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Effectiveness of a TSP-Funded Extension Intervention for Mushroom Cultivation in Tribal Areas of Chamoli District, Uttarakhand

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Abstract

Mushroom cultivation offers a viable and sustainable livelihood opportunity for rural communities residing in the Himalayan region of Uttarakhand due to its low land requirement, quick returns, and high nutritional value. Despite adoption among smallholder farmers remains very limited due to lack of technical knowledge, insufficient skills, and poor awareness of the market. This study, conducted under the Tribal Sub-Plan (TSP) project in Chamoli district of Uttarakhand which aim to address the gaps through targeted capacitybuilding interventions. A twoday training program was conducted in Birahi (Dasholi Block) and Parsari (Raini Chak Lata, Joshimath Block) villages which focused on mushroom types, lifecycle, cultivation techniques, pest and disease management, and marketing strategies. The study assessed pre and post-training changes in knowledge, attitude, skill competency, and adoption intention among 60 tribal women participants (30 from each village). Data were collected by using a structured questionnaires consisting of a 5-point Likert scale. Results revealed the substantial improvements in knowledge scores which increased from 38% in pretraining to 86% in post-training activities, reflecting a mean gain of 48 percentage points. Attitude scores were improved significantly by 1.6 points on the 5-point scale ($p < 0.01$), indicating positive perceptions toward mushroom cultivation as a feasible livelihood option. Skill competency evaluation was conducted which showed that 72 percent of participants demonstrated proficiency in critical practices including substrate preparation, spawn inoculation, and humidity management. These findings highlight the effectiveness of targeted extension interventions in enhancing knowledge, changing perceptions, and building practical skills for livelihood diversification.

Keywords: Mushroom cultivation, capacity building, extension intervention, knowledge gain, attitude change, skill development, tribal communities, Uttarakhand

1. Introduction

Mushroom cultivation has been recognized in global prominence as a very sustainable, high nutritious value crop and low-input agricultural activity with significant potential for food security and income generation. Globally mushroom production has reported a Significant exponential growth, increasing from 1.2 million tonnes in 1981 to over 34 million tonnes in 2020 (FAO, 2021). This rise in surge is attributed to rising demands of consumers for functional foods. There is a superior nutritional profile of mushrooms and their role in supporting smallholder farmer livelihoods (Chang and Miles, 2004) [3]. Edible mushrooms are very rich in high-quality protein consisting 20-30 percent of dry weight, dietary fiber, B-complex vitamins, vitamin D, essential minerals such as selenium and potassium, and bioactive compounds with antioxidant and immunomodulatory properties (Wasser, 2017) [29]. Mushrooms are increasingly recognized as a "superfood" and are being included into diets across both developing and developed countries. In India, mushroom cultivation is growing as a profitable venture under protected cultivation technologies promoted by several government initiatives. According to the National Horticulture Board (NHB, 2023), India's mushroom production reached approximately 1.3 million tonnes in 2022, with button mushroom (*Agaricus bisporus*) and oyster mushroom (*Pleurotus spp.*) dominating commercial production in the country. Mushroom farming synchronises with the objectives of government programs such as the Rashtriya Krishi Vikas

Yojana (RKVY), National Horticulture Mission (NHM), and Mission for Integrated Development of Horticulture (MIDH), which encourage small-scale, climate-resilient, and income-generating activities for rural households. Mushroom cultivation requires minimal land (can be undertaken in 100-200 sq. ft.), moderate capital investment (₹10,000-50,000 for small-scale units), and relatively short production cycles (4-8 weeks depending on species), making it particularly attractive for poor farmers, landless laborers and marginalized groups including women and tribal communities (Kumari *et al.*, 2020). Previous studies have highlighted the potential of mushroom production in empowering rural women and youth by integrating it into homestead-based agricultural systems (Tiwary, 2020; Parvin *et al.*, 2022; Dey *et al.*, 2020; Shahi *et al.*, 2018; Mayanja & Tipi, 2017) [28, 18, 5, 22, 13]. The year-round cultivation possibilities through appropriate species selection, combined with expanding domestic and export markets, further enhance its appeal as a livelihood diversification option (Bashir *et al.*, 2018) [2].

