management; Participant observation

1. Introduction

In many African countries, such as Côte d'Ivoire, edible mushrooms are known and consumed in households [1]. In the regions of Gbêkê, Bélier and N'Zi, 69.6 % to 76.0 % of the population prefer to eat mushrooms, especially in fresh form [2]. In rural areas, most people collect them for domestic consumption and for sale [3]. In these areas, mushrooms are considered a substitute for meat, but their consumption remains limited due to their seasonality [4]. Mushroom cultivation therefore appears to be a solution that can contribute both to their availability and to reducing the incidence of metabolic diseases such as diabetes mellitus [5]. Several studies have already highlighted their nutritional value, their acceptance in dietary habits and their therapeutic properties [1] [5]. These mushrooms are known to have a positive influence on the glycaemic response thanks to their ability to reduce glycaemia [6] [7]. They induce low postprandial glycaemic responses due to their high polysaccharide and soluble fibre content [8]. They are also excellent sources of bioactive compounds such as polyphenols, flavonoids, lectins, isothiocyanates, ergosterol, terpenoids, glycosides and alkaloids, as well as significant amounts of vitamins and minerals that contribute to good health [9]; [10].

Unfortunately, mushroom cultivation is still in its infancy in Côte d'Ivoire. Currently, the most widely cultivated species is *Pleurotus geesteranus* (*P. geesteranus*), also known as 'oyster mushroom', mainly in Dabou, in the Grands-Ponts region. It is a mushroom that adapts best to tropical climatic conditions [5]. Despite the popularity of this activity, its diffusion

* Corresponding author: Adam Camille KOUAME

remains limited. For mushroom growers, this form of agriculture is heavily dependent on neighbouring countries, particularly Ghana and Togo, which have a wealth of experience in cultivation practices. The seeds and technical staff needed for this activity come from these countries. This raises the issue of skills and technology transfer [5], given the strong agricultural competition from these countries. This situation has a further negative impact on national production, as Ivorian mushroom producers face difficulties in accessing seeds and skills [11]. Low production discourages potential players, leading to the abandonment of this income-generating activity [5]. The disarray of mushroom growers is also fuelled by the lack of government policies in favour of this sector of activity, as this crop is considered marginal.

The problem of the availability of edible mushrooms arises despite the high demand [4] [11], hence the inflation of the purchase price on the markets. In such a context, the sustainability of fungiculture in Côte d'Ivoire requires better dissemination of cultivated edible mushrooms, as well as support for growers. The cultivation of edible mushrooms therefore appears to be an activity that deserves support. However, questions remain as to its real contribution to the country's food system. Hence, the need to find answers to a number of questions, in particular:

- Does the current production system meet the requirements for sustainable development of the mushroom-growing activity?
- Does the model of periodic harvesting of the *P. geesteranus* mushroom enable its nutritional potential to be preserved?
- Is the *P. geesteranus* mushroom an alternative solution that is more respectful of people's consumption habits and cultural traits?

Finding answers to these questions could contribute to the development of mushroom growing. A resilient approach consists of a process for collecting and processing the information needed to identify the problems and opportunities of mushroom growing, analyse the key issues and propose potential solutions. The aim of this study was to diagnose several systems involved in the production of edible mushrooms (*P. geesteranus*). Specifically, the aim was to assess these production systems by analysing the strengths and weaknesses of one of the largest mycicultural and agro-pastoral farms in Cote d'Ivoire.

2. Material and methods

2.1. Biological materials used for the surveys

The species *P. geesteranus* (**Figure 1**), generally known as the oyster mushroom, is characterised by a slightly domed cap (pileus) which spreads out in a fan shape with a diameter of 4 to 15 cm. The non-biological material consists of data collection aids. These include two questionnaires for surveys of key players and an interview guide for indirect players in the value chain.

Figure 1 Cultivation of the *P. geesteranus* mushroom

2.2. Study setting

This study took place on an agro-pastoral farm. It focused mainly on the production activities of the farm 'Femme Solidaire pour l'Action pour Auto-Promotion' or FESAAP for short. This farm was chosen as the main research area because it supports the promotion of high organic value crop production. Created on 03 October 2006 (Reference:

N°559/MI/DGAT/DAGP/SDVA from the Ministry of the Interior), the FESAAP association is a women's group in the Dabou department (5°19'18,9''N 4°23'54,7''W) whose activities are aimed at improving the living conditions of its members, especially the most disadvantaged. Since 2011, FESAAP has been growing and marketing *P. geesteranus* edible mushrooms on its farm.

