International Journal of Social Sciences
Citation: IJSS: **13**(02): 81-89, June 2024
DOI: 10.46852/2249-6637.02.2024.7

Case Study

Enhancing Livelihood Security via Mushroom Production: A Case Study of Technological Support and Farmers' Ingenuity

Sumita Acharya[1] and Debendra Nath Sarangi[2]*

[1]*Krishi Vigyan Kendra, Sakhigopal Puri, Odisha, India*
[2]*ICAR-Central Institute for Women in Agriculture, Bhubaneswar, Khurdha, Odisha, India*

*Corresponding author: dnsciwa@yahoo.com (**ORCID ID:** 0000-0002-2944-8998)

Received: 11-03-2024 **Revised:** 25-05-2024 **Accepted:** 05-06-2024

ABSTRACT

Mushrooms, a diverse and vital organism, offer an economical and eco-friendly solution for utilizing agricultural and forest wastes, presenting substantial potential for sustainable farming globally. This study employed a case study approach to evaluate technological interventions in mushroom cultivation among 40 mushroom growers in Puri district over three years. Practices compared included using crumpled straw soaked with 2% calcium carbonate for paddy straw mushrooms, humidity management with fogger, and cultivating blue oyster mushrooms. Results indicated significant improvements in yield, biological efficiency, and economic returns, demonstrating the effectiveness of these interventions. Focusing on Mr. Laxman Bastia, an innovative farmer from Puri district, the study also highlighted his adoption of advanced mushroom cultivation techniques with support from KVK Puri. By implementing these interventions in mushroom cultivation, Mr. Bastia significantly increased yields, reduced costs, and enhanced profitability. His innovations, including a spawn bottle-carrying trolley, fuel-saving chulla, and wheat cleaner, further improved efficiency and reduced labor dependency. These efforts earned him widespread recognition, including the "Progressive Mushroom Grower Award" by ICAR. Mr. Bastia's success underscored the potential of mushroom cultivation to boost productivity, profitability, and nutritional security, offering a viable livelihood option for farm families. His enterprise achieved an impressive annual turnover of ₹ 63,82,000/-, creating year-round employment for five individuals and part-time opportunities for Women Self-Help Group members. The study highlighted the importance of training, technological support, and innovative practices in advancing mushroom entrepreneurship, particularly among farm-women and rural youths. Future strategies aim to strengthen market connections and promote value-added mushroom products, ensuring continued growth and sustainability in the mushroom industry.

HIGHLIGHTS

- Improve mushroom cultivation efficiency with new techniques.
- Boost yields and profitability through innovative practices.
- Promote sustainable farming using agricultural wastes.
- Train farmers and SHGs to enhance mushroom production.
- Expand market reach with new sales channels and partnerships.

Keywords: Mushroom entrepreneurship, Technology support, Livelihood security, Farmers' ingenuity

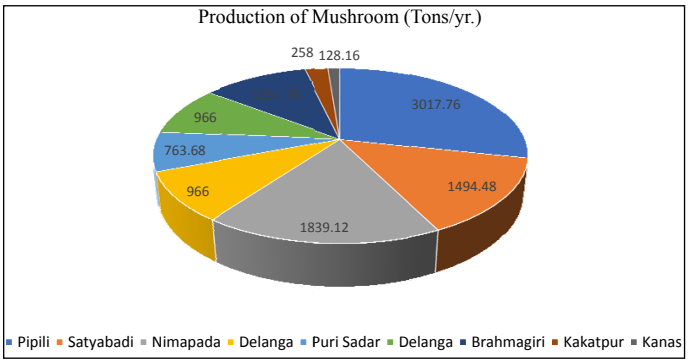
How to cite this article: Acharya, S. and Sarangi, D.N. (2024). Enhancing Livelihood Security via Mushroom Production: A Case Study of Technological Support and Farmers' Ingenuity. *Int. J. Soc. Sci.*, **13**(02): 81-89.

Source of Support: None; **Conflict of Interest:** None

Mushrooms are one of the most diverse organisms on earth and since primitive times have played a vital role in human welfare (Martinez –ibarra *et al.* 2019). Despite constraints in production, mushrooms offer an economical and environmentally friendly approach to utilizing agricultural and forest wastes, suggesting significant potential for sustainable farming practices globally (Gupta *et al.* 2022).

