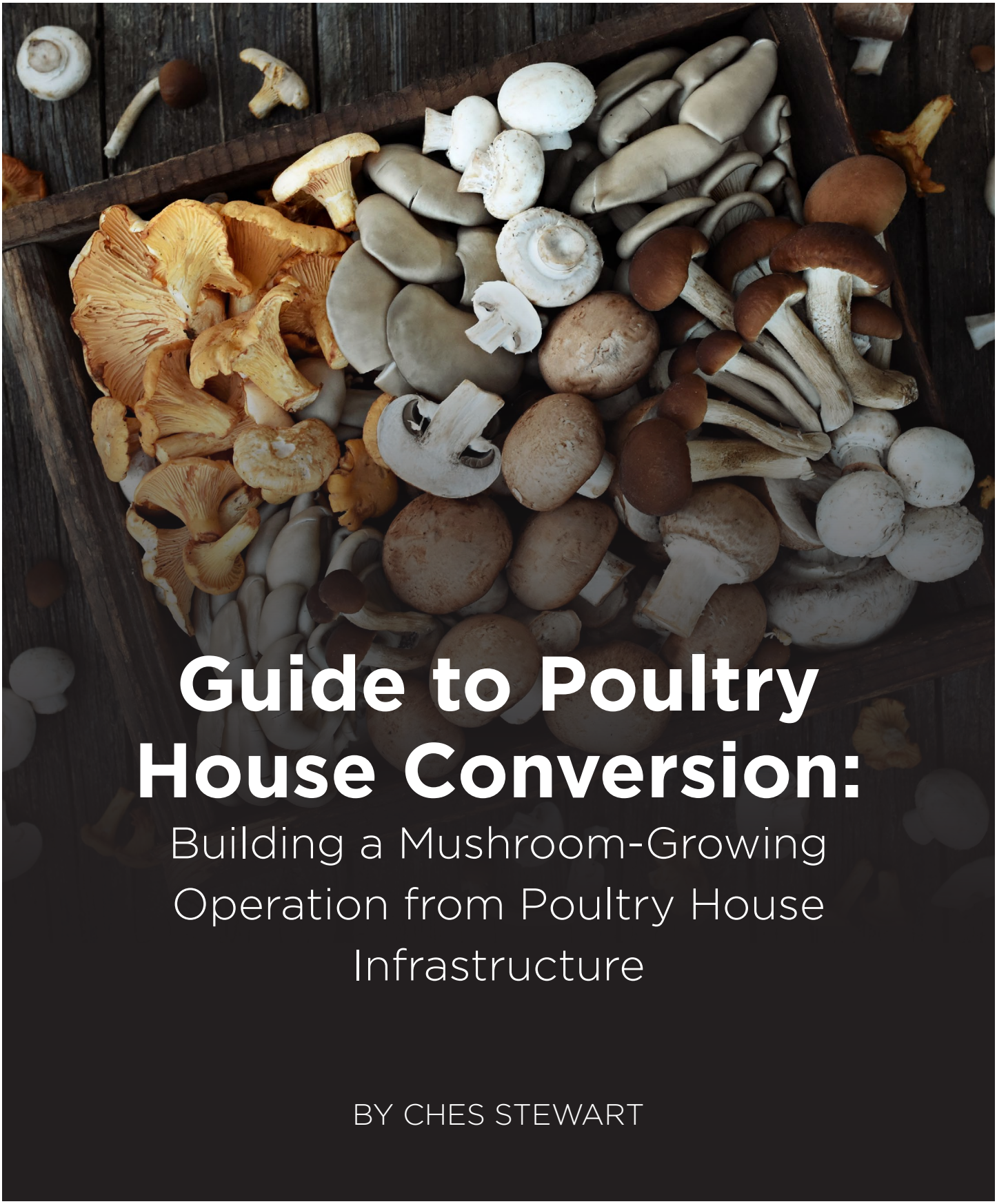

Guide to Poultry House Conversion:

Building a Mushroom-Growing Operation from Poultry House Infrastructure

BY CHES STEWART

Transfarmation® × SAXAPAHAW • NC HAW • RIVER • MUSHROOMS

Important Disclaimer

This document ("Document") or any written material provided to you by Mercy For Animals, Inc., (including Transfarmation™) or any of its affiliates (together, "MFA"), including but not limited to information or written material prepared by third parties, should not be construed as advice or in any way an endorsement or a recommendation by MFA.

The Document should not form the primary basis for any decision that you make in relation to matters referenced herein and is not a substitute for performing any and all necessary due diligence, including consulting independent agricultural, legal, tax, finance, and other expert advisors.