The data for this study was collected through a diagnostic survey of the actors in the value chain. The survey was based on the use of data collected in the field (participant observation, semi-directive interview and observation grid) and the implementation of a SWOT analysis. Data collection was carried out at the FESAAP farm from February 2016 to March 2017. The data collected related to the production and marketing of edible mushrooms. The aim was to learn more about the organisation of the mushroom farm, to identify the actors involved, to understand the rules that govern its operation, to assess its strengths and weaknesses, and finally to identify prospects and courses of action to improve the productivity of edible mushrooms. This analytical approach was complemented by observations, interviews and discussions with the actors involved, as well as with a number of key informants from the various support services for the mushroom sector, such as input suppliers, financial institutions and research institutes.

2.2.1. Field data collection

Data were collected by means of participant observation and semi-directive interviews in order to:

- identify the actors involved in mushroom cultivation,
- understand the rules governing its operation,
- identify its strengths and weaknesses (SWOT), and
- identify prospects and options for improving mushroom productivity.

For this purpose, an observation grid was developed**.** Participant observation is an inductive approach that aims to discover, through observation, what organises the social relations, practices and representations of the actors in the field under study [12]. The interviewer or participant-observer, whose role is defined in advance within the host organisation, takes an active part in the immersion tasks. If the researcher succeeds in creating a relationship of trust with the interviewees, he or she will then be able to increase his or her ability to observe from the data-source subjects. In this study, participant observation enabled access to information that was not easily accessible and a better understanding of certain functions that are difficult to grasp, especially for an outsider. This method makes it possible to collect data from several sources:

- Participant observation proper (what the researcher notices or 'observes' by living with people, by sharing their activities);
- Ethnographic interviews;
- Occasional conversations in the field and studies of official and,
- Above all, 'personal' documents (this term refers to material in which people reveal their point of view on the terrain observed, using their own language).

In practice, the semi-directive interview, also known as the 'focused interview' [13], is an interview in which the interviewer defines a general topic using a structured guide to address a series of issues. More specifically, the interviewer talks to a number of targeted interviewees (resource persons, consumers, producers and traders) to get a clear idea of the main issues raised by the topic under study. This was not a simple discussion, but a social exchange guided by the search for specific information, framed in terms of a hypothetical working problem related to the subject under study. This involved talking to a series of targeted contacts (resource persons, consumers, producers and traders) in order to get a clear idea of the main issues raised by the subject under study. The aim of these interviews was to learn in depth about the capacity for investment and the day-to-day management of the FESAAP farm. To do this, the topics in our interview guide were discussed in terms of investment capacity, FESAAP's assets, access to credit from other organisations, how FESAAP members are paid, how the sales force is monitored, how training is organised, and the farm's ambitions and forecasts.

2.2.2. Overall strategic diagnosis

At the end of the participant observation on the farm, the qualitative data collected were subjected to a diagnostic analysis. This diagnosis was justified by the unexplained decline in mushroom production. Two different but complementary approaches were used. The first approach is based on the ISHIKAWA diagram [14] which explains the causes of this decline in mushroom productivity, and on an analysis of internal factors (strengths and weaknesses) and external factors (opportunities and threats), which would allow the information from the diagram to be classified in a SWOT matrix. The second approach is to use the data collected with the SWOT diagnostic tool.

To explain the decline in the production of *P. geesteranus* mushrooms, the ISHIKAWA 'cause-effect' or fishbone diagram (**Figure 2**) adapted to organisations was used [15]. This tool makes it possible to identify all the causes that may affect an observed effect, in this case the lack of production. For this diagram, the diagnosis was limited to the seven main causes of potential malfunctions in our organisation, namely: the environment, the workforce, the method, the materials, the equipment, the management and the financial

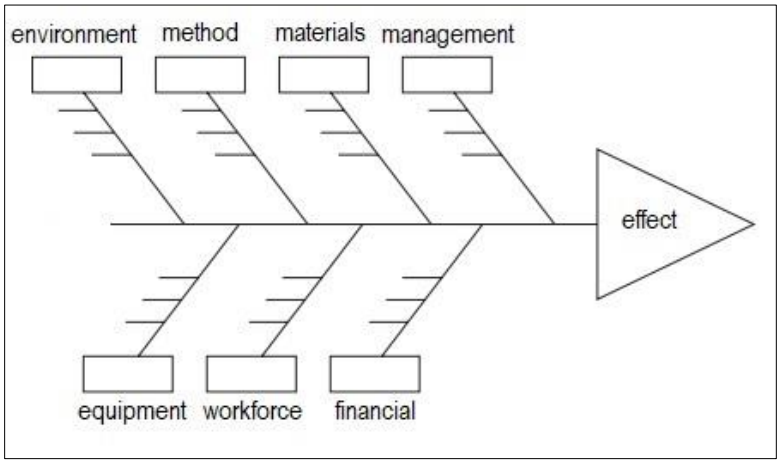

Figure 2 ISHIKAWA diagram [15]

