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UNVEILING THE MUSHROOM VALUE CHAIN: OPPORTUNITIES AND CONSTRAINTS IN PARTIDO DISTRICT, CAMARINES SUR, PHILIPPINES

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Abstract: The agribusiness sector in the Philippines faces costs, productivity, and crop yield challenges, with a persistent focus on traditional crops despite evidence supporting the potential of high-value crops. The objectives include identifying key actors, analyzing costs and returns at each stage, and uncovering constraints and opportunities within the mushroom value chain. A comprehensive methodology involving key informant interviews, focus group discussions, observations, and document reviews was employed to collect primary data from various stakeholders. The study reveals the diverse channels in the mushroom value chain, including direct sales to consumers, processing by farmers, and engagement with intermediaries like wholesalers. The value chain map visually depicts these relationships and interactions. Results highlight the roles of different actors, such as mushroom farmers, middlemen, retailers, and processors. The processor, often a farmer, emerges as the most profitable, benefiting from processed mushroom products with an extended shelf life. The study calculates the net profit margin for each actor, revealing the financial dynamics across the value chain. The study also discusses the constraints and opportunities faced by various value chain actors and concludes with policy recommendations to enhance the development of mushroom production in the district. Agribusiness managers can leverage the insights from this study to make informed decisions, develop strategic plans, and implement initiatives that capitalize on the oyster mushroom value chain's untapped potential, contributing to the agricultural sector's overall development in the Partido District and beyond.

Keywords: mushroom, oyster mushroom, value chain analysis, supply chain analysis

Abstrak: *Sektor agribisnis di Filipina menghadapi tantangan terkait biaya, produktivitas, dan hasil panen, dengan fokus yang terus-menerus pada tanaman tradisional meskipun ada bukti yang mendukung potensi tanaman bernilai tinggi. Tujuan penelitian ini meliputi identifikasi pelaku kunci, analisis biaya dan hasil pada setiap tahap, serta mengungkapkan kendala dan peluang dalam rantai nilai jamur. Metodologi komprehensif yang melibatkan wawancara dengan informan kunci, diskusi kelompok fokus, dan tinjauan dokumen digunakan untuk mengumpulkan data primer dari berbagai pemangku kepentingan. Penelitian ini mengungkap kanal yang beragam dalam rantai nilai jamur, termasuk penjualan langsung kepada konsumen, pengolahan oleh petani, dan keterlibatan dengan perantara seperti pedagang besar. Peta rantai nilai secara visual menggambarkan hubungan dan interaksi ini. Hasil penelitian menyoroti peran berbagai pelaku, seperti petani jamur, perantara, pengecer, dan pengolah. Pengolah, yang seringkali seorang petani, muncul sebagai yang paling menguntungkan, mendapatkan manfaat dari produk jamur olahan dengan umur simpan yang diperpanjang. Penelitian menghitung margin keuntungan bersih untuk setiap pelaku, mengungkapkan dinamika keuangan di sepanjang rantai nilai. Penelitian juga membahas kendala dan peluang yang dihadapi oleh berbagai pelaku rantai nilai dan menyimpulkan dengan rekomendasi kebijakan untuk meningkatkan pengembangan produksi jamur di distrik tersebut. Manajer agribisnis dapat memanfaatkan wawasan dari studi ini untuk mengambil keputusan yang berdasar, mengembangkan rencana strategis, dan melaksanakan inisiatif yang memanfaatkan potensi belum tergali dari rantai nilai jamur tiram, yang akan berkontribusi pada pengembangan keseluruhan sektor pertanian di Distrik Partido dan sekitarnya.*

Kata kunci: *jamur, jamur tiram, analisis rantai nilai, analisis rantai pasokan*

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INTRODUCTION

Agribusiness in the Philippines encounters many issues related to costs, productivity, and crop yield. The country's agricultural development policy persists in prioritizing traditional crops despite compelling evidence highlighting the substantial contribution of other crops to agricultural diversification and rural development (Briones, 2009). Although these high-value crops are considered important activities, there are obstacles to redirecting resources to these crops. These obstacles include insufficient marketing and logistics infrastructure, inadequate protection of land rights, and regulations that favor traditional crops and create distortions (Teruel & Kuroda, 2004). Furthermore, there has been a decrease in the rate of productivity development in the agricultural sector despite implementing policy adjustments intended to stimulate it (Mopera, 2016). Moreover, post-harvest losses within the supply chain lead to substantial wastage of agricultural produce, underscoring the necessity for enhanced post-harvest infrastructure and facilities. These difficulties necessitate the implementation of new policies, allocating resources towards measures that enhance productivity, and implementing institutional reforms to encourage diversification of agriculture, boost production, and minimize food loss in the Philippines. One initial approach to addressing these concerns is to conduct a value chain analysis (Araza, 2023; Pastolero & Sassi, 2022; Zapata et al. 2023).

