Sustainability Standard Applicability to Mushrooms

Guidance for Producers and Auditors

Introduction

The purpose of this document is to provide mushroom producers and auditors with supplemental, mushroom specific guidance on how production and best management practices align with Sustainability Standard v2.0 criteria. This guidance is informed by interviews with mushroom experts and Sustainability Standard auditors, a review of audit reports from certified mushroom operations, feedback from the Sustainability Standard stakeholder consultation process for v2.0 revisions, and a literature review. This guidance is intended to improve the Sustainability Standard audit experience and efficiency. The information contained in this guide is primarily applicable to Agaricus (button) mushroom production. Information applicable to specialty mushrooms is denoted as such.

This guidance was developed in recognition of the unique nature of mushroom production. Auditors should be cognizant of these distinct growing characteristics when determining alignment with the Sustainability Standard v2.0, as sustainability best practices for mushroom organizations may extend beyond examples provided in the Audit Guidelines.

This guidance was independently developed by Sustainable Food Group with financial support from the American Mushroom Institute.

Organizational-Level Checklist

Sustainability Standard Criteria	Mushroom-Specific Guidance
Environmental Certifications	See Sustainability Standard Audit Guidelines for guidance.
Policies	See Sustainability Standard Audit Guidelines for guidance.
1.02.04 Legal Compliance (Minimum Requirement)	Of relevance to growing operations in Pennsylvania, effective 1/30/2025, the Pennsylvania Department of Agriculture issued a quarantine order that requires a mandatory steaming off procedure for mushroom houses in two Pennsylvania townships due to the rise in phorid fly populations.
Air Quality	Given that mushrooms are grown indoors, the practices that will be most relevant for protecting air quality are those specific to indoor production.
1.03.01 Protect Air Quality	Example air quality protection practices for mushroom operations include: • Reduce odors by careful handling and storage of compost and waste materials • Minimize internal vehicle usage due to proximity of production sites, packinghouse operations and, if applicable, compost production site(s); no idling policy For other potential air quality practices specific to indoor environments, please see the Sustainability Standard Audit Guidelines.
Water Conservation	Effective water management is essential in mushroom production, as mushrooms require precise watering to ensure their needs are met (but without overwatering) and yield is optimized. This makes it challenging to reduce water used in production. Water is also used in compost production. Despite the limitations in water conservation with crop irrigation, there are still opportunities for mushroom operations to receive credit in the Sustainability Standard, improve overall water management and support regional watershed health.

1.04.01 Watershed Improvements	See Sustainability Standard Audit Guidelines for guidance.
1.05.01 Greenhouse Gas Accounting	Existing tools to account for greenhouse gas (GHG) emissions from agricultural production do not adequately reflect mushroom production practices due to the indoor growing environment, specific growing medium and inputs used including compost and peat, and the by-products generated. As such, mushroom operations will very likely be piecing together GHG emissions information from a variety of sources, including existing tools and scientific literature on emissions associated with specific aspects of production or inputs. For total conformance, a greenhouse gas assessment for mushroom operations includes: • Scope 1: Fuel use in owned/controlled operations, e.g., natural gas, diesel, gasoline used for buildings and equipment. Includes any fuel used for compost/substrate production done by the organization. Tools listed in the Audit Guidelines may help calculate these emissions. • Scope 2: Purchased electricity. Tools listed in the Audit Guidelines can be used to calculate these emissions. • Partial Scope 3: Emissions from purchased inputs, i.e., materials used in the growing medium/substrate and casing material including peat. Most mushroom operations do not purchase synthetic fertilizer – purchase of growing substrate and casing materials should be accounted for instead. Referencing peer-reviewed, published literature is an acceptable method of estimating these emissions. Peat is not used in specialty mushroom production.
1.05.02 Science-Based Targets	See Sustainability Standard Audit Guidelines for guidance.
1.05.03 Reduce Food Miles	Efforts by mushroom operations to reduce food miles or transport emissions from product distribution can be scored here. These efforts may include: • Reducing the amount of peat used by utilizing peat alternatives in casing materials. • Minimizing transport emissions by centralizing locations or locating production (growing house) near packinghouse operations. • Distributing product, spent mushroom substrate and/or compost locally, reducing distance traveled.