Farmers with technology support generate innovative ideas. The farmers while working with the technology want its suitability in different aspects. So, their effort to develop instruments according to their requirement. This leads to the development of farmers as innovators. The present investigation focused on one innovative farmer Mr. Laxman Bastia, who adopted the advanced technology of mushroom cultivation and developed implements as an innovator, and how his effort made him a role model for livelihood security through mushroom production.

The climatic situation of Puri, a tropical humid climate zone, creates a premier hub for mushroom cultivation in Odisha, earning it the distinguished title of the state's mushroom capital. The district boasts a substantial share of Odisha's total mushroom production, predominantly cultivating Paddy straw mushrooms from February to December and Oyster Mushrooms from November to February. These mushrooms thrive as intercrops within coconut plantations, benefiting from Puri's moderate temperatures and high humidity levels. According to data compiled by the Horticulture Department and the Mushroom Federation of Odisha, Puri yields an impressive annual mushroom production totalling 10,584.96 tons. Notably, Pipili Block leads this production with 3,017.76 tons, followed by Nimapada Block with 1,839.12 tons, and Satyabadi Block with 1,494.48 tons. The strategic proximity of Puri to the state capital and efficient communication infrastructure ensures seamless market access for local mushroom growers. Approximately 3,000 growers sustain their livelihoods through mushroom farming. Significant participation of farm women is there, thereby enhancing household incomes. Successful entrepreneurship in this sector demands distinctive business acumen and a thorough grasp of performance metrics. Key factors for success include innovative packaging and marketing strategies, cost-effective temperature modulation techniques, and personal dedication to the enterprise (Shirur *et al.* 2017).



Source: *Compiled survey data of Department of Horticulture and KVK, Puri District*

Fig. 1: Status of Mushroom production in Puri District

MATERIALS AND METHODS

This study employed a case study approach and presented qualitative data about a mushroom enterprise in the Puri district. Data from 2020-2023 were collected through observations and in-depth interviews with the mushroom grower and key persons associated with the enterprise. The research framework is based on a technological system framework, and some of the collected data were validated using secondary sources. Interviews were also conducted with the mushroom farmer to gather comprehensive insights. Secondary data sources include reliable online and printed news articles, as the enterprise has gained notable recognition within the state. Additionally, these data were corroborated with findings from previous studies. A limitation of this study is that the research findings are derived solely from the respondents' perspectives. The methodology is structured into three main parts: (1) identification of the type of innovation, (2) Analysis of how the innovations were developed and implemented, and (3) Examination of KVK technological interventions.

In each technological intervention, 40 mushroom growers from the Puri district were selected for three years, with continuous data collection. The different practices were compared under two situations i.e., Farmer's Practice (FP) and Research Practice (RP).

The various practices compared i.e., the production of paddy straw mushrooms using untreated bundle straw (FP) versus crumpled straw soaked with 2% calcium carbonate (RP), humidity management using three-layer paddy straw substrate without a fogger (FP) versus with a fogger (RP), management of competitive fungus using untreated bundle straw (FP) versus pre-soaked straw with 2% calcium carbonate (RP), and the cultivation of *P. sajarcaju* at 20-30°C (FP) versus blue oyster mushrooms (*Hypsizygous ulmarious*) with optimized substrate and temperature conditions (RP). This comprehensive study aimed to evaluate the effectiveness of these technological interventions in enhancing mushroom cultivation practices and outcomes.

RESULTS AND DISCUSSION

The cultivation of mushrooms is increasingly recognized as a sustainable source of livelihood. In the Puri district, there has been a notable rise in the adoption of mushroom cultivation. To harness its potential as a profitable enterprise, essential training, demonstrations, and technological support from Puri KVK was provided to farmers, Self-Help Groups (SHGs), and Farmer Producer Organizations (FPOs). Under the guidance of Puri KVK, the mushroom growers selected implemented various technological interventions, outlined below, resulting in increased mushroom yield and reduced cultivation costs, ultimately enhancing profitability.

