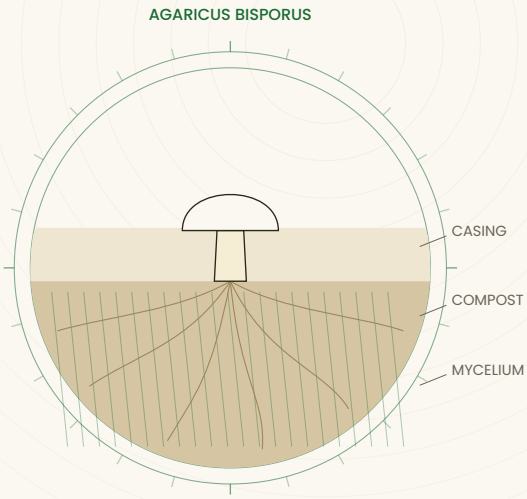
A MUSHROOMWALE FIELD GUIDE

The Button Mushroom.

Grower's Guide

From compost to harvest — the complete reference for India.



MushroomWale™
The Mushrooming Expert

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ABOUT THIS GUIDE

A practical reference, not a sales brochure.

This guide distils what we have learned from designing and commissioning climate-controlled button mushroom facilities across India. It is written for first-time growers, agripreneurs evaluating mushroom farming as a business, and bank-loan applicants who need to understand the cycle before they sign the disbursement papers.

We do not romanticise the work. Button mushroom cultivation is a demanding, biology-driven discipline where small environmental errors compound into total crop failures. The growers who succeed treat their rooms like clean-room laboratories and their compost like a living organism. If that is not the kind of attention you can sustain, this is not the crop for you.

Where we recommend infrastructure, we recommend what we install. Where we cite figures, we cite figures from working facilities we have built. Where we say a thing does not work, we have watched it fail.

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A NOTE FROM THE FOUNDER

Why we wrote this guide.

We get the same questions every week. From a tomato farmer in Vidarbha who watched a neighbour build a mushroom unit. From a returning Gulf migrant in Punjab looking for a second income. From an MBA student writing a NABARD project. From a hotelier in Bengaluru who wants to control the supply chain behind her menu. The questions are almost identical, and the answers are almost never short.

We have spent the last several years designing, building and commissioning climate-controlled button mushroom facilities across India. Some have succeeded beyond what their owners projected on paper. Others have failed in ways we did not predict at the time, and now do. The patterns are clear enough to write down.

This guide is the document we wish every first-time grower had read before signing a single contract. It is not a brochure. It will not flatter the reader, will not promise eighteen-month paybacks, and will not pretend that compost is something you can outsource and forget. It is structured the way the crop actually moves — from raw straw to the first flush on a tray — because that is the only structure that produces growers who still own working farms five years later.

We have published this without a paywall, without a contact-capture form, and without a registration wall. If you find it useful, recommend it. If you spot an error, write to us at info@mushroomwale.com. If after reading it you decide mushroom is not for you, we have done you a larger favour than any sales call we could have run.

And if after reading it you decide to build — well. You will know what to ask for, what to refuse, and what to budget. That is the only honest place to start.

Chirag Deep Singh
Program Head, MushroomWale / Agrimotion Engineering Pvt Ltd
Sirsaganj, Uttar Pradesh / Edition 2026

CONTENTS

What you will learn here.

Twenty-one chapters and a glossary, organised the way the crop actually moves — from substrate to harvest to balance sheet.

Edition 2026, Vol. 01. Content current as of publication. Indicative ranges across recent Indian projects.

BEFORE YOU BEGIN

How to read this guide.

This guide is built in three reading layers. Decide which you need before you start.

THE EVALUATOR

You are deciding whether mushroom farming is the right business for you. Read Chapters 1, 2, 13, 14 and 15. Skip the operational chapters until you have decided.

THE FIRST-TIME GROWER

You have decided to build. Read every chapter in order. Pay particular attention to Chapters 5 and 6 on compost, because that is where most first-time growers actually fail.

THE OPERATOR WITH A PROBLEM

You already have a facility and something is going wrong. Find your symptom in Chapter 12 (Pests and Diseases) or Chapter 14 (Top Failure Modes) and work backward to the chapter that explains the underlying biology.

All cost and revenue figures in this guide are indicative bands from MushroomWale's design and project work across India, 2022–2026. Validate against your facility's actuals or request a site-specific Detailed Project Report.

CHAPTER

01

Why Button Mushroom

Market, economics, and why India

If you cannot answer why this crop, why now, why you — do not build the room yet.

KEY NUMBER

Rs 100–150/kg

blended wholesale gate price for fresh button mushroom in India — branded retail with cold chain achieves Rs 200–300/kg

IN THIS CHAPTER

- The Indian market for fresh and processed button mushroom
- Why button outperforms oyster and milky mushroom commercially
- Realistic capex bands by facility size
- What the unit economics actually look like at steady state
- When the business stops working — and why

1.1

Why this crop, why now, why India.