Waste and Recycling	For the purposes of the Sustainability Standard audit, spent mushroom substrate can be included in the scope of "food loss and waste" because it is an organic material that is a byproduct of the production process. Similarly, organic byproducts from other agricultural processes that are used in mushroom production, and therefore diverted from landfill, can also be considered "food loss and waste" for the purposes of this audit. Practices related to reuse or diversion from landfill can be captured in this section.
1.06.01 Food Loss Diversion	Organic byproducts of production, namely, spent mushroom compost/substrate, can be reused, donated, or sold for a variety of purposes that divert the material from a landfill. For instance, spent mushroom substrate can: • Be applied as a soil amendment, e.g., by local farms. • Serve as an additive to compost or casing after additional processing (e.g., after being composted, steamed and pasteurized, a small portion may be able to be used in the casing layer as an alternative to peat). • Be sold to homeowners, gardeners, or other entities for use as potting mix, landscaping or green roof material. Additionally, if mushroom operations produce their own compost from organic byproducts from other cropping systems (such as hay, straw, manure, corn cobs, etc.), these can also be considered efforts to divert food loss and waste from a landfill, as they are effectively diverting food waste and repurposing it. In specialty mushroom production, organizations' efforts to reuse spent substrate, including use for animal feed, biofuel or compost additives, can also be counted towards "food loss diversion".
1.06.02 Material Waste Diversion	This question recognizes efforts to divert non-organic waste, e.g., plastic, glass, paper, from landfill. See Sustainability Standard Audit Guidelines for additional guidance.
1.06.03 Sustainable Packaging	See Sustainability Standard Audit Guidelines for guidance.

1.06.04 Recycled Content	See Sustainability Standard Audit Guidelines for guidance.
Worker Safety and Welfare	See Sustainability Standard Audit Guidelines for guidance. The Question Applicability Matrix provides guidance on questions that may not be applicable to small farms.
Sustainability and Stewardship	See Sustainability Standard Audit Guidelines for guidance.

Farm-Level Checklist

Sustainability Standard Criteria	Mushroom-Specific Guidance
Biodiversity and Environmental Protection	While mushrooms are grown indoors, producers can still implement and earn credit in the audit for measures to restore or conserve habitat to support native species, wildlife and biodiversity. Natural or managed areas surrounding production sites can be considered this section. v2.0 now offers credit off-site efforts to protect/conserve biodiversity and establish pollinator habitat through investment in or purchase of off-site managed habitat.
2.01.01 Protect Sensitive Areas	Enclosed (indoor) production is recognized as one measure that protects sensitive areas. See Sustainability Standard Audit Guidelines for additional guidance.
2.01.02 Avoid Sensitive Areas	Auditors can consider this criterion as N/A unless the mushroom organization has expanded and put new land into production since the previous audit, or within the past year for new auditees.
2.01.03 Visual Monitoring	See Sustainability Standard Audit Guidelines for guidance.
2.01.04 Quantitative Data	See Sustainability Standard Audit Guidelines for guidance.
2.01.04a Improvement Over Time	See Sustainability Standard Audit Guidelines for guidance.

2.01.05 Biodiversity Conservation	Measures to conserve and protect biodiversity in areas surrounding grow houses can be reflected in this criterion and may include the following: • Maintaining natural wooded/forested areas surrounding grow houses and production sites, or on other off-site managed land. • Maintaining or establishing riparian buffers that feature native plants. • Investing in or contributing to local/regional habitat restoration projects.
2.01.06 Pollinator Habitat	Efforts by mushroom producers to implement pollinator habitat can be reflected here. These efforts may include: • Planting pollinator-friendly native plants on the perimeter of grow houses or on off-site land within the growing region. • Efforts to establish pollinator habitat through investment in or purchase of off-site habitat.
2.01.07 Reducing Impacts of Managed Bees	N/A, managed bees are not used in mushroom production.
Environmental Emergency Management	See Sustainability Standard Audit Guidelines for guidance.
Fertilizer and Pesticide Drift	Pesticide use is generally minimal in mushroom production as few products are registered for use. Applications are contained in the indoor production environment, inherently mitigating much of the risk of drift to the outside environment. However, risks to workers are still applicable.
2.03.02 Drift Mitigation Plan	Drift management plans are applicable to any mushroom operation that uses pesticides. Indoor production mitigates pesticide drift, as well as practices that limit air exchange between grow rooms and the outdoors. Weather conditions can be considered not applicable. See Sustainability Standard Audit Guidelines for additional guidance.