Neither MFA nor any of its officers, directors, agents, or employees makes any warranty, expressed or implied, of any kind or accepts liability for any losses, damages, costs, or expenses of any kind or description relating to the adequacy, accuracy, or completeness of the information contained in the Document.

The Document is for your general information only, and MFA is not soliciting any action based on it. Any views or opinions expressed in the Document are those of the author except where MFA specifically states that they are the views of MFA. Any view or opinions expressed are valid only as of the date indicated. MFA does not accept any responsibility to update any views, opinions, or other information contained in the Document.

Table of Contents

Table of Contents 3

Introduction 4

About the Author 4

The Mushroom Market Today 4

Building Out a Grow Space 5

Poultry House Grow-Space Construction 5

Four Components for Any Successful Grow House 6

Poultry House Designs 6

Materials List 7

CAD Drawings and Building Models 8

Step by Step: Converting One Poultry House 9

Site Preparation 9

Establish a Concrete Pad 9

Framing the Rooms 10

Preparing a Climate-Controlled Environment 11

Adding Value to the Remaining Covered Square Footage 12

Conclusion 13

Introduction

This guide has been prepared to provide beginning and prospective commercial mushroom producers with a foundation for setting up and operating their first commercial-scale mushroom operation. The principles laid out here are applicable to mushroom farms ranging in scale from supplying a small farmers market to serving wholesalers and national distributors. This guide discusses input sourcing, substrate preparation and sterilization, basic lab skills, colonization monitoring, grow-room management, post-harvest handling, and finding a market.

Figure 1. Author and family in one of their grow rooms.

About the Author

Ches Stewart is the co-founder and owner of Haw River Mushrooms, alongside his wife and business partner, Laura Stewart. He received his masters in agricultural economics from Clemson University and a bachelors in animal science from Middle Tennessee State University. His agricultural experience includes managing six high tunnels at an Ohio-based produce farm and gathering data and reporting for the 2015–16 poultry census.

Ches began cultivating mushrooms in 2012, expecting it to be a one-off crop amid a range of diversified produce. He soon became enamored with the growing process and realized that demand for mushrooms was high. But few growers produced them, especially at that time. After starting Haw River Mushrooms, he spent the first five years balancing off-farm work as a crop adjuster with scaling his business. Ches started growing on hardwood logs (a less labor-intensive growing method), transitioned to growing on straw bags in a high tunnel, and in his third year graduated to growing on amended sawdust. In 2017 he transitioned to full-time mushroom farming. As of this writing, Ches is in his 11th year of mushroom production and sixth year of full-time farming. Haw River Mushrooms produces over 37,000 pounds of mushrooms a year, supplying farmers markets, wholesale buyers, and a line of shelf-stable and frozen prepared foods. The company grows a variety of hardwood mushrooms, including blue (or "gray") oyster, golden oyster, pink oyster, snow oyster, Italian oyster, lion's mane, cinnamon cap (or "chestnut"), reishi, and shiitake.

Today's Mushroom Market

The mushroom market has considerable room (and need) for more U.S. mushroom growers. The North American mushroom market is expected to grow at a compound annual growth rate of 7.7% over the 2019–2027 forecast period. American consumers are increasingly interested in plant-based proteins, functional foods that provide health benefits as well as flavor, and crops that can be sustainably produced through regenerative agriculture. Mushrooms sit at the nexus of these trends, creating market opportunities for new growers in both small- and large-scale niches.

Building Out a Grow Space

Grow spaces can be as simple as an unheated greenhouse or hobbyist tent, but to expand to a commercial scale, producers should invest in building out a climate-controlled structure. This need not be a brick-and-mortar space. Many growers (including Ches) build their infrastructure in modular structures, such as an insulated shipping container or a refrigerator trailer. More complex spaces may comprise a conditioned warehouse and multiple conditioned grow rooms.

Although mushrooms can be grown in a simple, unconditioned structure, for our purposes, this document focuses on growers who start out in small modular buildings, such as shipping containers and reefer trailers, and aim to expand into existing structures on their own farms, such as a poultry or hog barn.

Figure 2. Exterior view of converted poultry house.

Poultry House Grow-Space Construction

This guide focuses on retrofitting a poultry house that has not held birds in 12 to 18 months and has been cleared of equipment and litter.