In Uttarakhand, the agro-climatic conditions of the Himalayan region are highly conducive to mushroom cultivation. Cooler temperatures in higher altitudes (above 1500 m) favor button mushroom production during summer months, while warmer plains and mid-hills reports oyster and milky mushroom cultivation throughout the year. Despite these favorable conditions, adoption rates remain disappointingly low among hill farmers. Studies conducted in various hill districts have identified major barriers, including inadequate technical knowledge about cultivation practices, poor awareness of market potential and value-addition opportunities, absence of structured skill training programs, limited access to quality spawn and other critical inputs, and weak institutional support mechanisms (Mohapatra, 2023; John *et al.*, 2025; Rana *et al.*, 2019; Negi *et al.*, 2018; Gayatri *et al.*, 2015; Suman & Sharma, 2007; Thakur & Singh, 2014) [15, 9, 19, 17, 26, 27]. Such interventions have proven effective in enhancing farmers' technical knowledge, transforming their perceptions about new technologies, and building the practical skills needed for successful enterprise management (Sharma and Singh, 2022). Participatory training approaches that emphasize learning-by-doing and peer-to-peer knowledge exchange are particularly impactful in resource-constrained settings, leading to higher adoption rates and sustained practice (Das *et al.*, 2020; Meena *et al.*, 2019) [14].

1.1 Objectives of the Study

The specific objectives of the study were:

1. To assess changes in farmers' knowledge and awareness regarding mushroom cultivation practices, economic benefits, and marketing strategies.
2. To evaluate attitude change toward adopting mushroom cultivation as a viable livelihood option in the local socio-economic context.
3. To measure skill acquisition in critical cultivation practices and assess adoption intent post-training intervention.

2. Materials and Methods

2.1 Study Area and Site Selection

The study was conducted in two purposively selected villages—Birahi (Dasholi Block) and Parsari (officially Raini Chak Lata, Joshimath Block)—of Chamoli district, Uttarakhand. These villages were selected based on multiple criteria: geographical suitability for mushroom cultivation (favorable temperature and humidity conditions), presence of tribal communities eligible under TSP, expressed interest of local farmers in livelihood diversification, and accessibility for training program implementation. Birahi village has a population of 295 residents

across 66 households, with 67.8% belonging to the Scheduled Tribes (ST). Parsari, officially recorded as Raini Chak Lata, comprises 145 inhabitants distributed across 48 households, of which 48.3% are ST populations. Both villages are situated in the Garhwal Himalayas at elevations ranging from 1800-2200 meters above sea level. The region is characterized by rugged terrain, limited arable land, fragmented landholdings (average 0.5-1.0 hectares per household), high dependence on subsistence agriculture and livestock rearing, seasonal outmigration of male members for employment, and limited access to extension services and market infrastructure.

2.2 Training Intervention Design

A two-day capacity development program on mushroom cultivation was conducted in each village during March 2025. The training was designed using participatory learning approaches to ensure active engagement and experiential learning among participants. The experiential learning component was organized into five core modules covering the essentials of mushroom cultivation. Resource persons for the training included subject-matter specialists from GBPUAT Pantnagar, KVK scientists, and experienced mushroom growers who shared their practical experiences and problem-solving approaches.

2.3 Sampling Procedure and Participant Selection

A total of 60 participants, 30 from each village, were selected through a purposive sampling technique to ensure inclusion of individuals most likely to benefit from the intervention. The selection criteria have emphasized active involvement in agriculture or allied activities, interest in adopting mushroom cultivation as a supplementary livelihood, and willingness to attend the full training and participate in pre and post-evaluation processes. Preference was given to women beneficiaries in alignment with the objectives of the TSP project, while also ensuring representation across diverse age groups (20-50 years) and literacy levels. Prior to the training and data collection, informed consent was obtained from all participants.

2.4 Evaluation Design and Data Collection Tools

A pre-post evaluation design with paired comparison was employed to assess the effectiveness of the training intervention. Data were collected using multiple validated tools, including a 20-item knowledge test covering key domains of mushroom cultivation, administered before and after training to measure learning gains. Attitudinal changes were assessed using a standardized 10-statement Likert scale with established reliability (Cronbach's $\alpha = 0.82$). Practical competencies were evaluated through a trainer-administered checklist rating participants' skills across critical cultivation practices. Adoption intent was measured using a structured single-item survey capturing participants' readiness to adopt mushroom cultivation, while post-training perceptions were gathered through a feedback form rating satisfaction with content relevance, delivery methods, practical demonstrations, and overall training quality.