Performing a value chain analysis for agribusiness is crucial as it enables the identification of how benefits are distributed among participants and offers valuable insights for enhancing the value chain (Aurobindo & Mishra, 2022). Value chain analysis enables identifying key actors, examining profit allocation, and assessing tools and strategies for enhancing the chain (Nguyen & Nguyen, 2022). Additionally, it aids in comprehending customer needs and preferences, which can guide the development of strategies to enhance demand and market expansion (Ahenkora et al. 2013). Implementing a well-organized value chain system can decrease costs, improve productivity, and increase crop yields in agricultural enterprises (Stoian, 2022). Through examining the value chain, agribusinesses can uncover opportunities for enhancement, streamline operations, and bolster their competitive advantage (Cerio, 2021). Hence, value chain analysis is a valuable tool that agribusinesses can use to improve their performance, profitability, and overall economic contribution. One of the important crops that requires a value chain analysis is the mushroom due to its diverse range, nutritional benefits, and therapeutic capabilities. Indigenous communities in the Philippines utilize diverse mushroom species for food and medicinal purposes (dela Cruz & de Leon, 2023). In their review of wild mushrooms in the Philippines, Dulay et al. (2023) recorded a vast array of fungal biodiversity, encompassing more than 2,300 distinct kinds of mushrooms that are classified under 72 different families. Indigenous peoples often use certain edible mushrooms, such as Schizophyllum commune, Auricularia auricula, Pleurotus, and Lentinus species (De Leon et al. 2021). The economic viability of mushroom farming in the Philippines is attributed to its low production costs, abundant supply of inexpensive substrates, and strong market demand (Chang et al. 2014). Promoting mushroom enterprises is crucial for fostering rural development, creating employment prospects, and generating revenue for small-scale growers. Mushrooms substantially impact the agricultural environment in the Philippines, offering valuable advantages in terms of nutrition and economy.

Within the agricultural landscape of the Partido District in Camarines Sur, an increasing number of farmers have ventured into mushroom cultivation, particularly oyster mushrooms (*Pleurotus ostreatus*). In 2022, the Bicol region produced 2 metric tons of oyster mushrooms. Nevertheless, there is a dearth of research on the mushroom value chain within the specified area. In light of this context, this study aims to thoroughly evaluate the complex dynamics of the mushroom value chain in the district. The objectives are to identify and define the actors involved in the value chain, establish their roles and connections, analyze the costs and returns associated with mushroom production and marketing at each stage, and identify current constraints and opportunities. This study aims to enhance comprehension of the mushroom sector in the Partido District, hence providing significant insights for local growers, policymakers, and stakeholders. This inquiry anticipates providing actionable insights to guide the development of targeted policies, resource allocation strategies, and institutional reforms, fostering sustainable agricultural practices, economic growth, and improved livelihoods for local growers in the Philippines.

METHODS

The study employed the value chain framework (Figure 1), incorporating quantitative and qualitative methodologies. Participants include individuals or actors engaged in various mushroom production and marketing aspects. The study employed a complete enumeration approach; however, certain limitations were encountered during the data gathering, resulting in a reduction in the number of participants. According to the master list of the Department of Agriculture, there are 16 mushroom farmers in the district; however, upon field visits, only half of them are still operating. Hence, all eight farmers serve as participants in the study. One middleman, two sellers, and three processors also served as the main participants of the study. Key informants, including municipal agriculturists, the Local Government Unit (LGU) representatives, and the Department of Agriculture (DA) officers, contribute valuable insights to enhance the study's depth and breadth.

Primary data is collected through KII, FGD and field observation to capture the perspectives of participants involved in the mushroom value chain. These methodologies facilitate in-depth insights into the experiences and challenges of cultivators, collectors, traders, and processors.

One FGD among the value chain participants was conducted. This tool is used to gather qualitative data about the experiences, perspectives, and challenges participants face in the mushroom value chain. A value chain map was also drafted and verified in this activity. Participants, including cultivators, collectors, traders, processors, and representatives from academia and government agencies, engaged in open dialogues that provided nuanced information on their roles, interactions, and the broader dynamics influencing mushroom production and marketing.