Soil Health	While mushrooms are not grown in soil, there are some questions in this section of the audit where auditors can consider management of the mushroom growing substrate, as well as the soil/ground surrounding mushroom production houses that is owned/under management of the organization. On-site compost production, if applicable, should also be considered part of the farm-level audit scope.
2.04.01 Erosion Mitigation	Practices that mitigate soil erosion, which can be caused by water and wind, on ground surrounding production houses should be considered here. These practices can include • Vegetative cover to minimize/eliminate bare ground. • Water retention lagoons or ponds that manage/mitigate runoff. • Tree lines serving as wind breaks.
2.04.02 Advanced Soil Health Testing	Testing of the mushroom growing substrate can be evaluated for conformance against the audit guidance as written. This provides an opportunity for mushroom operations to receive credit for any substrate testing that is conducted. (An N/A score is also acceptable, as mushrooms are not grown in soil.)
2.04.03 Improving Soil Health	N/A is the best response option, as mushroom substrate is created and managed for the purpose of best meeting the needs of mushroom growth, and this question aims to recognize practices that improve soil health.
2.04.04 Soil Health Improvement Goals	N/A is the best response option, as mushroom substrate is created and managed for the purpose of best meeting the needs of mushroom growth, and this question aims to recognize goals to improve soil health.
Water Conservation	Effective water management is essential in mushroom production, as mushrooms require precise watering to ensure their needs are met. Both overwatering and underwatering can adversely affect mushroom cultivation. This makes it challenging to reduce water usage during the growing process and leaves little opportunity for additional water conservation in production. Generally, specialty mushroom production utilizes even less water, as almost all water applied to the mushrooms is used during the growing process.

2.05.01 Prevent Contamination	On-farm efforts by mushroom operations to ensure that water leaving the operation is not contaminated with sediment, nutrients or pesticides can be scored and reflected in this criterion. These practices may include: • Retaining wastewater in detention basins, ponds or lagoons for treatment before release into the environment, or use irrigating non-food fields. • Establishing riparian buffers, filter strips or other vegetative cover surrounding grow houses. • Capturing and recirculating water used in composting systems to minimize/eliminate runoff from compost production. • Having a Mushroom Farm Environmental Management Plan and implementing the BMPs related to how to prevent nutrients from reaching the streams/tributaries.
2.05.02 Irrigation Based on Crop Need	Water use in mushroom production is carefully matched to the needs of the mushroom; excess water is not used as it would be detrimental to crop growth. In general, and in the absence of evidence to the contrary, mushroom production practices are generally aligned with total conformance.
2.05.03 Irrigation Use Efficiency	See Sustainability Standard Audit Guidelines for guidance.
2.05.04 Irrigation Efficiency Improvements	Most mushroom growing operations use irrigation water very efficiently - water must be carefully managed and not overused for optimal mushroom growth. Advanced, industry-leading irrigation efficiency practices for mushroom production may include: • Closed-loop or circular irrigation systems. • Using technologies that monitor substrate moisture levels and adjusting water application accordingly. • Capturing, recirculating or reusing water from compost systems.

Energy Conservation	Indoor production facilities require energy, primarily electricity and fuel usage, to produce a crop. On-farm energy efficiency measures mushroom operations employ may go beyond those listed in the Sustainability Standard Audit Guidelines. Auditors should be open to reviewing these measures and their supporting documentation to holistically assess the energy conservation practices mushroom producers are implementing in their grow houses.
2.06.01 Energy Efficiency On-Farm	Energy conservation and efficiency practices may include: • Utilizing variable speed motors for fans, air conditioners, HVAC units, and other equipment allows for more efficient energy use to control temperature. • Using energy efficient (non-energy intensive) inputs such as compost and mushroom substrate made from organic agricultural by-products. • Reducing peat usage for casing by incorporating alternative materials, replacing peat entirely or substituting a portion of it with alternatives. • Minimizing fuel usage due to the close proximity of grow houses to packing facilities, processing operations or distribution facilities. • Using electric vehicles. • Reducing energy loss (e.g., heat loss and air leaks) from the grow house structure through double coverings, thermal screens, additional insulation and/or sealing/weatherstripping.
2.06.01a Improvement Over Time	See Sustainability Standard Audit Guidelines for guidance.
2.06.02 Renewable Energy On-Farm	See Sustainability Standard Audit Guidelines for guidance.