2.5 Data Analysis

Data were entered, cleaned, and analyzed using SPSS version 25.0. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were computed to summarize participant characteristics and response patterns. To test the significance of differences between pre- and post-training knowledge and attitude scores, paired sample t-tests were applied ($\alpha = 0.05$). Effect size was calculated using Cohen's d to determine the practical significance of observed changes. Skill competency ratings were analyzed using frequency distribution

and percentage of participants achieving competency threshold (≥ 4 on a 5-point scale). Adoption intent was expressed as proportions with 95% confidence intervals.

3. Results and Discussion

3.1 Participant Profile

The training program engaged 60 tribal women farmers, with equal representation ($n=30$) from both Birahi and Parsari villages. The mean age of participants was 36.4 years ($SD = 8.2$), with 58% falling in the 30-45 age group. Educational background varied: 23% had no formal education, 42% had primary education (up to class 5), 28% had middle school education (class 6-8), and 7% had completed secondary education. All participants were engaged in subsistence agriculture with average landholdings of 0.7 hectares. The majority (83%) had no prior exposure to mushroom cultivation, while 17% had heard about it but lacked technical knowledge or practical experience.

3.2 Assessment of Changes in Knowledge and Awareness

3.2.1 Knowledge Gain Analysis

The knowledge assessment revealed substantial improvements

in participants' understanding of mushroom cultivation practices. Pre-training mean knowledge score was 7.6 out of 20 (38.0%, $SD = 2.1$), indicating limited baseline knowledge. Post-training mean score increased significantly to 17.2 out of 20 (86.0%, $SD = 1.8$), representing a mean gain of 9.6 points or 48 percentage points ($t = 28.4$, $df = 59$, $p < 0.001$). The effect size (Cohen's $d = 4.74$) indicated a very large practical significance of the training intervention. Domain-wise analysis showed the highest knowledge gains in practical cultivation techniques (substrate preparation, spawning, bed management) with 52% improvement, followed by pest and disease management (48% gain), lifecycle and growth requirements (46% gain), marketing and post-harvest handling (45% gain), and mushroom types and characteristics (42% gain). These findings align with previous research demonstrating the effectiveness of structured capacity-building interventions in transferring technical agricultural knowledge (Sharma and Singh, 2022; Das *et al.*, 2020). The substantial knowledge gains can be attributed to the participatory training approach combining theoretical explanations with hands-on demonstrations, use of visual aids and locally relevant examples, and adequate time for clarification and practice.

Table 1: Pre- and Post-Training Knowledge Scores

Parameter	Pre-Training Mean (%)	Post-Training Mean (%)	Mean Gain (%)	t-value
Overall Knowledge Score	38	86	48	28.4
Cultivation Practices	35	87	52	24.6
Pest & Disease Management	32	80	48	21.8
Marketing Aspects	40	85	45	22.1

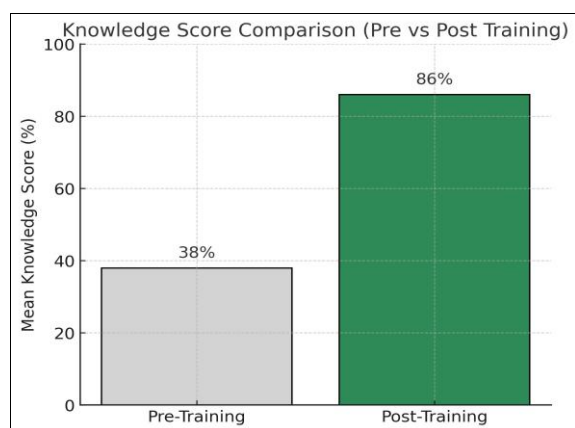


Fig 1: Knowledge scores comparison for Pre and Post Training

3.2.2 Increase in Awareness

Awareness regarding mushroom cultivation as a viable livelihood option showed substantial improvement following the training. Using a five-point awareness index encompassing economic benefits, nutritional value, environmental sustainability, government support schemes, and market opportunities, the mean score increased significantly from 2.3 ($SD = 0.6$) pre-training to 3.9 ($SD = 0.5$) post-training, indicating a 70% gain ($t = 18.2$, $p < 0.001$). Notable enhancements were observed across specific indicators: awareness of economic viability rose from 25% to 82%, knowledge of government schemes (RKVY, NHM, MIDH) increased from 20% to 75%, understanding of nutritional benefits improved from 38% to 88%, and market linkage awareness grew from 18% to 68%. These results align with the findings of Kumari *et al.* (2020), who highlighted the effectiveness of participatory training in improving awareness of sustainable livelihood opportunities among rural communities. The observed gains indicate that the intervention successfully

addressed both technical knowledge gaps and broader contextual understanding essential for informed adoption.