Before any first-time grower spends a rupee on PUF panels or a compost contractor, they should be able to answer one question in one sentence: what is the actual business I am stepping into.

Button mushroom — Agaricus bisporus — is the world's most-produced edible fungus, and within India it is by a long margin the most commercially organised mushroom crop. While oyster and milky mushroom have lower entry costs, button mushroom dominates institutional and retail channels — hotels, QSR chains, organised retail, processed food — and commands a premium price that justifies the climate-controlled infrastructure this guide is about.

The Indian market has moved decisively past the curiosity phase. Per-capita consumption is still a fraction of European or Chinese levels, but the absolute volumes flowing through Delhi-NCR, Mumbai, Bengaluru and the larger Tier-2 cities have grown consistently for more than a decade. The buyers are real and they want consistent supply, not seasonal flushes.

What has changed in the last five years is the supply side. Climate-controlled growing rooms are no longer the preserve of large corporate farms. A unit producing 50 to 100 kilograms a day can now be financed, built and operated by a first-time entrepreneur using a NABARD or PMEGP loan stack. The risk is not in the demand. It is in the discipline of execution.

> *Demand is not the problem. The risk sits entirely inside the grow room.*
>
> — FROM CHAPTER 14

This chapter sets the commercial frame. The chapters that follow take the lid off the room.

1.2

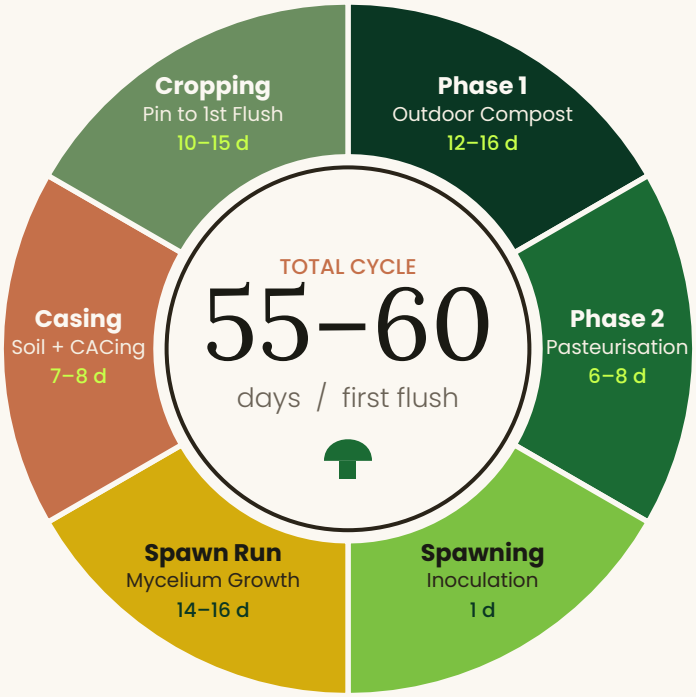
The Indian market

The Indian button mushroom market has been pulled forward by three developments that any new grower should understand. Urban households now treat fresh mushroom as a year-round vegetable rather than a seasonal exotic. Organised retail and quick-service restaurant chains have built cold-chain infrastructure that small farms can plug into without owning trucks. And processed food — sauces, frozen products, ready meals — has emerged as a separate channel that absorbs second-grade and bulk-graded output at predictable rates. None of this guarantees demand for your specific farm. It does mean the market is not the constraint.

1.3 INFOGRAPHIC

One crop, six stages, fifty-five days.

A complete button mushroom cycle from raw compost to first flush harvest.



Wheel shows time to first commercial harvest. Subsequent flushes (2nd, 3rd, 4th) extend cropping by 15 to 20 days. Flush distribution by yield: 1st 35-40%, 2nd 25-30%, 3rd 15-20%, 4th 10-15%.

4	18-30	3-4	365
FLUSHES	KG / 100 KG	YEAR	DAYS
per crop run	short to Phase-III compost	payback on total project	no seasonal downtime

1.4 REFERENCE

Room sizes and what they actually produce.

Standard configurations used across the MushroomWale design library. Yields are conservative steady-state figures for a competently run room on quality Phase-2 compost.

ROOM	BAGS	YIELD/DAY	COOLING	INDICATIVE PROJECT
18 × 30 ft	1,000	30 kg	5 TR	**Rs 12–16 L**
18 × 40 ft	1,500	50 kg	7 TR	**Rs 16–22 L**
18 × 60 ft	2,500	80 kg	9 TR	**Rs 24–32 L**
18 × 70 ft	3,000	100 kg	12 TR	**Rs 36–46 L**

Indicative single-room project cost (PUF + refrigeration + automation + civil + working capital). Excludes land. Actual figures vary with state, automation depth, compost source and site logistics. Request a site-specific Detailed Project Report from MushroomWale.

PRO TIP

Start at 18 × 40.