The data presented in Table 1 detailed the production of paddy straw mushrooms using the bundle straw method, which followed standard practices where straw bundles were used as the primary substrate. In contrast, the research practice involved producing paddy straw mushrooms using crumpled straw. This method utilized 5 kg of straw soaked for 5 hours, mixed with 3% pulse powder and 3% spawn, maintaining a moisture content of 65% in the mushroom beds. Additionally, 2% calcium carbonate was incorporated into the mixture. The prepared substrate was then placed in vegetable crates or baskets for optimal growth conditions. The yield increased by 13.8% per bag, while the biological efficiency improved by 13.7%. Moreover, the gross cost per bag decreased by 17.5%, and the gross return per bag increased by 5.2%. Consequently, the net return per bag rose by 27.1%, resulting in an enhanced benefit-cost ratio, which climbed by 27.6%. Therefore, in the absence of bundled straw or with a view to utilizing the large quantities of crumpled straw generated from bullock/tractor threshing, the mushroom growers adopted this simple production technology for higher profit.

The data presented in Table 2 described the farmer's practice of producing mushrooms with a paddy straw substrate arranged in three layers and no fogger installed in the production unit. In contrast, the research practice improved upon this by installing a fogger in the mushroom production unit to effectively manage humidity during the summer. This modification aimed to enhance the growing conditions, potentially improving yields and quality of mushroom. The research practice (RP) with a fogger in the mushroom production unit

Table 1: Comparison of Yield and Economic Efficiency of Paddy Straw Mushroom production Using Crumpled Straw

Technology	Yield (Kg/ Bag)	Biological Efficiency (%)	Gross Cost (₹/Bag)	Gross Return (₹/Bag)	Net Return (₹/Bag)	B C Ratio
FP	0.58	11.7	57	116	59	2.03
RP	0.66	13.3	47	122	75	2.59

Source: *Author's compilation from conducted demonstrations.*

Table 2: Impact of Humidity Management on Paddy Straw Mushroom Production

Technology	Yield/Bed (kg)	BE (%)	Humidity (%)	Net Return (₹)	B:C ratio
FP	0.70	10.0	56	77	2.4
RP	0.88	12.57	84	110	3.0

Source: *Author's compilation from conducted demonstrations.*

Table 3: Effect of Competitive Fungus Management on Paddy Straw Mushroom Production

Technology	Production/ unit	Biological efficiency (%)	Intensity of Coprinus (%)	Cost of input (₹/bed)	Gross income (₹/bed	Net Income (₹/bed	BC Ratio
FP	0.53	7.57	46.5	60	89	29	1.40
RP	0.98	14.0	12.0	70	163	93	2.38

Source: *Author's compilation from conducted demonstrations.*

Paddy straw Mushroom cultivation by rack system inside a semi-structured agro-shed net house

Pre-soaking of Straw with 2% Calcium Carbonate

significantly outperformed the farmer's practice (FP) without a fogger. Yield per bed in RP increased by 25.7% (0.88 kg vs. 0.70 kg), biological efficiency improved by 25.7% (12.57% vs. 10.0%), and humidity levels rose by 50% (84% vs. 56%). Net returns in RP increased by 42.9% (₹ 110 vs. ₹ 77), and the benefit-cost ratio improved by 25% (3.0 vs. 2.4). This demonstrated that using a fogger greatly enhanced mushroom production and profitability.

The data in Table 3 showed the farmer's practice (FP) of producing paddy straw mushrooms, where bundle straw was used without any treatment. In contrast, the research practice (RP) involved a pre-soaking process where the straw was soaked with a 2% calcium carbonate solution for 6 hours. Additionally, the polythene and racks were dipped and wiped with calcium carbonate to manage competitor fungi such as Coprinus (Inkcaps). This treatment aimed to enhance the overall efficiency and yield of paddy straw mushroom production by creating a more controlled and optimal growing environment. This technology minimized the incidence of Coprinus by 74.19%, recorded an 84.9% higher yield, and achieved a 220.6% higher monetary return. Due to its simplicity and the significant increase in biological efficiency and income, farmers readily adopted this technology.