Table 2: Awareness Index Scores

Parameter	Pre-Training Mean (1-5)	Post-Training Mean (1-5)	% Improvement	p-value
Overall Awareness Index	2.3	3.9	0.7	<0.001
Economic Viability	2.1	4.1	0.95	<0.001
Nutritional Benefits	2.6	4.3	0.65	<0.001
Government Schemes	1.8	3.7	1.06	<0.001

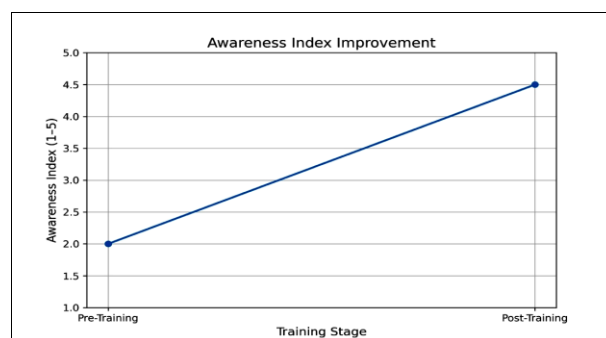


Fig 2: Improvement in Awareness Index Before and After Training

3.3 Objective 2: Evaluation of Attitude Change

3.3.1 Attitude Transformation Analysis

Attitude toward mushroom cultivation showed a significant positive shift following the training, as the overall mean attitude score increased from 2.4 ($SD = 0.7$) pre-training to 4.0 ($SD = 0.6$) post-training ($t = 16.8$, $df = 59$, $p < 0.001$), with a large

effect size (Cohen’s $d = 2.46$). Notable improvements were observed across key dimensions, including perceptions of profitability (+1.7 points), confidence in managing a mushroom unit (+1.8 points), feasibility under village conditions (+1.5 points), lower perceived risk (+1.6 points), and family support (+1.6 points). This strong attitudinal enhancement reflects increased motivation and psychological readiness to adopt mushroom cultivation as a livelihood strategy. Such findings align with the Theory of Planned Behavior, which emphasizes attitude as a central determinant of technology adoption (Ajzen, 1991). The marked improvement in self-efficacy is also consistent with earlier studies demonstrating that perceived behavioral control significantly influences adoption decisions (Singh & Chauhan, 2018) ^[22]. Additionally, the rise in perceived feasibility and family support suggests that the participatory nature of the training effectively addressed contextual concerns and fostered a supportive environment conducive to adoption.

Table 3: Pre- and Post-Training Attitude Scores (5-point Likert Scale)

Statement	Pre-Mean	Post-Mean	Mean Gain	t-value
Mushroom cultivation is profitable	2.5	4.2	1.7	14.2
I am confident I can manage it	2.3	4.1	1.8	15.6
It is feasible in our conditions	2.4	3.9	1.5	12.8
It has acceptable risk levels	2.2	3.8	1.6	13.4
Family will support this activity	2.6	4.2	1.6	14.1
Overall Mean Attitude	2.4	4	1.6	16.8