The 18 × 40 ft room is the sweet spot for first-time growers. Big enough to teach you compost discipline and harvest rhythm at meaningful volume. Small enough that one crop failure does not end your business.

COMMON MISTAKE

Building too big, too soon.

First-time growers routinely build four or six-room facilities before they have run a single successful crop. The compost goes wrong, every room fails at once, and the EMI clock keeps ticking. Build one, get it right, then scale.

1.5 THE ECONOMICS

What a working facility earns.

Indicative annual economics for two reference configurations. Numbers assume 85% capacity utilisation from Year 2 onward and Rs 100–150/kg blended wholesale realisation across mandi, direct and processor channels.

FACILITY A

Single 18 × 40 room

Daily output	**50 kg**
Annual output	**~14,000 kg**
Wholesale revenue	**Rs 14–21 L**
Operating cost	**Rs 8–11 L**
Operating profit	**Rs 5–10 L**
Total project cost	**Rs 16–22 L**
Payback (no subsidy)	**3–4 years**
Payback (with subsidy)	**1.5–2 years**

FACILITY B

100 kg/day farm

Daily output	**100 kg**
Annual output	**~28,000 kg**
Wholesale revenue	**Rs 28–42 L**
Operating cost	**Rs 15–20 L**
Operating profit	**Rs 10–22 L**
Total project cost	**Rs 36–46 L**
Payback (no subsidy)	**3–4 years**
Payback (with subsidy)	**1.5–2 years**

Indicative ranges from MushroomWale's design and project work across India, 2022–2026. Actual figures vary with state, compost cost, energy tariff, harvest discipline, market channel mix, and season. Validate against your facility's actuals or request a site-specific Detailed Project Report.

1.6 CHAPTER SUMMARY

Six things to carry into the next chapter.

01

Demand is settled.

Button mushroom has structural urban demand across retail, HORECA and food processing. Supply discipline, not market access, decides who wins.

02

It is a biology-driven business.

Every successful operator treats their compost as a living organism and their rooms as laboratories. There is no shortcut to this discipline.

03

Climate control is non-negotiable.

Seasonal sheds work only at hobby scale. Anything past 50 kg/day requires PUF, refrigeration and active automation.

04

Start small, get one right.

An 18 × 40 ft room is the right first build. Master a single room before you scale to two, four or six.

05

Compost is the constraint.

Quality of substrate sets the ceiling of every other decision. If you cannot make or source good Phase-2 compost, do not build the rooms.

06

Payback is realistic, not magical.

Three to four years on a well-run facility on total project cost. Subsidy stacks bring this to 1.5 to 2 years. Anyone selling you eighteen-month payback without subsidy is selling you a story.

UP NEXT / CHAPTER 02
The Biology — meet Agaricus bisporus
Turn the page

CHAPTER

02

The Biology

Meet Agaricus bisporus

You are not growing a vegetable. You are managing a living organism that briefly produces fruit.

KEY NUMBER

16 to 18 °C

fruiting body temperature range that defines every infrastructure decision in this guide

IN THIS CHAPTER

- What Agaricus bisporus actually is, in plain terms
- The lifecycle from spore to fruiting body
- Parts of a mushroom — and what each one tells you
- Environmental envelope by stage — temp, RH, CO2 targets
- Six biology blunders we see most often

2.1

What you are actually growing.

Most first-time growers think of mushroom as a vegetable. It is not. It is the fruit of a fungus, and that single distinction shapes every decision that follows.

Agaricus bisporus is the species behind almost every white button mushroom sold commercially. It is a fungus, not a plant. It has no chlorophyll, does not photosynthesise, and cannot make its own food from sunlight. It feeds by digesting decomposed organic matter — which is why compost, not soil, is the starting point of every successful crop.

The visible mushroom you eventually harvest is the fruiting body of the organism. The actual organism — the part that does the work — lives unseen inside the compost as a white, thread-like network called mycelium. The fruiting body's only biological job is to produce and release spores. Your commercial objective is to interrupt that cycle by picking the fruit before it opens.

This biology has three consequences that matter operationally. First, the crop is invisible for most of its life. From spawning to first pinning, the work is happening inside compost you cannot see into. Second, the conditions that favour mycelium growth are not the conditions that favour fruiting — you have to actively switch the environment at the right moment. Third, Agaricus competes with other fungi and bacteria for the same substrate. Contamination is not a failure mode, it is the default state. Sterility is what you have to engineer.

> *Mushroom is fruit. Mycelium is the tree. Manage the tree, not the fruit.*
>
> — A WORKING PRINCIPLE

This is why experienced growers obsess over compost quality and barely talk about the mushrooms themselves. The visible crop is a downstream symptom of upstream work that ended weeks earlier.