Table 4 presented the results of cultivating *P. sajarcaju* at temperatures ranging from 20-30°C in the farmer's practice. Conversely, the research practice (RP) involved the cultivation of the blue oyster mushroom variety (*Hypsizygous ulmarious*). This method included cutting paddy straw into 2–3-inch pieces, soaking it in a 1% lime solution for 6-7 hours, draining the straw to achieve a moisture content of 65%, and placing it in 40x80 cm^2 polythene beds. The cultivation process was conducted at a temperature range of 18-30°C. This approach aimed to optimize conditions for the growth of blue oyster mushrooms, potentially enhancing yield and efficiency. The cultivation technology for both species was the same. Farmers adopted the cultivation of Blue Oyster Mushroom (*Hypsizygous ulmarious*), which yielded an impressive average of 2.16 kg per bag, boasting a

Table 4: Economic Performance of Blue Oyster Mushroom Cultivation

Technology	Yield (Kg/ Bag)	Biological Efficiency (%)	Gross Cost (₹/Bag)	Gross Return (₹/Bag)	Net Return (₹/Bag)	B C Ratio
FP	1.70	85	55	157	106	2.86
RP	2.16	107	55	200	142	3.76

Source: *Author's compilation from conducted demonstrations.*

Oyster mushroom Unit of Mr. Bastia

Demonstration on Oyster Mushroom Cultivation by KVK Scientist

remarkable biological efficiency of 107%. Financially, RP achieved a 27.4% higher gross return per bag and a 34% higher net return per bag. Farmers expressed positive feedback on RP, highlighting its superior yield, higher efficiency, and increased economic benefits.

Adoption and innovation lead to success

Mr. Laxman Bastia, aged fifty-two and with an under-matric qualification, defies expectations with his flourishing mushroom cultivation enterprise in Suhagpur, Po-Mangalpur, Puri. Despite owning just 0.08 hectares of land, he has achieved remarkable success in his agricultural pursuits. His success serves as a guiding light for unemployed youths, Self-Help Groups (SHGs), and Farmer Producer Organizations (FPOs) aspiring to bolster their income through mushroom cultivation.

Mr. Bastia has adopted various technological interventions of KVK, Puri, outlined above, resulting in increased mushroom yield and reduced cultivation costs, ultimately enhancing profitability. He has successfully implemented various technological interventions under the guidance of KVK Puri, leading to increased mushroom yield and reduced cultivation costs, thereby enhancing profitability. He has adopted an advanced mushroom production technique using bundled paddy straw substrate and sand flooring for summer humidity control. Additionally, he employs an innovative method for cultivating paddy straw mushrooms, utilizing 5 kg of crumpled straw, achieving higher yields per bed. To manage competitive fungus (Coprinus/Inkcaps), Mr. Bastia has also adopted effective strategies and has started cultivating blue oyster mushrooms (*Hypsizygous ulmarious*), yielding an average of 1.85 to 2.2 kg per bed with remarkable biological efficiency.

Mr. Laxman Bastia's foray into mushroom spawn production began with technical support from KVK

(Krishi Vigyan Kendra) and financial backing from the National Horticulture Board (NHB). However, his journey was not without its challenges. In his local area, the availability of labour was scarce, posing a significant obstacle to the smooth operation of his venture. Recognizing the need for innovative solutions,

Innovations in Mushroom Spawn Production Process

Mr. Bastia, in collaboration with KVK, embarked on a journey of ingenuity. Together, they identified the key pain points in the mushroom spawn production process and set out to develop practical solutions. Drawing upon their combined expertise and a deep understanding of the local context, they conceptualized and refined three innovative tools tailored specifically for mushroom spawn production.

Spawn bottle-carrying trolley

With the expert advice of KVK scientist, Mr. Bastia, designed and developed an innovative tool i.e., the Spawn bottle-carrying trolley which serves multiple purposes within his mushroom spawn production process. Crafted from wood and equipped with four wheels, this versatile apparatus efficiently shifts cleaned bottles to the production unit, sterilized bottles to the inoculation chamber, and subsequently to the incubation chamber. Facilitating seamless transportation, not only saves on labour costs and time but also significantly enhances the overall efficiency of labour operations. With a carrying capacity of 400 bottles per batch and an affordable cost of ₹ 4000/-, this ingenious solution exemplifies His commitment to leveraging innovation, for the advancement to carry out his mushroom enterprise.

Fuel Saving Chulla

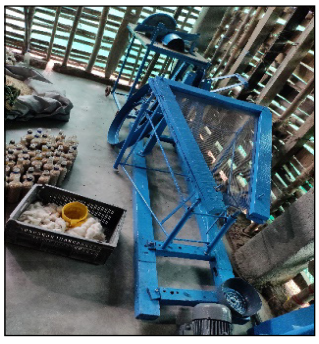
Mr. Bastia's innovation, the Fuel-Saving Chulla, is designed with cement, bricks, and sand to enhance wheat boiling processes in his mushroom spawn production unit. This inventive apparatus minimizes ash production, shortens boiling time, and significantly reduces fuel consumption. Priced at ₹ 2000/-, it conserves 20 kg of wood per 1.2 quintals of wheat boiled, offering a cost-effective and eco-friendly solution for his production needs.