2.2.3. Data treatment

The SWOT matrix (**Table 1**) was used to analyze and process the data. SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis is a marketing tool often used in the development of innovative projects. It is used to summarise the strengths and weaknesses of the company, as well as the potential opportunities and threats of the market or activity, in order to help define improvement strategies. In this context, the analysis focused on the problem of the productivity of mushrooms grown on the farm, in particular those grown from *P. geesteranus* mushrooms. The implementation took place in two distinct stages: identification of the internal qualities of the exercise (strengths and weaknesses) in the overall context and in relation to external factors (opportunities and threats), followed by the development of corrective strategies. In order to provide an overall view of the various issues addressed in the context of this study, the results of the SWOT analysis were presented in the form of a table detailing the strengths, weaknesses, opportunities and threats.

Table 1 SWOT matrix

	Positive	**Negative**
Internal	Strengths	Weaknesses
External	Opportunities	Threats

3. Results

3.1. Information from participant observation

The internal workings of the FESAAP farm and the environment in which it operated from February 2016 to March 2017 are described in Table 2. Activities such as composting, bagging, sterilisation, larding on sterilised logs, incubation and fruiting and their positioning were the main points noted. At the composting stage, the farm had four formulations. The staff, mostly women, had neither the physical capacity nor the workers to turn the compost twice a week. To remedy this situation, young workers looking for work occasionally augmented the production team. In the face of repeated failures (low or no production), those in charge (chairman of the board and production manager) enlisted the help of growers from other farms. However, the production of *P. geesteranus* mushrooms could not be resumed.

Apart from these facts, some ingredients, such as chalk, were difficult to access, although others, such as sawdust and rice bran, were available. At the bagging stage, the staff were able to demonstrate a high level of expertise. This activity is easy to carry out and does not require additional staff. It took between 2 and 3 hours, or even a whole day if the

quantity of compost available was large. The limiting factor in the implementation phase was the acquisition of heat-resistant bags, as suppliers often required expensive orders for the manufacture and delivery of bags. As regards the log sterilisation phase, a good command of the sterilisation technique was observed. This activity lasted 4 hours and did not require any external support. The disadvantages were the use of rudimentary equipment whose effectiveness could not be verified or controlled, and the absence of a preventive maintenance plan for the sterilisation system.

The shortage of firewood used as fuel was causing concern among the FEESAP production team. Stock shortages meant that the production process for *P. geesteranus* mushrooms had to be systematically halted. The inoculation process proved to be a delicate operation, requiring compliance with strict aseptic conditions. Working conditions were found to be unsatisfactory and the risk of cross-contamination of the logs was high. The farm did not have a seeding room, which is necessary to ensure hygiene. In addition, the staff did not have adequate equipment for larding, and the farmers did not have a sufficient grasp of the concepts of hygiene, cross-contamination and asepsis. In addition, there were stock-outs of spawn, which was often of poorer quality. This posed a threat to the smooth running of the operation.

At the incubation and fruiting stages, the activities carried out were similar in terms of managing environmental parameters and hygiene. However, these activities differed according to the objectives pursued. The incubation process lasted 45 days and was intended to allow complete colonisation of the logs. As for fruiting, it was intended to promote the transformation of the mycelium into the fruiting body, i.e. the mushroom. The investigations revealed a disturbance in the incubation and fructification process. The incubation and harvesting rooms were not equipped to control environmental parameters (temperature, humidity, CO_2, O_2, etc.). These same rooms were also used to store various tools (shovels, wheelbarrows, watering cans, etc.) and inputs (chalk, rice bran, etc.). Pests had damaged the wooden shelves. The presence of animal droppings (mice, geckos, snails, etc.) in these premises was noted, despite attempts at pest control (installation of mousetraps, crawl space, etc.).

Observing the way these operations were carried out, it is a safe bet that the farm had not drawn up a cleaning and disinfection plan. In terms of the environment in which the farm operated, FESAAP was in a privileged position, thanks to its collaboration with several technical partners, in particular the Ministry of Agriculture and Rural Development (MINADER), the United Nations Development Programme (UNDP) and other mushroom farms, as well as with commercial partners (restaurants and consumer households). Despite this favourable position, FESAAP does not benefit from technical support from national supervisory structures such as ANADER (Agence Nationale d'Appui au Développement Rural), CNRA (Centre National de Recherche Agronomique), the National Rural Trades Training Programme, or financial support from funding structures such as FIRCA (Fonds Interprofessionnel pour la Recherche et le Conseil Agricoles), BNI (Banque Nationale d'Investissement), etc.