2.2

Why button, not oyster

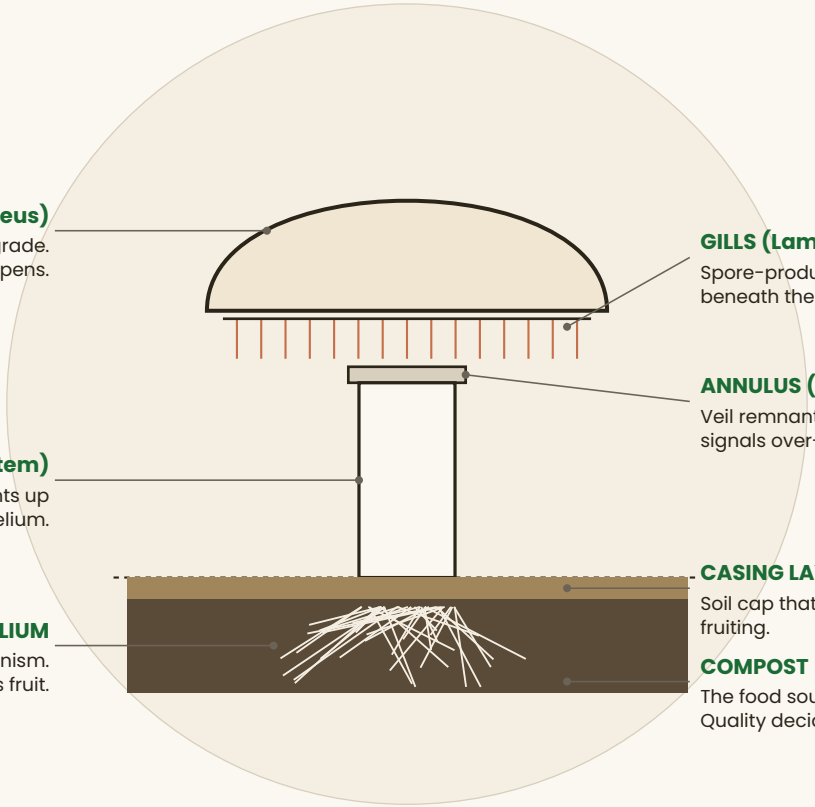
Button mushroom is harder to grow than oyster or milky. It needs Phase 2 compost, climate control, casing soil, and tighter environmental tolerances. Oyster will grow on a bag of pasteurised straw in a shed.

So why button. Because it commands roughly twice the realisation per kilo at retail, has a national distribution network already in place, and is the variety that institutional buyers ask for by default. The premium pays for the discipline.

2.2 ANATOMY

The parts of a mushroom, and what each one does.

Each visible feature corresponds to a function. Understanding the anatomy is the first step to reading what your crop is telling you.



CAP (Pileus)
The umbrella. Determines grade. Pick before it opens.

GILLS (Lamellae)
Spore-producing surface beneath the cap.

ANNULUS (Ring)
Veil remnant. Tearing signals over-maturity.

STIPE (Stem)
Conducts nutrients up from mycelium.

CASING LAYER
Soil cap that triggers fruiting.

MYCELIUM
The actual organism. The mushroom is its fruit.

COMPOST
The food source. Quality decides yield.

KEY INSIGHT

The mushroom is fruit. The mycelium is the tree. Manage the tree, not the fruit.

2.3 ENVIRONMENTAL ENVELOPE

What each stage needs to thrive.

Temperature, humidity, CO2 and air-exchange targets shift by stage. Building a room that holds these envelopes is the work of Chapter 4. Knowing them is the work of this page.

STAGE	TEMP (°C)	RH (%)	CO2 (PPM)	AIR EXCHANGE	INDICATOR
Spawn run	23–25	90–95	5,000–15,000	Low	Compost colour
Casing	23–25	90–95	5,000–10,000	Low	Mycelium recovery
Pinning	17–18	92–95	800–1,200	High pulse	Pin density
Cropping	16–18	85–90	800–1,200	Continuous	Cap quality
Between flushes	16–18	90–92	1,000–1,500	Moderate	Watering

Indicative envelopes consistent with published research and MushroomWale's design library. Specific strain selection and compost type can shift these by 1–2°C or 5% RH.

PRINCIPLE

One transition matters most.

The shift from spawn-run/casing (warm, high CO2) to pinning (cool, fresh air) is the single trigger that makes mushrooms appear. Missing it by two days costs you a full flush.

MISTAKE

Treating ranges as targets.

A range like 16–18°C is a working tolerance, not a setpoint. Holding 16.0°C steady is the goal. Drifting between 16 and 18 within a single day shocks the crop.

2.4 COMMON MISTAKES

Six biology blunders we see most often.

Failures usually trace back to one of six misunderstandings about what the organism actually needs. Recognising them is the first defense.

MISTAKE

Treating it like a vegetable.

Mushroom is not a crop you water and weed. It is a fungus you incubate and protect. The mental model decides every operational call you make.

MISTAKE

Skimping on compost.

Cheap or under-pasteurised compost guarantees contamination and weak flush. There is no operational excellence that compensates for bad substrate.

MISTAKE

Opening rooms too often.