PREP WORK:

Before any changes take place, one should remove as much poultry equipment as possible and then scrape out the poultry litter (typically four to 12 inches deep) with a skid steer bucket. The University of Delaware Cooperative Extension recommends scraping out and removing all poultry litter down to the compacted soil. Then pressure wash the walls and any exposed rafters with a sanitizing solution. Chlorine dioxide is ideal, but other sanitizers will work. Cleaning all remaining vents and fans is also important. Wear clothes that can get muddy! (See photo.)

Figure 3. Ground preparation.

Four Components of Any Successful Grow House

Growing in a poultry house requires us to follow some of the same basic guidelines as growing in trailers or other structures.

1. **Heating, cooling, ventilation:** In setting up a grow room, a good rule of thumb for sizing the HVAC system is .75 to 1.00 ton per 100 square feet of actual grow space. Because spores and high moisture can shorten a system's life dramatically, dedicating a portion of the grow-space entrance to a preconditioning space is highly recommended. From there the conditioned air is ducted directly into the grow space.
2. **Humidity:** Humidity should be kept at 90%–95%. A high-pressure misting system is needed to evenly distribute moisture throughout the grow room. This can be accomplished with a quarter-inch water line and misting nozzles. With proper shelf spacing, wet spots on fruit bodies shouldn't be an issue.
3. **Fresh air exchange:** Mushrooms require fresh air to colonize, initiate pinning, and fruit. Because mushrooms consume oxygen and emit CO_2, always bring in fresh air and exhaust the CO_2-heavy air. This can be done with fans, such as simple "can fans" (8", 6", or 4") that can be installed and replaced easily. The importance of keeping CO_2 concentrations below 700 ppm cannot be overstated. This CO_2 level signals a need for urgent action to save the room; if a grow room's CO_2 level exceeds 800 ppm, fruit bodies will be leggy. Above 900 ppm, pinning mushrooms will stop developing.
4. **Water escape/cleaning drains:** Super important, but often overlooked, drains are vital to a successful growing operation. Without drains, one cannot quickly clean grow rooms (a regular chore) using pressure washers and a commercial soap or sanitizer. With fixed drains, a P-trap install will help keep pests from entering grow rooms through the drains. Otherwise they can easily get in and cause issues. A fine mesh screen over the hole can help control the fungus gnat, beetle, and slug populations in grow rooms and allow water to escape.

Poultry House Designs

Houses come in a variety of designs, but this guide references a poultry house in southern North Carolina that is 50' x 450'. (See photo.)

Figure 4. Aerial view of standard poultry house rows.

North Carolina facility current details:

- Four poultry houses measuring 50' x 45'.
    - One house is already dedicated to growing vegetables hydroponically and in raised beds.
- 8' side walls with a 15.5' peak.
- Houses cleaned and poultry equipment removed
- Houses that are not in use will need to be checked and reconnected to the power meter, electrical equipment, and water lines. Three of the four houses are not connected to the generator.
- Houses were built around 1989 and require evaluation to ensure each house is in usable condition.
- Facility depends on wells for water.
- Gravel roads to and from the houses are in OK shape but will need rebuilding as foot and vehicle traffic increases.
- Project site is an hour drive from Charlotte, a major metropolitan area, and the smaller towns of Asheboro, Pittsboro, and Sanford. It is a two-hour drive to Raleigh and other major metropolitan areas.

Materials List

Below is a materials list and estimated costs as of September 2024 for the construction of two 500-square-foot grow rooms.

Materials	Sourcing options	Unit cost	Quantity	Line cost
Specialty sourcing				
Galvanized steel framing studs — For 1,000 square feet of grow space 16" spacing is recommended in addition to space to run misting and electrical lines outside the grow rooms.	Facebook Marketplace offers second-hand sourcing.	$7.00	87	$637.00
Concrete by the yard — For a 1,000-square-foot slab, one would need 13 cubic yards.	Search local concrete suppliers for quotes. Assumed farmers provide labor.	$183.00	13	$2,379.00
Available online or at a local hardware store				
Three-ton HVAC — 36,000 BTU 17.5 SEER ACiQ single-zone, wall-mounted mini split system w/WiFi		$1,850.00	3	$5,550.00
Duct elbows — 14" adjustable elbow, 26 gauge		$18.57	4	$74.28
Spiral ducting — 14" diameter, 26-gauge spiral pipe, five feet		$93.95	2	$187.90
Galvalum sheeting for interior and entrance walls		$28.48	47	$1,338.56
1000 PSI misting system — stainless steel high-pressure misting pump/kit		$3,699.00	1	$3,699.00
Eight-inch inline fan duct exhaust blower vent — hydroponics air cooling can		$128.99	4	$515.96
Four-foot LED vapor-tight light (four pack)		$149.99	2	$300.00
Low GWP 200 spray gun — indoor/outdoor spray foam insulation kit		$457.00	6	$2,739.00
#9 x one-inch silver, zinc-plated self-drilling roofing screws (115 count)		$13.98	4	$55.92
Hollow steel doors		$250.00	2	$500.00
Steel five-tier utility shelving unit (47.7" W x 18" D x 72" H), chrome, (350-pound capacity per shelf) — Farmer can custom build if comfortable welding.		$129.00	22	$2,838.00
Industrial polypropylene service cart for harvesting		$139.99	1	$139.99
14-inch outdoor-rated fans for airflow in grow rooms		$121.99	3	$365.97
Misc. cleaning supplies — bleach, industrial soap, oxidate, SaniDate		$100.00	1	$100.00
Misc. tools — wrenches, pliers, hammers, etc.		$100.00	1	$100.00
Plumbing supplies — drains, 3" PVC pipe, P traps				$300.00
Misc. electrical — wire, outlets, amp box, vapor-proof switches, and GFCI outlets • 200-amp breaker box • Nonmetallic gray, one-outlet weatherproof electrical outlet cover, vapor-proof switches • 15-amp, 125-volt recessed GFCI residential duplex outlet with wall plate				$700.00
Total				**$22,520**