Table 2 Information from participant observation

Activities observed	**Composting stage**
Preparing the compost.	Sawdust (the main ingredient in the matrix) and rice bran (a protein supplement) are available and cheap
	Lime (which the women call 'chalk') is difficult to get hold of. The supplier requires a taxpayer's account before any deliveries can be made.
	To obtain supplies of lime, the farm places its orders through other farms.
	The farm offers four formulas for preparing compost.
	Despite these formulas, the farm calls on outside help to deal with its low production.
	The actions of the technicians are not controlled, due to a lack of clear guidelines when preparing the compost
Turning the compost	The compost is not turned regularly, which slows down the composting process. This composting activity requires a lot of effort from brave women of a certain age (> 40).
	This activity took place once a week instead of twice a week
Activities observed	Bagging stage
Bagging process	This stage is easy to carry out.
	It takes between 2 and 3 hours, or even a day if you have a large quantity of compost.

	Heat-resistant bags are not readily available. The supplier requires an order of three million CFA francs before making and delivering the bags. The farm uses a private individual (who is himself a grower) rather than a wholesaler or a possible cooperative for delivery.
Activities observed	Sterilisation stage
Sterilisation process	The metal drum is used to sterilise the logs and the firewood is used as fuel.
	The equipment is rudimentary, so it is difficult to assess its efficiency or control.
	The metal drum is rusty, due to the lack of a preventive maintenance plan.
	The staff have a good command of the sterilisation technique.
	Staff let the logs cool in the drum before seeding.
	Fuel shortages frequently observed.
	This stage takes 4 hours
Activities observed	Spawning stage on sterilised logs
Seeding process	A delicate operation, in which aseptic conditions are recommended.
	Working conditions are not aseptic, with a high risk of cross-contamination.
	The farm does not have an inoculation room, which is essential to ensure hygiene.
	The staff have no equipment to reduce the risk of contamination of the logs during the operation.
	The supplier is based in Ghana.
	There is a risk of a shortage of spawn due to domestic demand in Ghana.
	Seedling spawn imported from Ghana is often of poor quality.
	A metal rod sterilised only with alcohol is used to scrape the spawn to detach the grains.
	The staff do not have a good grasp of the concepts of 'hygiene', 'cross-contamination' and 'asepsis'.
Activities observed	Incubation and fruiting stage
Incubation and fructification processes	A delicate operation, in which aseptic conditions are recommended.
	Working conditions are not aseptic, with a high risk of cross-contamination.
	The farm does not have a sowing room, which is essential to ensure hygiene.
	The staff have no equipment to reduce the risk of contamination of the logs during the operation.
	The supplier of seed spawn is based in Ghana.
	There is a risk of a shortage of spawn due to domestic demand in Ghana.
	Seedling spawn imported from Ghana is often of poor quality.
	A metal rod sterilised only with alcohol is used to scrape the spawn to detach the grains.
	The staff do not have a good grasp of the concepts of 'hygiene', 'cross-contamination' and 'asepsis'.
Activities observed	Positioning
Technical partners (Ministry of Agriculture and Rural Development) and UNDP	FESAAP is considered the showcase of fungiculture in Côte d'Ivoire. This is due in particular to the collaborations it has entered into.
	The supervisory ministry has been invited to the SARA (Abidjan International Agricultural and Animal Resources Show).
	The supervisory ministry is providing two places on an advanced training course in mushroom cultivation in China.

	The UNDP, as well as being a sponsor of the Mushroom project, provided training on simplified management at the request of the farm.
Activities observed	Positioning
Commercial partner Other growers	The partners consider FESAAP to be a reliable supplier.
	Households would like to see a reduction in the selling price of mushrooms.
	The mushroom growers consider the FESAAP farm to be a school farm, as it has helped some of them to train and set up in business.
	FESAAP helps other mycological farms to sell their mushroom production.
General observations	FESAAP does not receive any technical support from national supervisory bodies.
	FESAAP receives no financial support from funding bodies.
	FESAAP does not belong to any cooperative.

3.2. Restitution of the ISHIKAWA cause and effect diagram (the 7 M's)

The influence of management, materials, methods, the environment, financial resources, labour and materials and equipment (7 M) on the production of *P. geesteranus* mushrooms on the FESAAP farm was expressed using a cause-effect diagram or ISHIKAWA diagram (**Figure 3**). At management level, the absence of an operating organisation chart and production schedule was one of the causes identified for the lack of production. The risk of a shortage of sawdust and firewood, the poor quality of the spawn and its unavailability in the 'Materials' component also hampered mushroom production. In the 'Methods' component, causes such as frequent delays in the compost preparation phase and the watering of logs in the harvesting room were identified. The 'environment' in which FESAAP operated was not always conducive to good mushroom productivity. The causes were the lack of agricultural support from institutions and the very complex conditions for accessing loans. Financial resources' were also lacking in the production of *P. geesteranus* mushrooms, due to the farm's low investment capital. In terms of 'manpower', FESAAP had staff with little knowledge of mycology. The equipment used in their activity had a negative impact on mushroom yields. The risk of a shortage of heat-resistant bags and the use of rudimentary equipment were the main causes in the 'Materials' component.