Every door opening drops humidity, raises CO2 variance, and introduces airborne spores. Plan room visits — do not improvise them.

PRINCIPLE

Watch the mycelium, not the mushrooms.

A healthy white spawn run predicts a strong crop. Patchy or yellow mycelium predicts the opposite. By the time you see mushrooms, the verdict is already in.

PRINCIPLE

The shock triggers fruiting.

Mycelium fruits when it perceives that its current habitat is becoming hostile — cooler, fresher, drier. The shift is a feature, not damage.

MISTAKE

Ignoring spore release.

An open cap releases millions of spores per minute, which become next month's contamination. Pick before opening, every time.

2.5 CHAPTER SUMMARY

Six things to carry into the next chapter.

01

It is a fungus, not a vegetable.

Every decision flows from this. No photosynthesis, no soil, no chlorophyll. Compost is food and casing soil is a trigger, not nutrition.

02

The mushroom is fruit.

Mycelium is the tree, mushroom is the fruit. The fruit's job is spore release. Your job is to harvest before that happens.

03

Two envelopes, one transition.

Spawn-run conditions and cropping conditions are different. The transition between them — done well — is what makes mushrooms appear on schedule.

04

Contamination is default.

Other fungi and bacteria want the same substrate. You are not creating sterility — you are buying back the ground from contamination, every day.

05

The crop is invisible for most of its life.

From spawning to first pinning is roughly 22 days during which there is nothing to look at. Resist the temptation to open the room.

06

Premium justifies discipline.

Button is harder than oyster. The reward is a price floor that institutional channels respect, and a national distribution network that already exists.

UP NEXT / CHAPTER 03
The 55-60 Day Cycle
Turn the page

CHAPTER

03

The 55-60 Day Cycle

From raw straw to first flush

If the calendar slips, the crop slips. There are no second chances inside a cycle.

KEY NUMBER

55 to 60 days

from compost stacking on Day 0 to picking the first commercial mushroom

IN THIS CHAPTER

- Why mushroom calendar discipline is different from other crops
- The full timeline laid out day-by-day
- What happens biologically and what the operator controls at each stage
- Which slippages are recoverable, and which are fatal
- How overlapping cycles enable continuous output

3.1

Why the calendar is the boss.

Every other business optimises around the calendar. Mushroom farming optimises with it. A day lost at compost stacking is a day lost at harvest, six weeks later.

The button mushroom production cycle is biology unfolding in a fixed sequence. Each stage produces conditions the next stage requires. You cannot speed up spawn run by adding heat, you cannot trigger pinning by waiting, and you cannot improve compost quality by spending more on the room. The calendar is not a project plan — it is the crop.

This is what separates mushroom from most other agricultural businesses. A wheat farmer who sows late can still harvest, perhaps at lower yield. A mushroom grower whose Phase 1 runs short produces compost that will not colonise, and there is no operational fix downstream. The first 21 days either set you up for the next 39, or they do not.

The implication for facility design is direct. A single-room operator runs one cycle at a time. A four-room operator overlaps cycles so that one room is harvesting while another is in spawn run. Six rooms running on overlapped cycles can produce continuous daily output. But this depends on every cycle hitting its calendar — slippage in one room compounds across the schedule.

> *There are no second chances inside a cycle. Either the calendar holds, or the room does not earn this round.*
> — OPERATIONAL TRUTH

First-time growers consistently underestimate the importance of compost scheduling and overestimate their flexibility to adjust mid-cycle. Both are expensive mistakes.

3.2

Reading the timeline

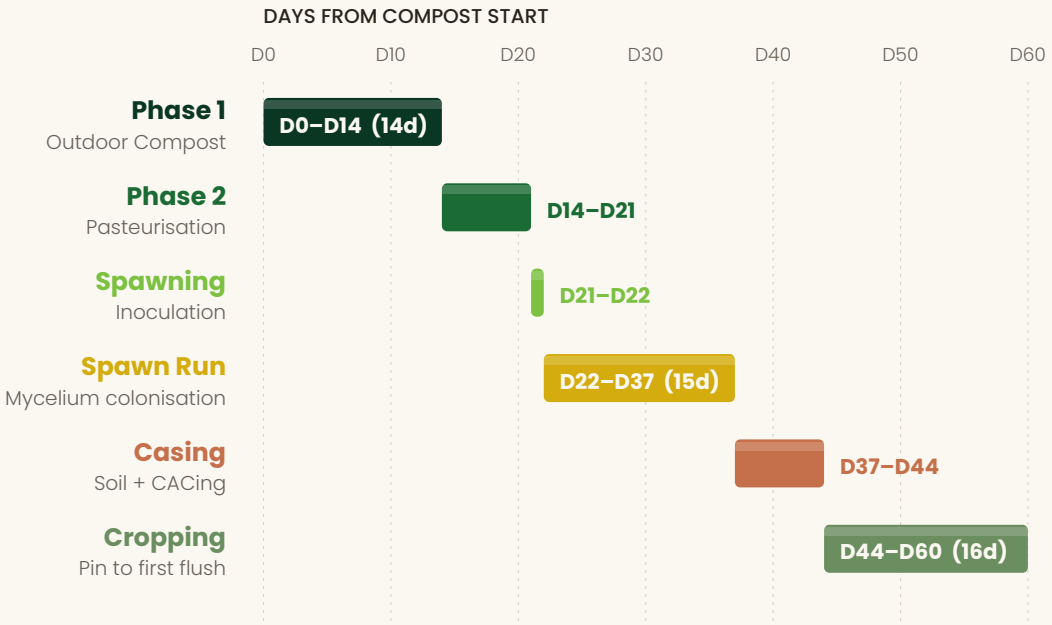
The diagram on the next page shows the full cycle laid out as a calendar. Each bar runs end-to-end. There are no gaps — when one stage ends, the next begins the same day, often the same morning.