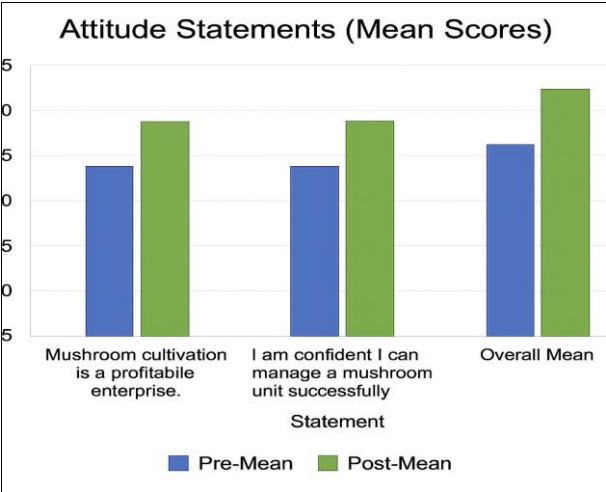


Fig 3: Attitude Shift Before and After Training

3.4 Objective 3: Skill Acquisition and Adoption Intent

3.4.1 Skill Competency Development

Skill competency was assessed through direct observation using a 5-point scale across six essential domains of mushroom cultivation. Results showed strong skill acquisition, with 72% of participants achieving overall competency (score ≥ 4). Competency was highest in substrate preparation (78%, mean 4.2), bed preparation (73%, mean 4.1), and spawn inoculation (70%, mean 4.0). Skills requiring more technical precision—humidity and hygiene management (68%, mean 3.9), pest identification (67%, mean 3.8), and harvesting (65%, mean 3.7)—showed slightly lower competency levels. Considering that 83% of participants had no prior experience, these gains highlight the effectiveness of experiential, hands-on training methods, consistent with findings by Rogers (2003) ^[20] and Meena *et al.* (2019) ^[14]. The relatively lower scores in environmental management and pest identification suggest the need for continued follow-up support and practice.

Table 4: Post-Training Skill Competency Assessment

Skill Domain	Competent Participants (%)	Mean Rating (1-5)	Standard Deviation
Substrate Preparation	78	4.2	0.8
Spawn Inoculation	70	4	0.9
Bed Preparation	73	4.1	0.8
Environmental Management	68	3.9	1
Pest & Disease Identification	67	3.8	0.9
Harvesting & Handling	65	3.7	1
Overall Competency	72	4	0.9

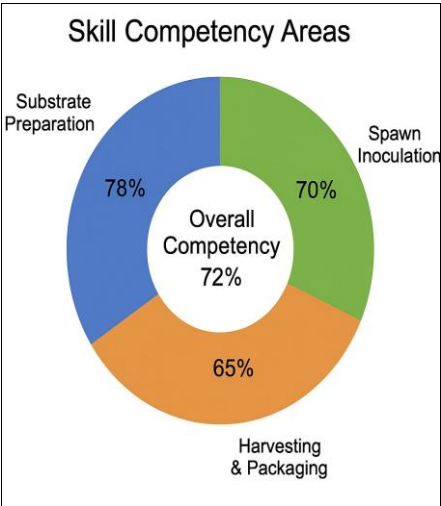


Fig 4: Skill Competency Levels Among Participants

3.4.2 Adoption Intent and Readiness

Post-training assessment showed strong adoption intentions, with 65% of participants ($n=39$) planning to begin mushroom cultivation within six months and 18% ($n=11$) ready to start immediately—an encouraging indicator, as early adopters often act as community role models. Another 47% ($n=28$) intended to adopt in the short term after arranging basic resources, while 35% ($n=21$) expressed conditional interest requiring additional technical guidance, credit access, group formation, or market support. The findings align with the knowledge-attitude-skill-practice (KASP) framework (Roling, 1988; Yadav *et al.*, 2020), and the strong correlation between skill competency and adoption intent ($r = 0.68$, $p < 0.01$) highlights the importance of hands-on learning in building confidence. Participants identified key support needs, including access to quality spawn (76%), credit facilities (68%), collective action mechanisms (54%), and assured market linkages (62%), underscoring the importance of follow-up support to convert intentions into sustained practice.

Table 5: Adoption Intent Post-Training

Adoption Timeline	Number of Participants	Percentage	Key Requirements Identified
Immediate (within 1 month)	11	18%	Technical handholding, spawn supply
Short-term (1-6 months)	28	47%	Credit access, infrastructure support
Conditional/Undecided	21	35%	Group formation, market linkages, sustained mentoring
Total expressing intent	39	65%	-