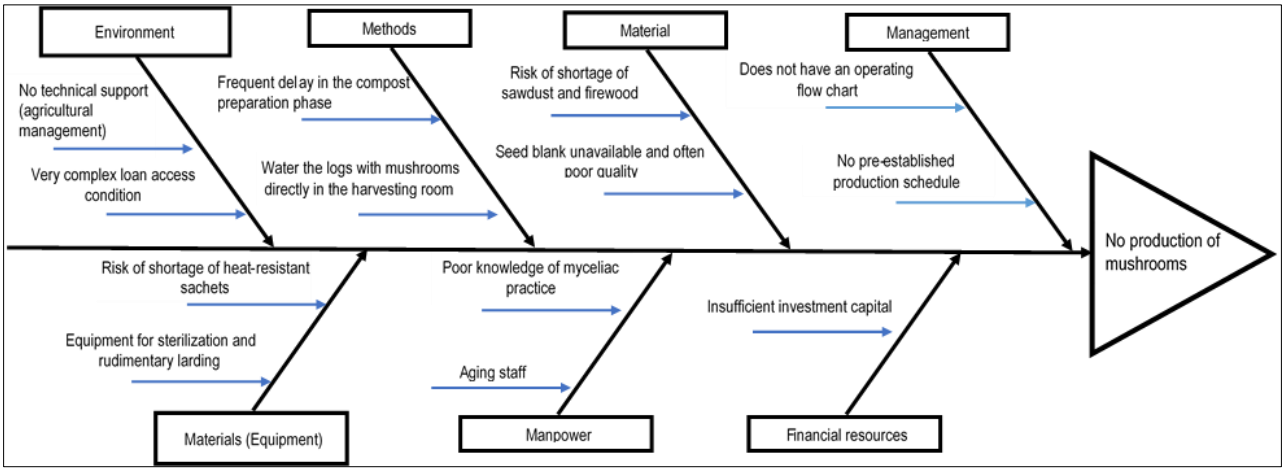

Figure 3 Cause-effect diagram (ISHIKAWA diagram) for the FESAAP farm and its environment

3.3. Restitution of the SWOT analysis

The data presenting the strengths, weaknesses, opportunities and threats of the FESAAP mycicultural farm illustrate perfectly the internal organisation put in place as well as the opportunities and difficulties linked to this sector of activity (Table 3). Seven strengths of the farm were listed. The availability of oyster mushrooms and the fact that they are popular despite their recent introduction make them a major asset. The low cost of production, observed during the observation, means that the mushrooms are very competitively priced compared with imported mushrooms. This is a major advantage when it comes to conquering the market. Given the marketing policy in place, the FESAAP farm seems

to sell off the production of other farms. These circumstances mean that FESAAP is well known among its partners. With its experienced staff, the farm has the opportunity to improve its productivity.

Looking at the farm's weak points, the excessive number of voluntary departures was a major issue. These many departures contributed to a drop in the level of staff, particularly in the management of environmental factors in the incubation and harvesting rooms, as well as in the execution of the technical itinerary. In addition, the staff did not benefit from any capacity-building sessions. In addition, the lack of financial resources available for investment was a limiting factor in its development. Other health-related shortcomings were identified by the survey in terms of contamination. These included the lack of a cleaning and disinfection plan and the layout of the various rooms, which was conducive to cross-contamination.

As far as opportunities were concerned, the mushroom market was not yet subject to strong competition. If production was high, FESAAP could have produced by-products in addition to selling mushrooms. This activity could have been another source of income and an alternative for preserving the mushroom. The policy of promoting local food products is also a boon for FESAAP in the event of an increase in production. As for the creation of a cooperative, this represents an opportunity, given that its mission will be to develop and market the production of its members.

The investigations also revealed threats associated with mushroom growing. These risks are associated with the poor quality of the seedling spawn, a shortage of sawdust and firewood, and the lack of technical support from supervisory bodies. The survey also revealed concerns about the marketing of mushrooms. This concern depends on the desire of households to demand a reduction in the selling price. Finally, the survey revealed the lack of financial support for producers. This is a major threat to FESAAP.