Key Informant Interviews (KII) complemented the FGDs by offering targeted insights from individuals in strategic positions within the mushroom value chain. Municipal agriculturists, representatives from the Local Government Unit (LGU), and officers from the Department of Agriculture (DA) provided valuable perspectives on policy implications, regulatory frameworks, and overarching strategies influencing mushroom production and marketing.

Researchers conducted actual visits to the mushroom production and marketing sites, directly observing the processes and activities. This approach allowed for firsthand exploration of on-the-ground realities, providing a more immersive understanding of the operational dynamics. Observations encompassed aspects such as cultivation practices, harvesting methods, trading transactions, and processing techniques. Incorporating actual visits and observations enriched the qualitative data, offering a tangible and contextualized dimension to the study.

Supplementary data was gathered through document reviews, allowing for a comparative analysis between research findings and existing mushroom production and marketing assertions. This method strengthens the reliability and contextual understanding of the study.

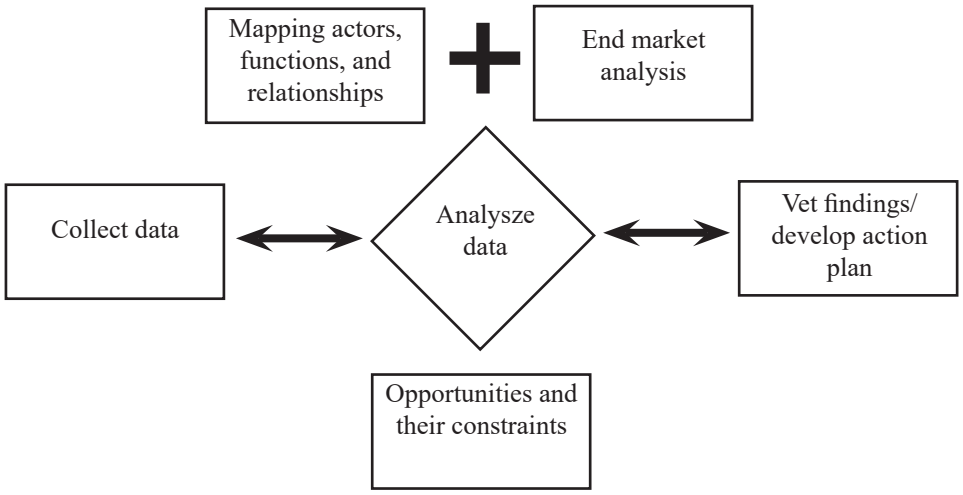

Figure 1. Value chain framework (Soriano, 2022)

Value Chain Mapping

Utilized to visually represent the roles, relationships, and dynamics among participants in the value chain, aiding in assessing production and marketing processes. The accuracy of the value chain map was validated through feedback from participants in the Focus Group Discussion (FGD) as well as experts from relevant line agencies and academic institutions.

Descriptive Statistics

Frequency counts and percentages are employed to describe the key individuals involved in the mushroom value chain, such as producers, traders, and processors.

Cost and Return Analysis

This method is employed to evaluate expenses, value contributed, and return on production and marketing. Equations consider factors such as direct labor, direct materials, factory overhead, revenue/sales, gross profit, and gross profit margin. This also involves subtracting incurred costs from the selling price, providing insights into the overall value created in the value chain. Formula for cost and return analysis in Table 1.

Table 1. Formula for cost and return analysis

	Formula
Total Cost (TC)	TC = Direct Labor + Direct Materials + Factory Overhead
Gross Profit	Gross Profit = Revenue/Sales − Total Cost
Value-Added	Value-Added = Selling Price - Total Cost
Net Profit Margin	Net Profit Margin = (Net profit/revenue or sales) × 100

RESULTS

Actors their roles and links in the Mushroom Value Chain Map

Mushroom farmers (producers), intermediaries (wholesalers), sellers/dealers (retailers), processors, and consumers are the key groups of industry players in the Partido. Earlier investigations have identified comparable value chain actors, as evidenced in studies conducted in Indonesia (Wulandari et al. 2022), India (Ganeshkumar et al. 2020), and Ethiopia (Getachew et al. 2016).

Mushroom growers/farmers

The cultivation of mushrooms and other fungi is known as fungi culture. Fungi can be grown for food, medicine, building materials, and other uses. A mushroom farm is a place where mushrooms are grown. Farmers are involved in all aspects of mushroom farming, including preparing the mushroom house, substrate, spawn, substrate sterilization, and mushroom inoculation. Mushroom farming necessitates much attention from the farmer because the fungi must be kept at a specific temperature to flourish and produce a healthy crop.