CAD Drawings and Building Models

These drawings illustrate the grow-room layout and preconditioning air chambers.

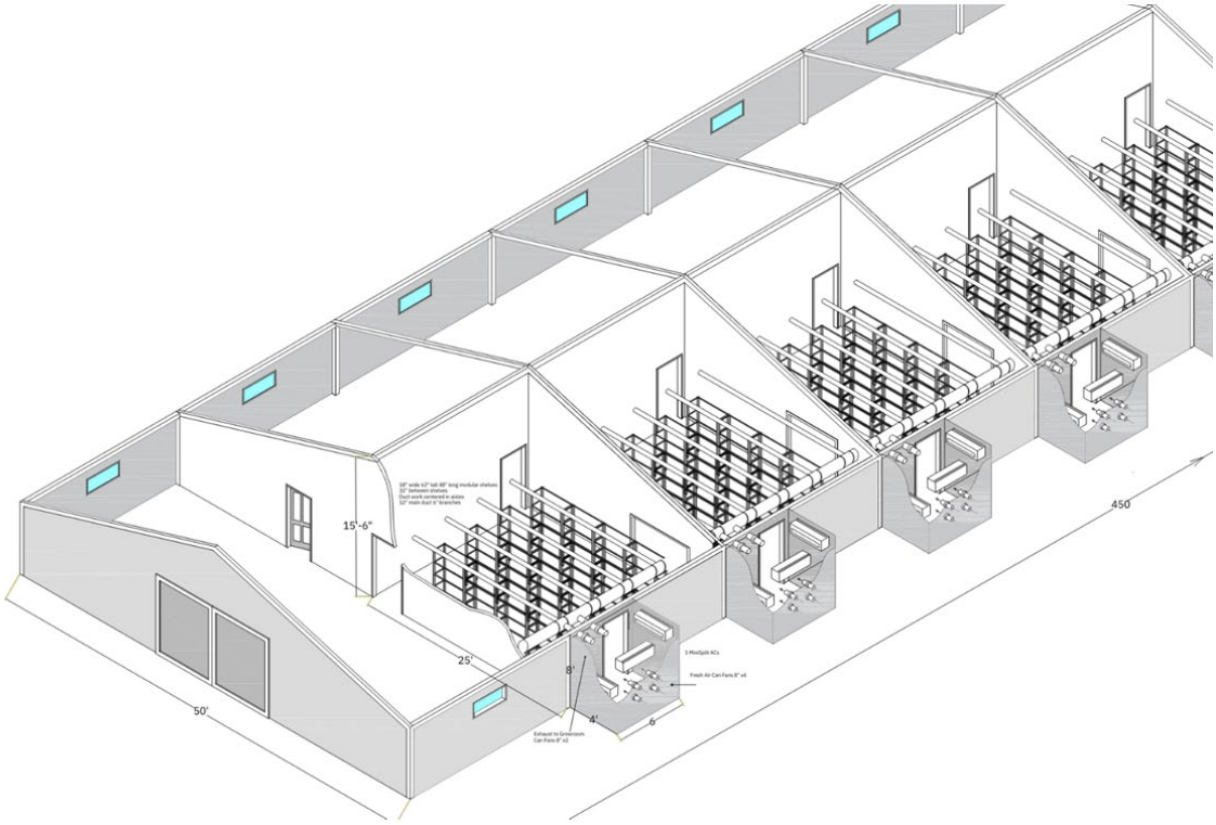

Figure 5. Model of modular buildout of grow-room spaces.