Table 3 SWOT matrix describing the internal factors (Strengths and Weaknesses) and external factors (Opportunities and Threats) of the FESAAP farm

Factors	**Positives**	**Negatives**
Internal factors	**Strengths**	**Weaknesses**
	Oyster mushrooms available and popular despite their recent introduction; Effective marketing policy; Proximity to customers, enabling FESAAP to sell off production from other farms; Low production costs for oyster mushrooms; Mushrooms produced locally are very competitively priced compared with those imported; Recognised reputation by partners; Experienced staff (8 years).	Absence of an operating organisation chart ; Technical itinerary poorly executed by staff; Layout of the various operating rooms conducive to cross-contamination; Too many voluntary departures; Staff not sufficiently trained to manage environmental factors; Lack of a cleaning and disinfection plan for premises and equipment; Lack of capital to cover the investment required for installation; Capacity-building sessions not planned.
External factors	**Opportunities**	**Threats**
	Market not yet subject to strong competition; Possibility of using products derived from mushrooms; Creation of a cooperative to pool efforts; A policy of promoting local food products, as advocated by supermarkets, in line with fungiculture.	Consumers who want lower prices for cultivated mushrooms ; Seedling spawn often of poor quality; Risk of shortages due to sawdust and firewood; Lack of financial support for producers; Lack of technical support from supervisory bodies.

4. Discussion

The data obtained during the participant observation enabled us to identify the strengths and weaknesses of this mushroom farm. One of these strengths is the door-to-door sales approach. This approach has contributed significantly

to an increase in the farm's customer portfolio (restaurants, private individuals and supermarkets). Unlike pick-your-own mushrooms [3], oyster mushrooms are perennial, which gives them an undeniable advantage. Their availability is enhanced by the low cost of production, using cheap and readily available organic waste, and simple techniques combining rudimentary local equipment such as metal barrels, plastic bags and forks. Not using fertilisers and pesticides also reduces production costs. This represents a twofold advantage for the farm, as it both reduces expenditure on these inputs and protects consumer health by avoiding the presence of pesticide residues in the mushrooms produced. This explains the lower prices of locally produced oyster mushrooms compared with imported ones. FESAAP is also recognised as a pioneer in mushroom cultivation in Cote d'Ivoire. To this must be added staff who have been growing mushrooms for a long time (8 years on average). This policy of promoting the cultivation of oyster mushrooms explains the reputation it now enjoys in this sector. This is perfectly illustrated by the various agreements signed with these partners.

However, this momentum has been held back by low oyster mushroom production. In fact, several dysfunctions linked to the internal organisation of the farm were observed. These malfunctions manifested themselves in the day-to-day running of the various production activities. The poor execution of technical itineraries can be cited. For example, the way in which compost was prepared varied from one formulation to another, so that the technicians used different formulations. These formulations were obtained through external collaborators to meet production needs. Although the farm managers generally knew these substrate formulations, the technicians in charge of preparing the compost did not really master them. The result was a multitude of formulations, which contributed to improvisation in the fermentation period.

Although the farm managers generally knew these substrate formulations, the technicians in charge of preparing the compost did not really master them. The result was multiple formulations that contributed to improvisation in terms of fermentation time. The farm's current infrastructure also affected the production process, particularly the incubation stage. Inputs were stored in the incubation room, and the comings and goings of workers in the room disrupted the incubation process. Incubation conditions were therefore no longer suitable for optimal vegetative growth. The low mushroom production could also be explained by the absence of a cleaning and disinfection plan for the premises and equipment. This contributed to the proliferation of parasites such as insects, mites and nematodes. It is well known that these pests are the agents responsible for biological stress in the cultivation of mushrooms [16]. They are one of the major causes of reduced crop yields. In general, up to 25% of harvests are lost to insects. Losses can be as low as 20 % with nematodes [17].

Financially, the FESAAP farm does not have sufficient capital to withstand the investment requirements necessary for its production (land, minimum specific equipment, etc.). This shortcoming was a limiting factor for implementing an expansion policy or upgrading human resources and material's [18]. This situation makes investment impossible. Apart from financial support from the UNDP to set up the farm and acquire the equipment needed to grow oyster mushrooms, the women's group's only income came from marketing the mushrooms. The financial situation of the FESAAP farm makes day-to-day management difficult. The difficulties in obtaining supplies of consumables such as calcium carbonate, firewood and heat-resistant bags are a perfect illustration of this. Added to this is the high number of voluntary departures and the lack of capacity building for newly recruited technical staff.