In this study, eight, or 50%, farmers were questioned out of 16 registered mushroom growers from the 2019 and 2020 master lists. This group included a student, an organic farmer, a farmer, and a mushroom enthusiast. The mushroom focal person of DA Region 5 stated that community-based enterprise development aims to support farmers who are interested in mushroom farming by helping them understand the budding opportunities and facilitating their access to a broader market within the region. They were to train people, such as farmers, military personnel, students, religious groups, and indigenous peoples, on how to grow mushrooms.

The mushroom farmer must gather the necessary materials, including substrate, fruiting bag, sterilization, and spawn sowing. Farmers must also plan where they will store the inoculated fruiting bag, which will vary depending on how many fruiting bags they plan to produce. He should disinfect the area to avoid a mushroom disease invasion by bugs and insects.

Farmers may have the option of selling inoculated mushroom fruiting bags to those interested in attempting mushroom planting at home. The farmer will receive training on preparing the substrate and fruiting bags, planting spawn, and building a mushroom house. They must wait 20-30 days for the mushrooms to grow in the fruiting bags after being placed in the mushroom house; if properly cared for, they can harvest for the next 4-6 months. The number of fruiting bags that survive the process determines their harvest. One fruiting bag can yield up to .8kg on average during the entire duration.

Mushroom middlemen or wholesalers

The recognized association, known as Bicol Entrepreneurs' Association for Mushroom or BEAM

Bicol, serves as the middleman for mushroom producers. BEAM aims to produce 100-200 kilograms of mushrooms per day for interested buyers. The association's members bring their products to the organization for consolidation, and the organization will look for fresh mushroom purchasers. In the case of mushroom farmers in Partido, however, they could not satisfy the association's standard requirement, so they sold their produce to local consumers.

Mushroom sellers or retailers

Mushroom retailers or sellers usually engage in online transactions to market their goods. In the case of mushroom farmers, the seller is also the farmer, and the mushrooms are only picked once an order is placed in order to maintain freshness. Mushrooms must be sold to the market once they have been picked since their look will deteriorate faster, but the taste will not be altered. Mushrooms are rarely seen in vegetable markets since those that are sold are wild mushrooms that grow on rotting banana stalks and other organic matter.

Mushroom processor

Mushrooms are a vegetarian delicacy that can be used in place of meat and eggs. It is well-liked in most developed countries and is gaining acceptance in many developing nations. Because fresh mushrooms have a short shelf life, it is advised that they be processed. Mushrooms are cleaned in cold water before being blanched for 3-4 minutes in boiling water. On the other hand, oyster mushroom is processed into various products, including *chicharon*, *sisig*, and *bagoong* paste in Partido. More products can be produced and developed from mushrooms. According to Gou et al. (2022), mushrooms can be used in various applications such as food, feed, and energy production.

In certain scenarios, the mushroom processor takes on the role of the farmer, a practice akin to what was observed in Indonesia. The Pesona Jamur farmer group, for instance, engaged in cultivating oyster mushrooms while simultaneously producing baglog (Yudha et al. 2022). A specific farm examined in the study revealed a distinctive division of responsibilities, with the husband serving as the farmer and the wife taking on the processor role. Gender role theory can further explain this result. This theory suggests that societal expectations and norms shape the roles and behaviors of individuals based on their gender (Rafat, 2022). In the case of this study, the husband's role as the farmer and the wife's role as the processor could be seen as an expression of traditional gender roles. Historically, agriculture has often been associated with masculine activities, involving physical strength and outdoor labor, while processing and domestic tasks are often associated with femininity

Value Chain Map

The value chain map of mushroom in Partido depicts the relationships among the different actors in the chain. This can be observed from the figure as they jump from actor to actor and identify the key institutional/policy factors that influence the chain dynamics and actor behavior (Figure 2). The figure was made based on the focus group discussion and validated by industry practitioners and experts in the academe. In the context of the mushroom industry in the district, the value chain is influenced by four key factors: government support services, market supply, market demand, and processing facilities. The government plays a pivotal role in supporting this chain, providing institutional assistance to both existing and potential farmers. A significant initiative in 2016 was the Bicol's Community-Based Mushroom Project, led by the Department of Agriculture Region 5. This project aimed to empower beneficiaries with the necessary technology for cultivating pure culture, producing spawn bags and fruit bags. In addition to technical support, participants received comprehensive training sessions and informative materials.