Wheat cleaner

Introducing a transformative solution to the arduous task of wheat cleaning, a novel apparatus has emerged, by Mr. Bastia promising to revolutionize traditional methods. Crafted from an iron stand featuring a wooden-framed strainer supported by four springs, this innovative tool drastically reduces the labour-intensive nature of wheat cleaning. Priced affordably at ₹ 2000, its implementation not only slashes labour costs and time but also significantly boosts the energy efficiency of labour operations. With an impressive capacity to clean 50 kg of wheat in just 5 minutes, a task that would typically require 2 hours of manual labour, this invention represents a remarkable advancement in streamlining wheat processing activities. Through adopting these innovations, farmers have managed to decrease their reliance on labour by two man-days per day, leading

Spawn bottle-carrying trolley

Fuel-Saving Chulla for Wheat Boiling

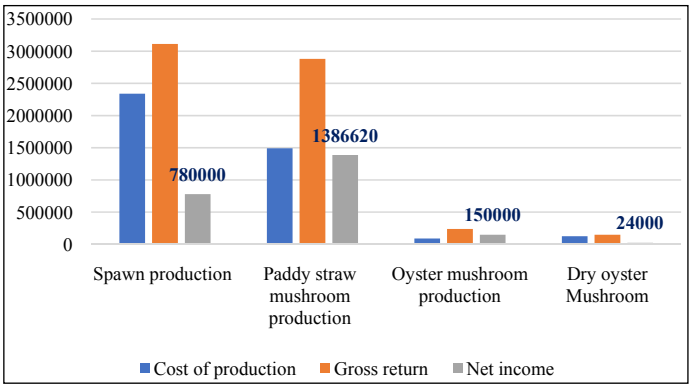


Wheat cleaner

Mushroom Spawn Bottles sterilization by Autoclave

Mushroom Spawn Storage Unit of Mr. Bastia

to considerable savings in resources and inputs. This efficiency gain translates into an additional earning of ₹ 8000/- monthly. With perseverance, teamwork, and a commitment to innovation, Mr. Laxman Bastia conquered obstacles and became a role model for those in the mushroom spawn production industry. Mushrooms constitute one of the most promising resources for promoting rapid socio economics development (Martinez-ibarra, 2019). Mr. Bastia's mushroom production venture demonstrates impressive financial performance across various activities.



Source: *Author's compilation from conducted demonstrations.*

Fig 2: Economic Analysis of Mr. Laxman Bastia's average income per Anum

Fig. 2 described the average data of 2020-23. Annually, 2,60,000 bottles of paddy straw mushroom spawn were produced, resulting in a net income of ₹ 7,80,000/- with a benefit-cost ratio (B.C. Ratio) of 1.32. Paddy straw mushroom production amounted to 192 quintals, yielding a net income of ₹ 13,86,620/- and a B.C. Ratio of 1.92. Additionally, oyster mushroom production (60 quintals) and dry oyster mushroom production (3 quintals) generated significant net incomes of ₹ 1,50,000 and ₹ 24,000, respectively. The total net income for Mr. Bastia's mushroom production venture amounted to ₹ 23,40,620/- with a benefit-cost ratio of 1.57.

Mr. Laxman Bastia's achievements in mushroom entrepreneurship have earned him widespread recognition. His journey has been featured in publications like the Odisha Mushroom Association's "Jibika" and KVK's "Successful Entrepreneurs: Our Pride." The ICAR-Directorate of Mushroom Research, Solan, awarded him the "Progressive Mushroom Grower Award" at the "National Mushroom Mela-2019." His innovative practices were commended by the ICAR QRT Team during their 2019 visit to KVK Puri. His success has inspired local entrepreneurs to adopt his techniques. Acknowledged as a master trainer, he supports SHGs, farm women, and youths in mushroom production. From humble beginnings, Mr. Bastia is now celebrated as the "Man of Mushroom" for his impactful contributions to the field.In the forthcoming strategy, efforts will focus on establishing market connections through exposure visits to marketing agencies, wholesale markets, and grocery malls to promote value-added products under different FPOs' brand names with the support of KVK. Furthermore, there are plans to collaborate with the Mushroom Federation of Odisha