Note that Phase 1 and Phase 2 together consume the first three weeks. These are the most labour-intensive stages and produce no mushrooms. New growers who outsource compost should still understand them — because the compost they buy is being made on someone else's calendar.

3.2 THE TIMELINE

Day zero to first flush, laid out as a calendar.

Each stage runs end-to-end. Slippage at one stage compresses the next. Read the bars left-to-right.



TOTAL CYCLE — 55 to 60 days — raw straw to first picked mushroom

THE BOTTLENECK

Phase 1 and Phase 2 together consume the first 21 days. There is no shortcut for them. Plan downstream calendar from compost availability, not the other way around.

THE INVISIBLE STAGE

Spawn run (Days 22-37) is the longest single stage but produces no visible output. Resist the temptation to disturb the room.

THE COMMERCIAL WINDOW

Cropping (Days 44-60) is when the room earns. Everything else is preparation.

3.3 STAGE BY STAGE

What happens at each step, and what you control.

Read this table next to the timeline. Each row corresponds to one bar in the chart. The 'Indicator' column is the single most-actionable signal at each stage.

STAGE	DAYS	BIOLOGY	OPERATOR ROLE	INDICATOR
Phase 1	12–16	Microbes degrade straw, ammonia	Stack, turn, wet, monitor temp	Internal temp 65–75°C
Phase 2	6–8	Pasteurise, condition, kill ammonia	Hold tunnel temperature	Compost smells sweet
Spawning	1	Inoculate compost with rye-grain	Mix at correct rate, bag/spread	Even distribution
Spawn run	14–16	Mycelium colonises full substrate	Hold 23–25°C, do not disturb	White cover at Day 12
Casing	7–8	Soil cap triggers fruiting hormones	Apply, ruffle, CAC if used	Pin formation under casing
Cropping	28–32	Pins form, mature, flush in waves	Pick, water, ventilate	Cap closure at harvest

Day ranges are short-method benchmarks. Long-method composters add 4–6 days to Phase 1. Phase III (bulk spawn run) tunnels compress total cycle to 45–50 days.

PRINCIPLE

One indicator per stage.

Choose one observable per stage and check it daily. Trying to watch everything means you watch nothing. The 'Indicator' column lists the single highest-signal observable.

MISTAKE

Compressing Phase 1.

Phase 1 cannot be shortened by adding more turnings or more nitrogen. The microbial activity needs the time. Compressed Phase 1 produces compost that looks ready but is not.

3.4 COST OF SLIPPAGE

What it costs when the calendar slips.

Each stage delay has a downstream cost. Knowing them in advance lets you decide whether to recover, abandon, or push through.

MISTAKE

Phase 1 runs short by 2 days.

Compost reaches Phase 2 with incomplete ammonia conversion. Phase 2 cannot fully compensate. Result: weak spawn run, 15-25% yield loss across all flushes.

MISTAKE

Phase 2 cuts conditioning early.

Ammonia residue at spawning kills inoculum on contact. Patches of compost never colonise. Result: bald spots and reduced flush surface area.

MISTAKE

Spawn run rushed by adding heat.

Above 28°C mycelium grows fast but produces weak strands. Crop appears strong then collapses at pinning. Result: lost cycle, full 60-day write-off.

PRINCIPLE

Casing applied 1-2 days late.

Recoverable. Mycelium pauses without harm. The full crop window simply shifts. Most common slippage and the least costly — do not panic.

MISTAKE

Pinning shock missed by 24 hours.

Mycelium continues vegetative growth and skips the fruiting trigger. Either a delayed first flush or a complete pin failure. Hard to recover.

PRINCIPLE

First flush picked late by 12 hours.

Caps open and release spores. Lower grade realisation on that batch, plus contamination risk for subsequent flushes. Bad but not fatal — clean the room.

3.5 CHAPTER SUMMARY

Six things to carry into the next chapter.

01

The calendar is the crop.

You cannot speed up biology by spending more. The cycle determines the schedule, not the other way around. Plan around it.

02

Phase 1 plus Phase 2 is 21 days.