Moreover, a community-based enterprise development program was implemented to enhance the business understanding and market outreach of the beneficiaries. This initiative aimed to enlighten participants about the lucrative potential of mushroom production and equip them with the skills to tap into broader markets. The collaborative efforts between the government and local farmers underscore the importance of comprehensive support in nurturing a sustainable and thriving mushroom industry in the district.

The mushroom value chain experiences significant impacts from market supply dynamics, particularly concerning inputs, market demand for mushrooms, and the availability of processing facilities. Within the district, the supply of inputs for mushroom production is generally sufficient. However, challenges emerge, specifically related to the quality of spawn bags and fruit bags.

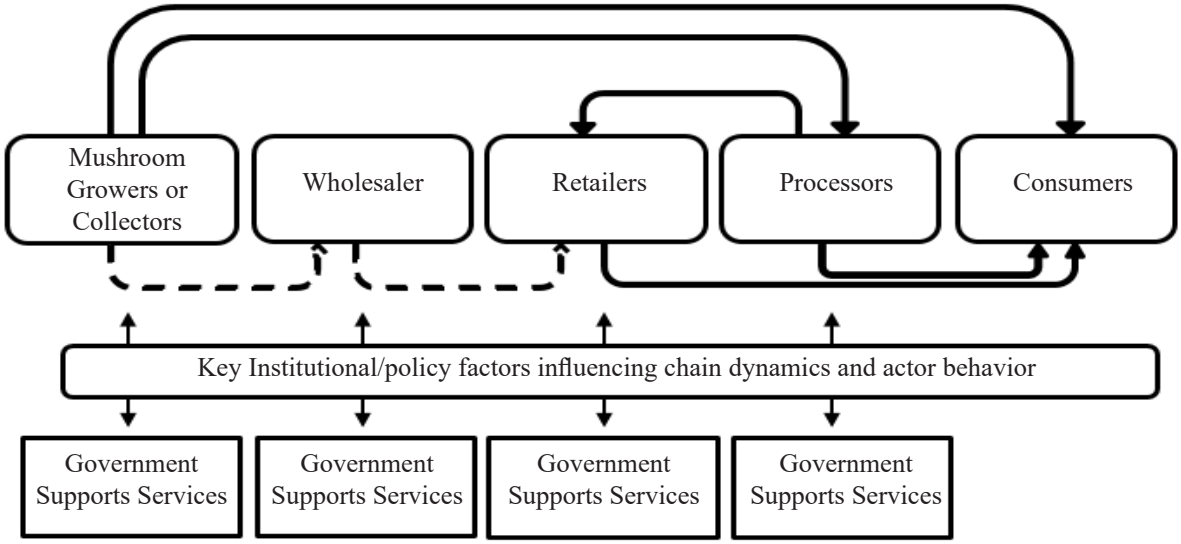

Figure 2. Value chain map of oyster mushroom (---- underdeveloped transaction; ── primary toutine transaction)

While the mushroom market presents substantial demand, necessitating a significant volume of mushrooms, the existing production capacity falls short of meeting the commercial demand. Despite their efforts, producers find themselves unable to match the scale required to fulfill the robust commercial demand for mushrooms. This disparity between demand and production underscores a notable gap that needs to be addressed within the mushroom value chain to optimize its potential in meeting market needs.

Channel 1. Mushroom grower – Consumer

This transaction is conducted by all mushroom growers, who directly sell mushrooms to consumers. As soon as the mushrooms start producing, farmers promote their products online, allowing customers to reserve fresh produce. Conversely, those with smaller yields prefer selling exclusively to local residents. In most situations, mushroom growers are also consumers, with 50% of mushrooms grown for personal consumption.

Mushroom growers also served as processor. Farmers with abundant produce widely adopt this practice to prevent wastage. By processing their harvest, they effectively prolong the shelf life. In this scenario, farmers are simultaneously involved in dual transactions—cultivation and processing.

Channel 2. Mushroom Grower – Processor – Consumer

This channel is activated when processors directly purchase fresh mushrooms for further processing. The district offers three noteworthy processed mushroom varieties: Sisig, chicharron, and bagoong. The processor then sells the by-products directly to consumers.

Channel 3. Mushroom grower – Processor – Retailer – Consumer

This distribution channel involves processors selling their produce to retailers, who, in turn, offer the product to end consumers. It constitutes a multi-step process wherein the processor acts as an intermediary, facilitating the flow of goods from production to retail. This approach not only broadens the market reach but also allows consumers to access the processed products conveniently through various retail outlets.