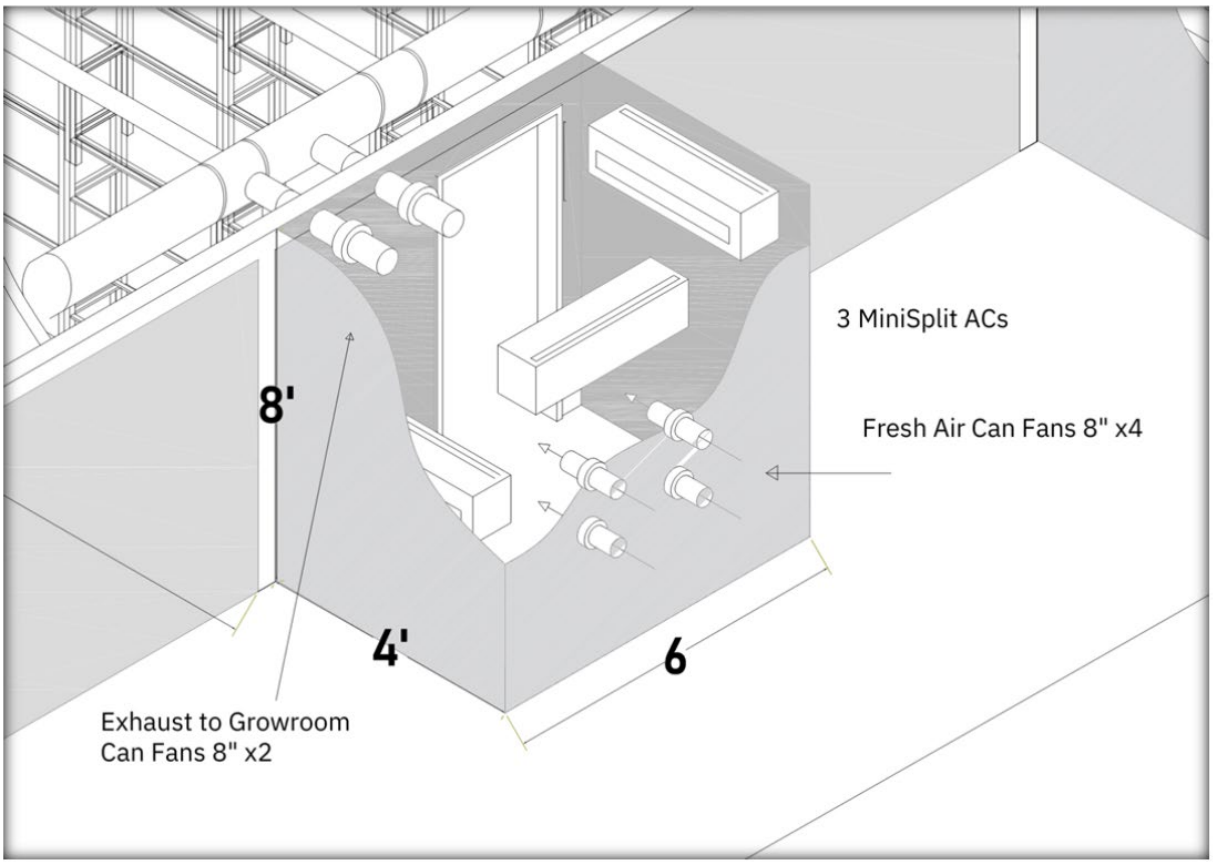

Figure 6. Detail of preconditioning chamber.