The first three weeks produce no mushrooms. New growers consistently underestimate this and run out of patience or money.

03

Spawn run is invisible.

Fifteen days of nothing visibly happening. The discipline to leave the room alone is the discipline that produces a crop.

04

Watch one indicator per stage.

Compost temperature in Phase 1, ammonia smell in Phase 2, mycelium colour in spawn run, pin density in pinning. One thing, daily.

05

Some slippage recoverable, some not.

Late casing is recoverable. Compressed Phase 1 is not. Knowing which is which protects you from chasing losses into worse losses.

06

Overlapping cycles need synchronised calendars.

Two rooms means two cycles offset by 15 days. Four rooms means four. The whole point of multi-room operation is continuous output, which requires continuous compost supply.

UP NEXT / CHAPTER 04
Infrastructure — rooms, PUF, HVAC, racks
Turn the page

CHAPTER

04

Infrastructure

Rooms, PUF, HVAC, racks

Infrastructure is what gives you the right to fail in a controlled way. Build it correctly once.

KEY NUMBER

80 mm PUF

wall panel thickness that defines every climate-controlled mushroom room in India

IN THIS CHAPTER

- Site selection and orientation
- Room sizing — why 18 × 40 is the default
- PUF panel specifications: thickness, surface, sealing
- HVAC sizing, refrigerant class, and the Daikin HMT choice
- Racks, doors, electricals, and automation hooks
- Where first-time growers consistently overspend

4.1

Build the room before the business.

Site, structure, climate control. Get these wrong and operational excellence cannot save you. Get them right and even an inexperienced operator can produce a crop.

Infrastructure decisions are the only ones in this business that you cannot unwind cheaply. A wrongly-sized AHU can be replaced. A wrongly-built room cannot — at least not without writing off most of what you spent. This is why MushroomWale spends as much time on site selection and PUF specification as on the crop biology itself.

The principles are not glamorous. Insulate well. Seal corners and door frames properly. Size cooling to the realistic worst-case heat load, not the average. Choose components from manufacturers who will still service them in five years. Run electricals with a safety margin. Wire for automation from day one even if you plan to use it later.

None of this is exotic engineering. What it requires is discipline against the temptation to economise where the consequences appear late. A poorly-sealed door produces temperature drift inside the room every time it is opened — and small temperature swings during pinning compound across every flush of every crop.

> *Cheap PUF, cheap doors, cheap compressors — three of the most expensive savings you can make.*
> — FIELD OBSERVATION

Cost discipline in infrastructure is not about spending less. It is about spending in the right places — and ruthlessly cutting elsewhere.

4.2

Three layers of decision

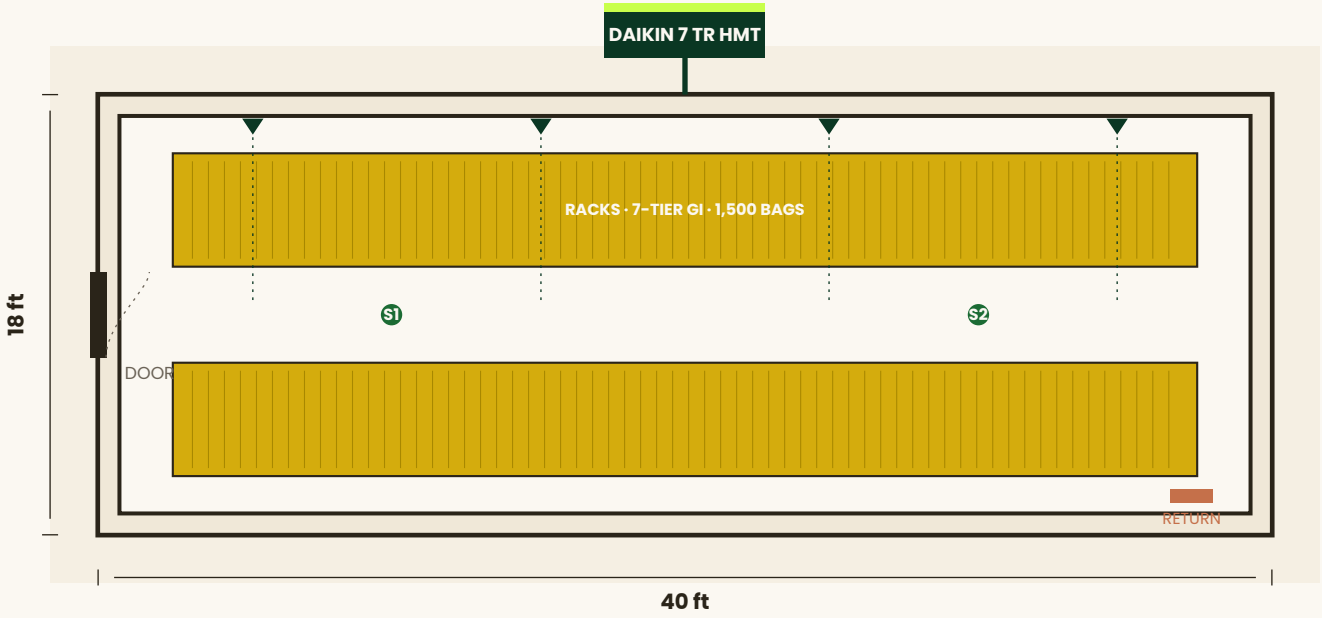
The site, the shell, the systems. Each layer constrains the next. A wet, poorly-drained site limits what kind of foundation you can build. A small shell limits what kind of racks fit. Undersized electricals limit what automation you can run.