Channel 4. Mushroom grower – Wholesaler – Retailer – Consumer

This route is uncommon since farmers' supply of fresh mushrooms is insufficient to meet the demand for roughly 10kg of mushrooms each week. Farmers are wary of doing so because the mushroom stalk will be chopped short, diminishing the weight of the fresh mushroom. Furthermore, mushroom shrinkage is so high that a wholesaler delay significantly impacts fresh

mushroom quality. In this instance, mushroom storage is critical to keep the mushrooms fresh. Due to this, mushroom farmers decided to learn how to process their product instead of selling their fresh produce to wholesalers.

Other Channel. Farmer - Farmer

One channel that has been indirectly practiced is selling inoculated substrate to other farmers. It was practiced by two, or 25%, of the farmer respondents. They sell the inoculated substrate for those who want to have their own mushroom plant in their home. Mushroom substrate is not that picky, as long as it is placed in a covered, fresh area away from insects or other pests. They were able to sell the substrates for 25 pesos each.

Costs, Returns and Value Added of actors in Value Chain of Oyster Mushroom in Partido Area

Table 2 shows that the processor had the highest Net Profit Margin in the Partido Area mushroom business, with percentages of 75%, 62%, and 63%, which translates to earnings of 75, 62, and 63 centavos per peso sold, respectively. Processed mushrooms have the benefit of an extended shelf life compared to fresh mushrooms available on the market. Nevertheless, it is challenging to advertise this product. Processed products have an extended shelf life. However, the durability of products may vary. Additional guidelines may involve storing the item in a cool and dry location or consuming it within a specified timeframe after opening.

Subsequently, mushroom farmers also conformed, receiving an income of 55 cents for every peso of mushrooms sold. Farmers with an average of 5,000 fruiting bags will generate approximately 7,200 pesos monthly and approximately 29,000 pesos throughout the cycle. However, the farmer dedicates a greater amount of time compared to the other players to ensuring that mushroom production is optimized. Farmers do many tasks, such as substrate preparation, sterilizing, spawn planting, and setting up the container for storing the mushroom fruiting bag. Performing this task requires a significant amount of time and patience, particularly if you are working alone. Alternatively, farmers may choose to provide the substrate and fruiting bag solely to the community, enabling them to cultivate it in their own backyard. The price of each fruiting bag containing the injected substrate could cost 25 pesos. In this case, farmers will not delay and will actively search for a market to sell their mushroom produce.

The middleman and retailer rank 3rd and 4th, respectively. Despite receiving a smaller share compared to the other three parties, they are spared from the laborious task of mushroom growing. Once the mushroom is distributed, the wholesaler will immediately gain profits; the same applies to the retailer.

In the study conducted in India, it was found that producers put more effort and energy into the mushroom value chain but received less revenue and profit than wholesalers and retailers (David, 2020). On the other hand, the study conducted in Cameroon showed that farmers who produce fresh mushrooms make an average net margin of 36%, while transformers make the least profit margin (0.42%) and retailers make an average net margin of 5.6% (Egwu et al. 2016).

Table 2. Computation of profit margin across value chain actors

Parameters	Farmer (N=8)	Middlemen (n=1)	Seller (n=2)	Processor (n=3)		
				Chicharrón	Sisig	Bagoong
Average revenue*	180.00	200.00	220.00	1,300.00	750.00	750.00
Average Cost*	80.50	170.00	200.00	320.30	285.50	274.30
Average Income*	99.50	30.00	20.00	979.70	464.50	475.70
Net Profit Margin	55%	15%	9%	75%	62%	63%
Rank	2	3	4		1	

Note:*Average per 1kg of fresh mushroom

Constraints and Opportunities in the Chain

Mushroom farming presents a unique set of challenges that span various production stages, from cultivation to marketing. The issues encountered by different actors in mushroom cultivation are complex and interconnected, necessitating comprehensive strategies for achieving long-term and environmentally friendly development. Figure 3 succinctly outlines both the constraints and opportunities within the mushroom industry in the district. The upper boxes denote constraints, highlighting challenges faced by various actors in the value chain. Conversely, the lower boxes represent opportunities, showcasing potential avenues for growth and development across the different stages of the value chain.