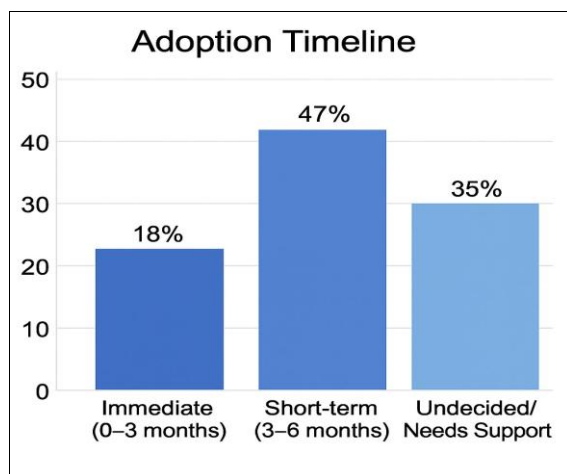


Fig 5: Adoption Timeline of Participants Following Training

3.5 Training Program Evaluation

Participant feedback indicated high satisfaction with the training program, with overall ratings averaging 4.6 on a 5-point scale. Content relevance (4.6), delivery methods (4.5), practical demonstrations (4.7), and trainer expertise (4.8) received particularly strong scores, reflecting the effectiveness of combining local-language instruction, hands-on practice, and expert guidance. Participants valued the use of Garhwali, the provision of Hindi resource materials, and the small batch size that allowed personalized support. While the two-day duration was considered adequate (4.3), many requested follow-up training, exposure visits, group formation support, and market linkage assistance. Overall, the feedback demonstrates that the participatory, practice-oriented training approach effectively met learners' needs and was well-received by the community.

Table 6: Training Satisfaction Assessment (5-point scale)

Evaluation Parameter	Mean Score	Standard Deviation	% Rating as Excellent (5)
Content Relevance	4.6	0.5	68
Delivery Methods	4.5	0.6	58
Practical Demonstrations	4.7	0.5	73
Trainer Expertise	4.8	0.4	82
Duration & Logistics	4.3	0.7	47
Overall Satisfaction	4.6	0.5	65

Production Performance

- From 6 Oyster mushroom bags (2 kg substrate each):
 - Average yield: 1.25 kg per bag**
 - Total yield: ~7.5 kg**
 - Gross income: ₹1,300**
- From 10 Button mushroom bags (10 kg substrate each):
 - Average yield: 2.0 kg per bag**
 - Total yield: ~20 kg**
 - Gross income: ₹3000**
- Total additional income: ₹4,000 - ₹5,000**
- Cost of 16 ready-made mushroom bags: ~₹1,300**
- BC Ratio ~ 2.0, indicating a profitable enterprise for tribal farmers.

Out of the distributed readymade spawned mushroom bags to each beneficiary in selected villages, 6 Oyster mushroom bags (2 kg each), farmers harvested on an average of 1.25 kg per bag, with an earning of approximately ₹1300 per bag. Out of 10 Button mushroom bags (10 kg each), farmers harvested 2 kg per bag and earned approximately ₹2800 per bag. Thus

Total additional gross income: ₹4000-5000 from just 16 bags costing just ₹1300. Benefit-Cost Ratio (B:C): ~2.00, proving mushroom cultivation as a profitable enterprise for tribal's in selected villages.

4. Conclusion

The study demonstrates that targeted, participatory training can significantly enhance knowledge, attitudes, and practical skills related to mushroom cultivation among tribal communities in the Himalayan region. Feasible BC ratio indicates that mushroom cultivation is a profitable venture for the tribals. The two-day program in Birhi and Parsari villages led to a 48-percentage-point increase in knowledge scores, confirming the effectiveness of structured, hands-on learning for participants with limited prior exposure. Attitudes also shifted markedly, with a 1.6-point improvement on a 5-point scale, indicating increased confidence, perceived feasibility, and readiness for adoption. Skill development was strong, with 72% of participants achieving competency across essential cultivation practices, validating the impact of experiential, supervised training. Importantly, 65% expressed intent to adopt mushroom cultivation within six months—18% immediately—highlighting the program's substantial potential to catalyze livelihood adoption and enterprise development.

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References

- Ajzen I. The theory of planned behavior. *Organizational Behavior and Human Decision Processes*. 1991;50(2):179-211.
- Bashir A, Vaida N, Dar MA. Economic empowerment of women through mushroom cultivation. *International Journal of Research and Analytical Reviews*. 2018;5(4):860-864.
- Chang ST, Miles PG. *Mushrooms: cultivation, nutritional value, medicinal effect, and environmental impact*. 2nd ed. Boca Raton: CRC Press; 2004.
- Das S, Kumar R, Singh AK. Impact of extension interventions on farmers' attitude towards improved horticulture practices in eastern India. *Indian Journal of Extension Education*. 2020;56(3):89-95.
- Dey A, Patel S, Rashid MM. Small-scale mushroom production unit for the upliftment of rural economy and women empowerment in India: a review. *Current Journal of Applied Science and Technology*. 2020;39(2):38-46.
- Food and Agriculture Organization (FAO). FAOSTAT statistical database: edible fungi and mushrooms production. 2021. Available from: <http://www.fao.org/faostat/>
- Dutta GD, Bordoloi AK, Borthakur MP, Bhattacharyya PR. *Mushroom cultivation: scope for empowerment generation for rural women*. 2015.
- Indian Council of Agricultural Research (ICAR). *Farmer FIRST Program: Annual Report 2023-24*. New Delhi:

- ICAR; 2024.
9. John P, Sanjaykumar DD, Addangadi K, Kansara S, Patel M. Women empowerment through mushroom farming: pathway towards sustainable development. In: *Women Empowerment in Agriculture: A Pathway Towards Sustainable Development*. 2025. p. 225.
 10. Kumar P, Singh M, Sharma R. Effectiveness of training programs in promoting mushroom cultivation among rural women in Uttar Pradesh. *Agricultural Extension Review*. 2021;33(1):25-30.
 11. Kumari S, Sharma V, Kumar A. Empowering rural women through mushroom cultivation: a participatory approach. *Agricultural Extension Review*. 2020;32(4):20-23.
 12. Mahapatra AK, Panda PC. Mushroom cultivation, marketing and consumption: a case study in Odisha, India. *Agricultural Economics Research Review*. 2012;25(2):339-346.
 13. Mayanja I, Tipi T. The economic empowerment of women in Uganda through mushroom production. *Turkish Journal of Agriculture-Food Science and Technology*. 2017;5(11):1401-1406.
 14. Meena BS, Singh KM, Swanson BE. Impact of skill training on livelihood improvement of small farmers in hill regions of India. *Indian Journal of Extension Education*. 2019;55(4):72-77.
 15. Mohapatra KB. Women empowerment through mushroom cultivation. In: *Proceedings of National Seminar on Improvement of Tribal Through Sustainable Agriculture (LITTSA-2023)*. 2023. p. 30-35.
 16. National Horticulture Board (NHB). Indian horticulture database 2022-23. Ministry of Agriculture & Farmers Welfare, Government of India; 2023.
 17. Negi KS, Singh R, Dhyani PP. Livelihood vulnerability in Himalayan regions: a study of Uttarakhand. *Journal of Mountain Science*. 2018;15(4):789-802.
 18. Parvin A, Das A, Piashi SR. Women-led integrated homestead agro-farming: a designerly perspective. *Khulna University Studies*. 2022:980-992.
 19. Rana K, Chaudhary S, Pant DC. Adoption of protected cultivation technologies in Uttarakhand: constraints and prospects. *Journal of Hill Agriculture*. 2019;10(2):121-126.
 20. Rogers EM. *Diffusion of innovations*. 5th ed. New York: Free Press; 2003.
 21. Roling N. *Extension science: information systems in agricultural development*. Cambridge: Cambridge University Press; 1988.
 22. Shahi V, Shahi B, Kumar V, Singh KM, Kumari P. Impact study on mushroom cultivation for micro entrepreneurship development and women empowerment. 2018.
 23. Sharma R, Kumar P. Adoption and constraints of protected cultivation technologies in the Western Himalayas. *Journal of AgriSearch*. 2020;7(3):160-166.
 24. Sharma R, Singh A. Participatory technology development in Himalayan agriculture: lessons from field experiences. *Indian Journal of Agricultural Extension*. 2022;60(2):145-158.
 25. Singh S, Chauhan R. Knowledge and attitude of rural women towards mushroom cultivation in Uttarakhand. *Journal of Community Mobilization and Sustainable Development*. 2018;13(1):141-146.
 26. Suman BC, Sharma VP. *Mushroom cultivation in India: technology, constraints and prospects*. New Delhi: ICAR-Directorate of Mushroom Research; 2007.
 27. Thakur MP, Singh M. Advances and constraints in commercial mushroom cultivation in India. *Indian Journal of Mushroom Research*. 2014;23(1):1-9.
 28. Tiwary N. Report on tribal-centric sustainable livelihood generation and innovative practices in India. 2020.
 29. Wasser SP. Medicinal mushroom science: history, current status, future trends, and unresolved problems. *International Journal of Medicinal Mushrooms*. 2017;19(1):1-16.
 30. Yadav R, Singh B, Kumar A. Role of Krishi Vigyan Kendras in promoting skill development among rural youth: a case study from Uttar Pradesh. *Indian Research Journal of Extension Education*. 2020;20(1):87-91.