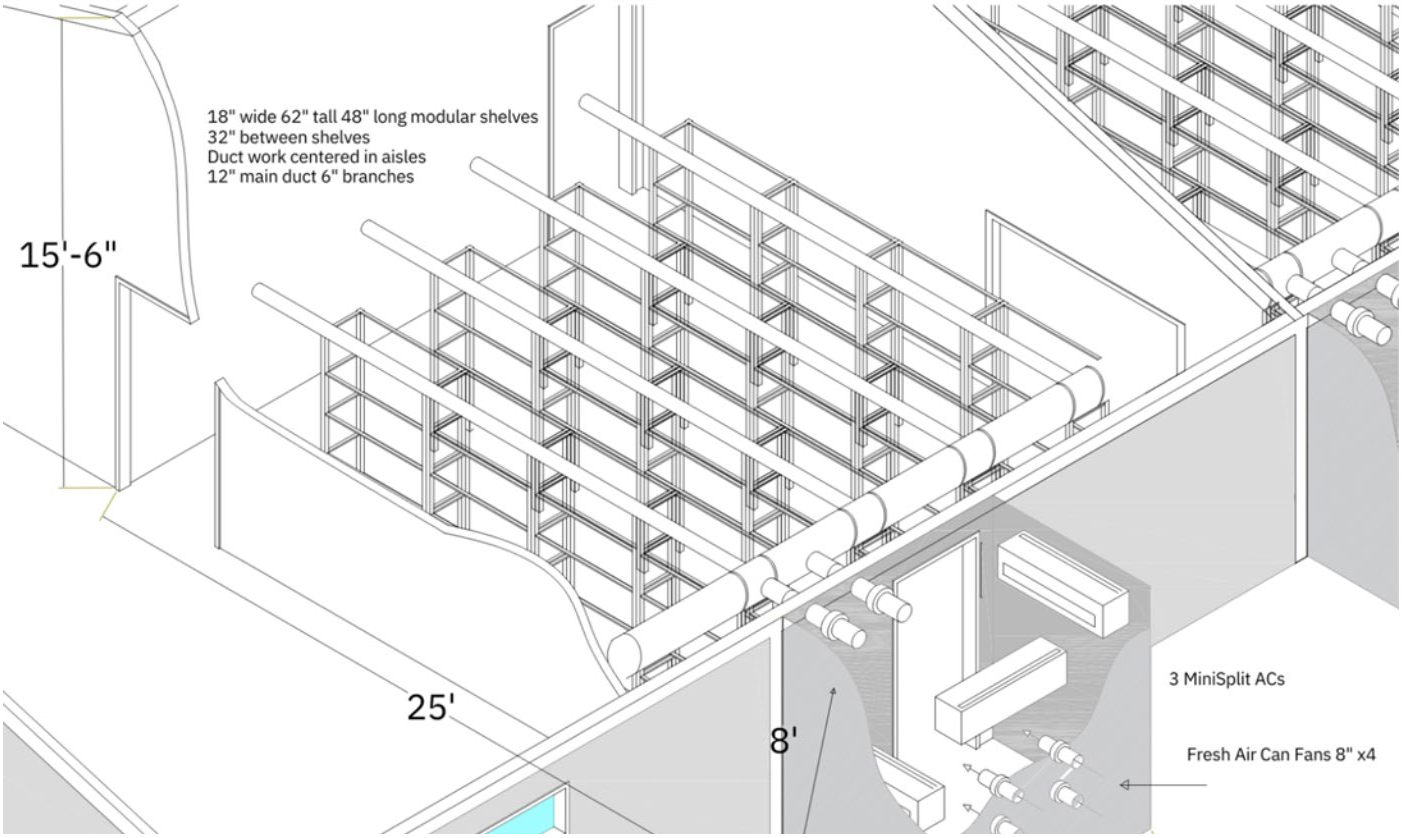

Figure 7. Shelves and preconditioning chambers.

Step by Step: Converting One Poultry House

SITE PREPARATION

- Scrape, clean, and sanitize all surfaces.
- See diagram of poultry house plan above.
- Use polycarbonate sheeting to fill in half walls; plywood sheeting could work in a pinch; greenhouse plastic could be a budget option as well.
    - The house could be left open (dependent on climate and location).
- Clean the front entry room and prep for other uses (see options below).
- Reconnect water and power.

For this project: Grow-room orientation and layout are based on the particular equipment the farmer has or will have (e.g., skid steer). This specific facility is a long, narrow building. Lining up the grow rooms on the right side and leaving the left side open for bringing in equipment and other uses is recommended to efficiently fill, empty, and clean grow rooms.

ESTABLISH A CONCRETE PAD

It may be helpful for farmers to consult a structural engineer to assess any repairs that are needed. A visual evaluation of one poultry house can cost around $1,500.00. Once the building has been cleaned and structural repairs made, if needed (e.g., replace rotting wood), the first step is to prep footings and pour a concrete slab for the grow rooms. Pouring a concrete slab is a multistep process that requires careful planning and execution to ensure a strong and durable foundation. Here's a general outline of how to do it in a poultry house:

- **Site preparation:** Clear the area where the concrete slab will be poured. Remove any debris, rocks, or vegetation. Ensure the ground is compact and level. Use stakes and string to mark the perimeter of the slab.