This state of affairs undermines the effectiveness of the FESAAP farm. These departures have an impact on the quality of the service, as Wynen and Kleizen [19] point out in 'Turnover & Performance; testing alternative views'. For this type of activity, capacity building is necessary to ensure the smooth running of the farm, as in any organisation that aims to be professional. Such capacity building facilitates the implementation of new activities, such as preventive maintenance and the management of critical points in farming practice. In this situation, some recommendations for growers can be made. These include:

- Drawing up a plan for cleaning and disinfecting premises and equipment,
- Defining a technical itinerary from the composting process through to harvesting the mushrooms,
- Clarifying the role of each member of the technical team and,
- Drawing up a capacity-building plan for staff.

The opportunities and threats associated with the FESAAP farm's activities have a strong influence on its operation, particularly the *Pleurotus geesteranus* mushroom production system. The opportunities identified during the observations augur well for the farm. These prospects can easily be seen in the fact that the mushroom market is not very competitive at the moment. This is undeniably an advantage for the FESAAP farm, as it will enable it to establish a long-term presence on the edible mushroom market in Côte d'Ivoire. However, there are a number of threats associated with growing and selling these mushrooms. The difficulties identified are proof of this. Most of these threats are

technical, logistical, financial, social and economic in nature. The frequent shortages of inputs such as calcium carbonate ($CaCO_3$) and heat-resistant sachets are a perfect illustration. In the case of heat-resistant sachets, suppliers require large orders, which is often well beyond the logistical and financial capabilities of the FESAAP farm. The unavailability of calcium carbonate can be explained by administrative constraints, but also by the difficult purchasing conditions for small farmers like FESAAP.

These very frequent input shortages led to the cessation of production activities, and therefore to a loss of income for the structure. Djomene et al [20] described the same complexity in their work on the management of the mushroom industry in Cameroon, despite the fact that this activity contributes actively to the development of the country's economy. The technical nature of mushroom production could be cited as a major obstacle to the smooth running of FESAAP. This is an environment characterised by several difficulties, in particular the lack of quality seedlings and producers' poor technical skills. For Kimole [21], these difficulties are even a precondition for the emergence of mushroom production. It is well known that spawn is the main ingredient in mushroom production [22] and, in Côte d'Ivoire; oyster mushroom spawn is imported directly from Ghana. Moreover, there is no branch selling seeds in Côte d'Ivoire. Importing seed spawn therefore entails additional production costs associated with handling, the acquisition of transport equipment and road congestion.

With regard to the threats posed by the FESAAP farm's activities, the following recommendations were made:

- Put in place a strategic action plan to promote the cultivation of edible mushrooms;
- Build the capacity of supervisory staff;
- Improve relations between mushroom growers and supervisory staff.
- Encourage the creation of a training centre for new learners;
- Organise the system of small farms to enable the development of projects and increase production per unit area;
- Encourage closer links between mushroom growers and financial backers (banks) finally,
- Encourage the creation of a seed centre

5. Conclusion

The SWOT assessment of the mushroom production process has enabled us to gain a better understanding of how the FESAAP farm operates and to optimise the management of its production unit. Strengths, weaknesses (internal factors), opportunities, and threats (external factors) were identified. Many problems were identified, particularly in terms of management, knowledge of production and good mushroom growing practices. Strengths such as proximity to customers and low production costs were also identified. The analysis of the external environment also revealed opportunities, such as a non-competitive local market and a diverse customer base. On the other hand, lack of technical support, lack of bank finance and unavailability of inputs were identified as threats to the sustainability of this activity. Recommendations are made to address the identified shortcomings and to further improve the production capacity of the *P. geesteranus* mushroom.

Compliance with ethical standards

Acknowledgments

The authors would like to thank the association FESAAP, a group of women in the department of Dabou who work to improve the living conditions of these members, especially the most disadvantaged.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] De Kesel A, Boukary AA, Yorou, NS, Degreef J. West African edible mushrooms (Y. Samyn, Ed.), 2024, 24:1-325, CEBioS, Royal Belgium Institute of Natural Sciences. ISBN: 9789073242777

[2] Anno HFA. Four edible saprophytic mushrooms from central Côte d'Ivoire: socio-dietary study, chemical characteristics and antioxidant potential. [Ph.D. dissertation]. Nangui Abrogoua University, Abidjan Côte d'Ivoire. 131p. 2017.

[3] Koné NA, Yéo K, Konaté S, Linsenmair KE. Socio-economical aspects of the exploitation of Termitomyces fruit bodies in central and southern Côte d'Ivoire: raising awareness for their sustainable use. Journal of Applied Biosciences, 2013. 70, 5580-5590. http://m.elewa.org/JABS/2013/70/6.pdf

[4] Soko DF, Kotchi V, Boye MAD, Yao KG, Aké S. Influence of substrate formulation and Pleurotusspwan age on the growth andcarpophores production in the locality of Allokoua (Côte d'Ivoire). International Journal of Food Science and Nutrition, 2018 6(3): 151 – 156.