One prominent challenge revolves around mushrooms is perishability or its limited shelf life. Mushrooms are extremely susceptible to spoilage and vulnerable to changes in their surroundings, making their storage and transportation critical aspect. Mushrooms exhibit a rapid respiration rate and possess a fragile outer layer, leading to their rapid decay following harvest. As per Aly et al. (2023), freshly collected mushrooms usually have a shelf life of only 1-3 days under normal environmental conditions. In order to address this issue, a range of preservation methods have been investigated. In their study, Xia et al. (2023) investigated the application of chemical processing techniques, including antioxidants, ozone, and coatings, as well as physical treatments such as non-thermal plasma, packaging, and latent thermal storage, to prolong the shelf life of fresh mushrooms. In contrast, Feng et al. (2023) reported that various packaging methods, such as modified atmosphere packaging (MAP), active packaging (ACP), biodegradable film packaging (BFP), and nanocomposite packaging (NCP), effectively maintained the quality of mushrooms and prolonged their shelf life. Mushroom farmers in the study area have inadequate processing technology and storage facilities, resulting in substantial post-harvest losses. Therefore, investing in improved processing technology and storage facilities is crucial to ensure the efficient and timely delivery of mushrooms, reduce post-harvest losses, and promote sustainable mushroom cultivation practices.

Marketing fresh mushrooms is tough since they are perishable products (Gurusamy & Vignesh, 2020). Similarly, inadequate marketing facilities and a general lack of awareness about cultivated mushrooms contribute to a limited consumer base. Studies conducted in Nigeria (Ogbo et al. 2022) and the United States (Moxley et al. 2022) have shown that increasing awareness and creating market opportunities are crucial for expanding the consumer base for cultivated mushrooms. Educational campaigns and initiatives to raise awareness about mushrooms' nutritional benefits and culinary versatility can help create a more robust market for these products.

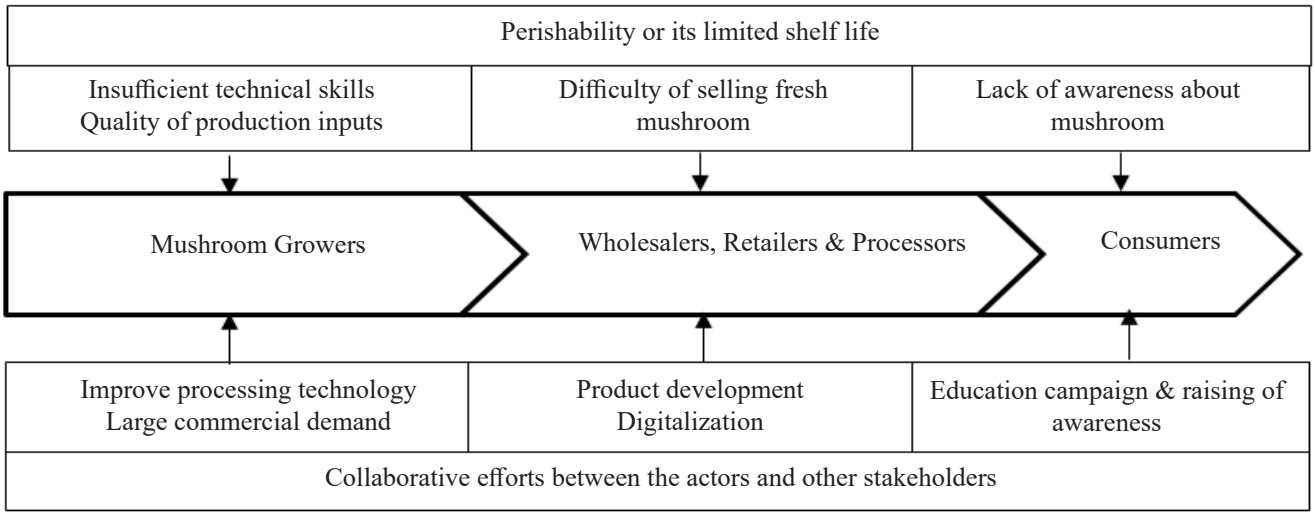

Figure 3. Summary of constraints and opportunities

Diseased spawn is another issue that farmers face, impacting the overall yield and quality of mushrooms. Fungal diseases, such as dry, wet, and cobweb diseases, can affect the growth of mushrooms and contaminate the entire crop (Jareanpon et al. 2024; Santhosh et al. 2022). These diseases are caused by water stagnation in mushrooms and can be prevented by maintaining the appropriate humidity levels in the cultivation environment (Gea et al. 2021). Additionally, mycoparasites, such as *Lecanicillium fungicola*, *Cladobotryum* spp., *Mycogone perniciosa*, and *Trichoderma* spp., can also cause significant losses in commercial mushroom farms (Rakhmonov & Soatov, 2023). Extended cultivation of mushrooms in the same location can lead to increased infection by harmful organisms, resulting in reduced yield and quality (Amin et al. 2021). Collaborative efforts between research institutions and farmers can help develop disease-resistant spawn varieties. Providing technical assistance and disseminating information about best practices in spawn management can empower farmers to combat diseases effectively (Jareanpon et al. 2024)