- **Formwork:** Build forms using wooden boards or metal stakes and panels to contain the concrete. Make sure the forms are properly aligned and leveled. They should be sturdy enough to withstand the pressure of the wet concrete.
- **Reinforcement:** Place reinforcement, such as rebar or wire mesh, within the formwork to add strength to the slab. This is especially important for larger slabs or those subjected to heavy loads.
- **Mixing concrete:** Although one can mix concrete, buying it by the yard and having it delivered premixed by a cement company is recommended. See materials list for the amount of concrete needed for the grow-space pour. If one decides to mix it, one must follow the instructions on the concrete-mix packaging to prepare the concrete. Use the appropriate ratio of cement, aggregate, and water. Folks can mix the concrete manually using a wheelbarrow and shovel or use a concrete mixer for larger quantities.
- **Pouring:** Start pouring the concrete into the formwork from one end to the other. Use a shovel or concrete rake to spread the concrete evenly within the forms. Work quickly but carefully to ensure the concrete doesn't start setting before the pour is done.
- **Leveling and finishing:** Once the concrete is poured, use a screed board to level the surface. Drag the screed board across the top of the forms in a back-and-forth motion to smooth out the concrete. Fill in any low spots with additional concrete and repeat the leveling process as needed.
- **Edging and jointing:** Use an edging tool to round the edges of the slab. This helps prevent chipping and makes the slab look more finished. One can also use a grooving tool to create contraction joints, which help control cracking as the concrete dries.
- **Curing:** Cover the freshly poured concrete with plastic sheeting or wet burlap to keep it moist and prevent it from drying too quickly. Proper curing is essential.
- **Finishing touches:** After the concrete has cured for the recommended time (typically a few days), remove the forms and clean up any excess concrete around the edges. Farmers can also apply a sealer to protect the surface and enhance its appearance.

The rooms are constructed from metal studs, the interior layer of galvalume sheeting, and spray foam behind the galvalume. The galvalume sheets will overlap the next sheet slightly to form a tight seal and then attach to the metal studs with metal screws (that have a special waterproof seal on them to prevent leaking). A bead of waterproof silicone caulk is then used to seal any gaps between the galvalume sheets.

FRAMING THE ROOMS

Framing a room with metal studs on a concrete pad is similar to framing on a wooden floor but with some additional considerations for anchoring the bottom track securely to the concrete surface. See below for instructions on building a grow room with metal studs on a concrete pad:

1. **Prepare the concrete pad:** Do this by ensuring that the concrete pad is clean, level, and free of any debris or obstructions. Pressure washing is always a good idea. Allow the surface to dry completely before proceeding.
2. **Lay out and mark the walls:** Use a chalk line or other marking tool to outline the walls of the room directly on the concrete pad. Measure and mark the locations for the bottom track, door and window openings, and any other framing elements according to the layout plan.
3. **Install the bottom track:** Cut the bottom track to length using a saw, and then position it along the chalk lines on the concrete pad. Use a hammer drill and concrete screws or anchors to secure the track to the concrete. Make sure the track is straight and level and use a leveler to check for accuracy.
4. **Cut and install the studs:** Measure the height of the walls, and cut the metal studs to the appropriate length using a saw. Insert the studs into the bottom track, spacing them according to the layout plan. Use a leveler to ensure the studs are plumb, and secure them to the track using screws or rivets.
5. **Install the top track:** Once the studs are in place, install a top track along the ceiling where the wall will be located. Cut the track to length, and secure it to the ceiling joists or structural elements using screws or other fasteners.
6. **Add blocking and bracing:** As needed, add blocking between the studs for support and stability. Use additional metal framing members or diagonal bracing to reinforce the structure, especially in load-bearing walls.

7. **Frame door and window openings:** Frame door and window openings using metal studs and additional framing elements as necessary. Ensure the rough openings are properly sized and aligned according to the specifications provided by the door or window manufacturer.
8. **Secure electrical and plumbing:** In this buildout, all electrical or additional water lines are run along the outside of the grow rooms as much as possible to avoid exposure to excess moisture in the grow rooms. Use metal conduit or protective plates to prevent damage to the wiring or pipes.
9. **Double-check and adjust:** Double-check the alignment, level, and plumb of the framing members before proceeding with further construction tasks, such as installing the interior metal walls and the spray-foam insulation.
10. **Install metal galvalume sheeting:** Once the structural framework is completed, install the metal galvalume sheeting for the interior walls and ceiling. Once installed, the walls of the grow rooms will be insulated with the spray foam kits outlined in the materials list. Materials listed should result in three-inch-thick closed-cell foam insulation rather than insulation of the entire poultry house.