[5] Boukary A-A, Olou B; Piepenbring M, Yorou NS. Mushroom cultivation in tropical Africa: Successes, challenges, and opportunities Original content: review Database. International Journal of Agricultural and Food Research, 2024, 18:101264, DOI: 10.1016/j.jafr.2024.101264

[6] Firenzuoli F, Gori L, Lombardo G. The Medicinal Mushroom Agaricus blazei Murrill: Review of Literature and Pharmaco-Toxicological Problems. Evidence-based complementary and alternative medicine, 2008, 5(1), 3-15. doi: 10.1093/ecam/nem007

[7] Henriques GS, Helm CV, Busato AP, Simeone MLF. Lipid profile and glycemic response of rats fed on a semi-purified diet supplemented with Agaricus brasiliensis mushroom. Acta Scientiarum. Health Sciences, 2016 38(1), 71-79. doi:10.4025/actascihealthsci.v38i1.29185

[8] Jeong SC, Jeong YT, Yang BK, Islam R, Koyyalamudi SR, Pang G, Cho KY, Song C H. White button mushroom (Agaricus bisporus) lowers blood glucose and cholesterol levels in diabetic and hypercholesterolemic rats. Nutrition Research, 2010. 30(1), 49–56. doi:10.1016/j.nutres.2009.12.003

[9] Hwang HJ, Kim SW, Lim JM, Joo JH, Kim HO, Kim HM, Yun JW. Hypoglycemic effect of crude exopolysaccharides produced by a medicinal mushroom Phellinus baumii in streptozotocin-induced diabetic rats. Life Sciences, 2005, 76(26), 3069-3080. doi: 10.1016/j.lfs.2004.12.019

[10] Bernaś E, Jaworska G, Lisiewska Z. Edible mushrooms as a source of valuable nutritive constituents. Acta Scientiarum Polonorum Technologia Alimentaria, 2006, 5(1), 5-20.

[11] Soko DF, Dally T, Kotchi V, N'guessan FF, Boye MAD, Ayolie KG, Aké S. Influence of spawn age (seed) on the carpophore production and nutritional quality of the edible mushroom pleurotus eous in allokoua (Côte d'Ivoire). Asian Journal of Science and Technology. 2019; 1(10):9239 – 9244

[12] Soulé B. Participatory observation or observant participation? Uses and justifications of the notion of observational participation in the social sciences, Recherches qualitatives, 2007, 27(1), 127-140

[13] Merton RK, Fiske M, Kendall PL. The Focused Interview: A Manual of Problems and Procedures. 2nd Edition, Free Press, New York. 1990.

[14] Zielińska-Chmielewska A, Mruk-Tomczak D, Wielicka-Regulska A. Qualitative Research on Solving Difficulties in Maintaining Continuity of Food Supply Chain on the Meat Market during the COVID-19 Pandemic. Energies, 2021, 14. 5634. 10.3390/en14185634..

[15] Hohmann C. Techniques de productivité, Comment gagner des points de performance. Pour les managers et les encadrants. Editions d'organisation EYROLLES. 2009, 258p. ISBN: 978-2-212-54295-0

[16] Rinker LD. Insect, Mite, and Nematode Pests of Commercial Mushroom Production: Technology and Applications. In book: Edible and Medicinal Mushrooms pp.221-237, 2017. DOI:10.1002/9781119149446.ch11

[17] National Institute of Biotic Stress Management. Biotic stress in agriculture [Available from: « http://www.nibsm.org.in/index.php/abiotic-stresses »] cited 07/01/2019.

[18] Marshall E, Nair G. Make money by growing mushrooms. Rome: FAO. 2009

[19] Wynen J, Kleizen B. Improving dynamics or destroying human capital ? The nexus between excess turnover and performance. Review of Managerial Science. 2017, 13(2):1-23 doi:10.1007/s11846-017-0249-9

[20] Djomene YS, Foudjet EA, Fon DE, Ninkwango TA. Marketing edible mushrooms in Cameroon. Revue Scientifique et Technique Forêt et Environnement du Bassin du Congo, 2017, 8 65-71,

[21] Kimole S. The Adoption of Mushroom Farming among Smallholder Farmers: A Case of Women Mushroom Farmers in Makuyu, Kenya. Unpublished ME d Thesis, School of Sciences, Van Hall Larenstein University of Applied sciences, Kenya, 2012.

[22] Imtiaj A, Rahman S. Economic viability of mushrooms cultivation to poverty reduction in Bangladesh. Tropical and Subtropical Agroecosystems, 2008, 8, 93-99.