SHG members engaged in boiled wheat filling and capping of glass bottles in Mr. Bastia's Spawn Production Unit

Mr. Bastia participated in the Live Demonstration programme for paddy straw mushroom cultivation in State level exhibition- Krishi Odisha

Awarded as "Progressive Mushroom Grower Award" by ICAR, DMR, Solan

Visit of the QRT team to Mr. Bastia's mushroom production unit

to send fresh mushrooms and value-added products to other states, alongside initiatives to popularize advanced technologies in mushroom production.

CONCLUSION

The transformative impact of technological interventions in mushroom cultivation, particularly in Puri district, has significantly enhanced yields and profitability while reducing cultivation costs. Farmers, Self Help Groups (SHGs), and Farmer Producer Organizations (FPOs) have adopted innovative practices under the guidance of Krishi Vigyan Kendra (KVK). Key advancements include i.e., the use of crumpled straw for paddy straw mushrooms, effective humidity management with foggers, competitive fungus management using calcium carbonate treatment, and the adoption of blue oyster mushroom cultivation. Additionally, the innovative tools developed by Mr. Laxman Bastia, such as the spawn bottle-carrying trolley, fuel-saving chulla, and wheat cleaner, have streamlined production processes and reduced labor dependency. Mr. Bastia's journey from a small-scale farmer to a nationally recognized "Man of Mushroom" underscores the potential for technological innovation to drive socio-economic development in rural areas. Fostering market connections and promoting advanced technologies will further enhance the sustainability and profitability of

mushroom cultivation, providing a viable livelihood option for rural communities.

ACKNOWLEDGEMENTS

We wish to acknowledge the AICRP, Mushroom at Odisha University of Agriculture and Technology, Bhubaneswar for their support and the financial backing from ICAR, which greatly contributed to this research. We extend our heartfelt gratitude to all the mushroom growers who contributed to this research, regardless of their technical expertise. We also confirm that there are no conflicts of interest related to this research paper.

REFERENCES

Febrianda, R. and Tokuda, H. 2017. Strategy and innovation of mushroom business in rural area Indonesia: case study of a developed mushroom enterprise from Cianjur district, West Java, Indonesia. *Int. J. Soc. Sci. Stud.*, **5**(6): 21-29.

Febrianda, R. and Tokuda, H. 2018. Learning the Adoption of Mushroom Farming Partnership: A Case Study of Farmers and an Enterprise from Cianjur District, West Java, Indonesia. *Int. J. Soc. Sci. Stud.*, **6**(7):1-13.

Gupta, N., Mehta, M. and Singh, K. 2022. Benefits, challenges and opportunities in mushroom production: a review. *The Pharma Innovation*, **11**(3): 360-364.

Kumar, A., Godara, A.K., Mukteshwar, R. and Rohila, A.K. 2023. Factors Associated with Rural Agriculture Work Experience (RAWE) Programme: An Impact. *Int. J. Soc. Sci.,* **12**(02): 49-54

Martinez-Ibarra, E., Gomez-Martin, M.B. and Armesto-Lopez, X.A. 2019. Climatic and socio-economic aspects of mushrooms: The case of Spain. *Sustainability*, **11**(4):10-30.

Rahmawati, N. 2021. Analysis of oyster mushroom farming in highlands: A case study in Sleman and Temanggung Indonesia. In E3S Web of Conferences (Vol. 232, 01012). EDP Sciences.

Saikia, D. and Bora, M. 2023. Challenges of mushroom production in Assam. *Asian Journal of Agricultural Extension, Economics & Sociology*, **41**(3):13-21.

Shirur, M. and Chandregowda, M.J. 2017. Ensuring success in Oyster (*Pleurotus* sp.) mushroom cultivation through marketing strategies - A case study and SWOT analysis. *Journal of Agricultural Economics and Rural Development*, **3**(1):184-189.

Suman, B.C., 2007. Book on mushroom cultivation in India. Daya Books, 5.

Thong-un, N. and Wong Saroj, W. 2022. Productivity enhancement using low-cost smart wireless programmable logic controllers: A case study of an oyster mushroom farm. *Computers and Electronics in Agriculture*, **195**: 106798.