The materials list above suggests enough materials for two 500-square-foot grow rooms or one 1,000-square-foot grow room. If one is adding space, the materials list is flexible enough for planning out materials and labor cost. With the space on one side of the chicken house, a single poultry house could have 20 grow rooms.

PREPARE A CLIMATE-CONTROLLED ENVIRONMENT

In order to grow mushrooms at any commercial scale, it is, of course, necessary to maintain proper temperatures, humidity, and cleanliness. In order to maximize production space and still allow for the harvest and disposal of blocks, 18" x 48" x 62" galvanized, rust-resistant wire racks are recommended. Spacing of 32" between racks allows for harvesting, harvest carts, and maintenance.

Ducting down the center of each aisle allows for even air distribution, and duct is easy to remove and replace when dirty. Humidity is added to the grow rooms via a high-pressure misting pump (see materials list). Misting nozzles can be run between rows of racks, with nozzles 36"–48" apart. This is a rough estimate, as ambient humidity and air flow could impact nozzle spacing.

In planning out the HVAC system for this commercial grow operation, several options are available. Usually, conditioned air is delivered directly to a room via a supply duct and returned to the system through a filtered "return" duct. In a normal room, that works great. However, exposing HVAC equipment to all the things (spores, cool temperatures, and excess moisture) that mushrooms love to grow in will dramatically decrease the effectiveness and life span of the equipment. Instead, having a small preconditioning room (to heat or cool the air before pumping into the grow room) reduces the wear and tear on HVAC equipment and more efficiently cools and heats grow rooms. In this instance, three one-ton mini splits condition the fresh air provided by four 8" centrifugal fans. The air is cooled and then pumped into the grow room and distributed by flexible polyducting down the center of the aisles.

As mentioned above, electrical requirements should be addressed and installed by experienced and licensed electricians. Due to the wet environment of a grow room, vapor-proof lighting is required, and any wiring should be installed on the exterior of the grow rooms.

ADDING VALUE TO THE REMAINING COVERED SQUARE FOOTAGE

Poultry houses offer a vast amount of covered space. Additional value can be captured from these spaces, and in the buildout process thought should be given to what additional functions will be accomplished in the poultry house and how the layout should be structured in order to maximize customer or project workflow. Here are some ideas for additional space uses:

1. Merchandise retail space

If a farm plans to host visitors, building out a farm store can be a great source of additional income and a method to attract and retain buyers. When constructing the farm store consider (1) creating barriers to separate farm facilities from public-facing facilities and (2) maintaining clear postings of when the store is open (keeping a "closed" or "by appointment only" sign at the farm entrance during all other hours to avoid drop-in shoppers).

2. Expanded packing, processing, or cold storage

A sanitary, covered, moderately temperature-controlled space in which to pack, weigh, and process mushrooms is necessary. Three to five six-foot tables are used to accomplish this at Haw River Mushrooms, with a padded rug underneath and a shelf to house supplies and cleaning instruments. Cold storage should be housed close to the point of harvest.

3. Additional grow rooms

A great benefit of building out a poultry house is the large amount of additional space that allows for adding growing space to an operation in a modular fashion. It's helpful to add grow rooms for additional climate separation, to specialize climate conditions based on the preferences of unique mushroom varieties, and to allow a space to be completely emptied and deep-cleaned without disrupting the growing schedule.

4. Composting windrows

Spent mushroom substrate is valued as a soil amendment. Market it in raw form, or build additional value by precomposting the substrate in windrows under the poultry-house roof. One can add value by building vermicompost windrows. Red wrigglers can survive on supplemented myceliated sawdust spawn, and the resulting vermicompost and worms can form a potential additional source of revenue.

5. Event space

Agritourism can be a great source of supplemental income for specialty farms, and the covered space can be used to host community events, farm-to-table dinners, and classes on mushroom growing or other farm activities.

6. Commercial kitchen for value-added products.

If the plan includes making prepared foods from the mushrooms, one may plan to host a certified kitchen near the grow space. Check local regulations for commercial kitchen and value-added processing.

7. Equipment and materials storage

Space should be conserved for storage of farm equipment, vehicles, and bulk supplies, such as boxes, packaging, and marketing materials. If one plans to make substrate, dry, rodent-resistant storage is recommended for multiple tons of soybean hulls and sawdust.

Conclusion

Mushroom growing offers a sustainable and productive crop that retains agricultural value in unused chicken houses. While modifications of the space are needed, aspects of the existing chicken house are highly amenable to conversion to this new and highly marketable crop.

If you use this conversion plan, please let us know! We would love feedback on what worked well for you and what challenges you encountered. Reach us via email at info@thetransfarmationproject.org.