IPM and Nutrient Management	Integrated Pest Management (IPM) is a science-based decision-making process that helps farmers produce high quality crops while minimizing input costs and environmental risks. By combining biological, cultural, physical and chemical controls, IPM reduces the use of non-essential and high-toxicity chemical applications, helping to promote biodiversity, support pollinator health and lower risk to pesticide applicators. This adaptable framework can be applied to various pest management contexts, including mushroom production. Nutrient management in mushroom production is distinct because it focuses not on the application of fertilizers, but on carefully managing the mushroom growth substrate and the compost formulation that serves as an input to the substrate. This approach ensures that the substrate maintains the right balance of nutrients, supporting optimal mushroom yield.
2.07.01 IPM Resources	Resources from University Extension programs such as Pennsylvania State University and University of Arizona are examples of unbiased sources of IPM information.
2.07.02 Identification (Minimum Requirement)	See Sustainability Standard Audit Guidelines for guidance.
2.07.03 Prevention (Minimum Requirement)	For mushroom growers, switching to lower-risk pesticides may not be feasible, as there are limited options of pesticides registered for use in mushroom production. Reducing pesticide use through implementing strict sanitation, hygiene and other cultural practices to minimize pest incidence, and transitioning to biological controls, such as nematodes, can be recognized as effective strategies for reducing pesticide risk and use.
2.07.10 Pesticide Resistance Identification (Minimum Requirement)	See Sustainability Standard Audit Guidelines for guidance.

2.07.11 Pesticide Resistance Mitigation (Minimum Requirement)	Pesticide resistance mitigation strategies that mushroom producers may use include: • Steam-off/post-crop pasteurization of growing rooms between crop cycles. • Efficient and effective sanitation practices, procedures or protocols. • Tank mixing multiple modes of action. • Rotating chemical and non-chemical methods. • Seasonal breaks in pesticide usage.
2.07.12 Evaluation	See Sustainability Standard Audit Guidelines for guidance.
2.07.13 Pesticide Risk Reduction for Specific Concerns	See Sustainability Standard Audit Guidelines for guidance.
2.07.14 Pollinator Protection	Pollinator protection is largely inherent to mushroom production, as mushrooms do not bloom (i.e., are not attractive to pollinators) and drift is largely prevented by using pesticides in an enclosed growing environment. Barring any evidence to the contrary, these conditions of mushroom production lend themselves to total conformance. If pesticides are applied outside of the growing house, e.g., to control weeds, practices to mitigate risk to pollinators should be considered in the evaluation of conformance, such as avoiding applications to blooming plants, and avoiding use of pesticides toxic to pollinators.
2.07.15 Basic Nutrient Testing	The efforts of mushroom producers to test and monitor nutrients (e.g., nitrogen, ammonia, pH, temperature, moisture, etc.) of the mushroom growth substrate should be considered in evaluating conformance to this criterion. Only testing for organic matter is considered not applicable to crops not grown in soil.
2.07.16 Nutrient Application Records	If no fertilizers (synthetic or organic) are applied after the substrate is created, this question can be assessed as not applicable. If supplemental nutrients are added to the substrate during mushroom growth, recordkeeping requirements apply.

2.07.17 Nutrient Management	Mushroom producers generally formulate the growing substrate to carefully match the crop's nutrient needs, considering inputs and specific ratios of inputs required for optimal mushroom growth. This process should be considered as the nutrient management process for mushroom production, and is eligible for total conformance, assuming there is written documentation available for review. (N/A is also correct, assuming no fertilizers (synthetic or organic) are applied after the substrate is formulated, however this misses an opportunity for credit.)
2.07.18 Nutrient Use Efficiency	The most appropriate response is N/A; this question is intended to evaluate the efficiency in a producer's use of added nitrogen (N) and phosphorous (P) in the production of a crop with the goal of optimizing efficiency relative to production of the crop. In mushroom production there is little opportunity to improve N or P use efficiency; the growing medium is designed to optimize production based on growth needs of the mushroom species, and at the same time there is little opportunity to minimize off-site movement of nutrients, e.g., through runoff or leaching, due to the indoor production environment. If producers are tracking the metrics described in the Audit Guidelines, they can receive credit.
2.07.19 Nutrient Use Efficiency Improvements	The most appropriate response is N/A based on the reasoning described in Nutrient Use Efficiency. This is a follow up to the previous question. If producers are tracking and can demonstrate improvement in the metrics described in the Audit Guidelines, they can receive credit.

Facility-Level Checklist

The facility-level checklist applies to any facilities processing and packaging mushrooms. Please see the Sustainability Standard Audit Guidelines for further guidance.

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