Technical skills are a pivotal determinant in the achievement of success in mushroom cultivation. Farmers may encounter difficulties in the preparation of fruiting bags, sterilization procedures, and the overall quality of the substrate. Participating in training programs and workshops focused on contemporary growing practices can boost the technical proficiency of farmers, empowering them to attain increased yields and superior-quality mushrooms. Introducing current agricultural technologies, such as the Internet of Things (IoT), is advantageous for farmers. Konain et al. (2023) and Eben et al. (2023) have demonstrated that utilizing the Internet of Things (IoT) and solar power in mushroom farming leads to enhanced productivity and efficiency in mushroom growing. Substrate sterilization, a key step in mushroom cultivation, also requires attention. The current method involving metal drums has limitations in terms of capacity and efficiency. Exploring and adopting advanced sterilization technologies can improve the scalability and effectiveness of the process, reducing production time and costs. An example of this technology is the solar powered heating energy sterilization cabinet.

The imbalance in mushroom supply, with a major percentage cultivated for personal use, causes issues for wholesalers. Promoting entrepreneurship and providing incentives for commercial mushroom cultivation can effectively boost the available supply for distribution. Additionally, attempts to connect farmers with potential purchasers, such as local markets and restaurants, can boost the market for fresh mushrooms.

The documented constraints in studies by Chang et al. (2014) and Wibowo et al. (2023) emphasized the necessity for continuous research and knowledge dissemination to address industry-wide challenges. The collaboration between academia and practitioners has the potential to result in innovations that optimize production processes and address the prevalent challenges in the mushroom value chain.

The emergence of processed mushroom products, such as mushroom chicharrón, *sisig*, and *bagoong*, offers a favorable opportunity for expanding and enhancing the range of options available and increasing their value. Farmers and other value chain actors can explore and capitalize on these opportunities to augment their revenue and innovate more commercially viable products. Participation in trade shows and exhibits provides a platform for farmers to showcase their products and establish connections with potential buyers.

Addressing the challenges in mushroom farming requires a holistic approach that encompasses research, education, infrastructure development, digitalization, and market expansion. By fostering collaboration among stakeholders and implementing innovative solutions, the mushroom farming industry can overcome its current constraints and unlock its full potential for economic growth and food security.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The study concludes by advocating for a holistic approach to overcome challenges, foster innovation, and unlock the economic potential of the mushroom industry. The subsequent analysis delves into the Costs, Returns, and Value Added of actors in the Mushroom Value Chain in Partido. The processor emerges with the highest Net Profit Margin, followed by farmers, middlemen, and retailers. Challenges such as perishability, inadequate marketing, and disease impact profitability. The study highlights the need for investment in processing technology, storage facilities,

and market expansion to optimize the value chain's potential. It underscores the importance of collaborative efforts and innovative solutions for sustainable growth in the mushroom farming industry.

To ensure the successful development of the mushroom industry in the district, it is necessary to unite mushroom farming enthusiasts and establish an association that will be either affiliated with BEAM or operate independently and be officially registered with the SEC or DOLE. This affiliation or registration will enable the association to potentially receive financial assistance from the Department of Agriculture, specifically for the procurement of equipment such as shedders, baggers, mixers, and sterilizers (autoclaves). In order for mushroom farmers to establish an organization, they must collaborate with the DA and a business body, such as the Chamber of Commerce, to secure a sustainable market for their product. The Department of Agriculture (DA) should enhance the training of mushroom growers and, if feasible, monitor farmers' progress until they can operate autonomously.

In order to address the issue of spawn availability, the biology program at Partido State University should prioritize the production of high-quality spawn that mushroom farmers can readily access in the Partido Area. In order to support the sustainable marketing of mushroom produce, it is recommended that the DTI continue to train mushroom processors and offer assistance in establishing market connections.

Recommendations

In future studies, there is an opportunity to deepen the understanding of the Mushroom Value Chain in the Partido district by exploring areas such as supply chain optimization, market dynamics, technological integration, disease management, gender dynamics, environmental impact assessment, economic impact analysis, policy evaluation, and the cultural and social dimensions of mushroom consumption. These investigations can contribute to the development of targeted strategies to enhance production efficiency, market expansion, sustainability, and inclusivity within the value chain.

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