The diagram on the next page shows a standard MushroomWale 18 × 40 ft configuration with the systems we recommend. It is not the cheapest configuration. It is the configuration that produces growers who are still running five years later.

4.2 ROOM LAYOUT

Inside an 18 × 40 ft room, as seen from above.

Standard MushroomWale configuration: two rows of seven-tier GI racks, ceiling-mounted DX cooling with ducted distribution.



PUF PANELS

80mm walls / 60mm partitions / PPGL both faces. Roof thickness selected by climate zone.

COOLING

7 TR Daikin HMT

Single split unit. R32 refrigerant. Sized for 50 kg/day output.

AUTOMATION

Naayom NWC 1000

Touchscreen controller. Sensors for temp, RH, CO2. 6 actuators for dampers.

4.3 PUF & HVAC SPECIFICATIONS

What goes into the walls, what goes on the ceiling.

Standard specifications for the four MushroomWale room sizes. PUF panel rates are ex-GST per square metre. HVAC is Daikin HMT class — designed for high ambient temperatures common across north Indian summers.

ROOM SIZE	WALLS PUF	ROOF PUF	COOLING	HVAC CONFIGURATION
18 × 30 ft	80 mm @ Rs 1,735/sqm	80-110 mm roof	5 TR	Single HMT R32 outdoor + indoor unit
18 × 40 ft	80 mm @ Rs 1,735/sqm	80-110 mm roof	7 TR	Single HMT R32 outdoor + indoor unit
18 × 60 ft	80 mm @ Rs 1,735/sqm	80-110 mm roof	9 TR	Single HMT R32 outdoor + indoor unit
18 × 70 ft	80 mm @ Rs 1,735/sqm	80-110 mm roof	12 TR	Twin HMT R32 outdoor + single indoor unit

Wall panels 80 mm across all room sizes; partition walls between adjacent rooms use 60 mm. Roof thickness 80 mm or 110 mm based on climate zone — heavier roof for hotter zones (Rajasthan, Gujarat, interior Maharashtra). PPGL (pre-painted galvalume) surface on both faces of every panel. HMT cooling for Indian summer ambient; R404A is being phased out and should not be specified on new builds.

PRINCIPLE

Roof spec above wall spec.

Roof PUF carries direct solar load on top of ambient conduction, which is why roof thickness goes to 110 mm in hot zones even with 80 mm walls. Match roof thickness to climate, not to wall thickness.

MISTAKE

R404A or non-HMT cooling.

R404A refrigerant is being phased out globally and is now hard to source in India. Non-HMT units lose capacity in hot ambient conditions — useless for Indian summer months. HMT R32 class is the current standard.

4.4 WHERE FIRST-TIMERS OVERSPEND

Six places we see money disappear without yield.

Most over-budget projects share a pattern. Not lavish equipment — wrong equipment, oversized in the wrong dimensions, or correctly sized but bought from vendors who cannot support it.

MISTAKE

Imported HVAC.

Daikin Japan is wonderful and you will pay 3x for it. Daikin India sells the same product family at Indian prices with local service. The technology is identical.

MISTAKE

Hand-built racks.

Local fabricators promise to save you 30% on rack cost. They deliver racks that flex, rust at the welds, and need replacing in three years. GI 7-tier from established suppliers is the standard.

MISTAKE

Branded controllers from abroad.

Fancom, RIOD, Q-Comp are excellent but priced for Dutch labour costs. Naayom or similar Indian controllers run the same logic at one-third the price with local technical support.

PRINCIPLE

Spend on door sealing.

The cheapest insulation upgrade with the largest yield impact. A properly-sealed door cuts temperature drift every time the room is entered. The cost premium is small against cycle-after-cycle exposure.

MISTAKE

Polishing the floor.

Smooth-finish concrete looks professional and is dangerous when wet. Broom-finished or epoxy-floored surfaces drain better, last longer, and reduce slip injuries. Skip the polish.

PRINCIPLE

Wire for automation from day one.

Cat6 to every sensor location, conduit for actuator cables. Adding this later means cutting open PUF panels. Doing it during construction is almost free.

4.5 CHAPTER SUMMARY

Six things to carry into the next chapter.

01

Infrastructure is irreversible.

You can replace a compressor. You cannot replace a poorly-built shell. Spend the time and money upfront.

02

PUF: 80mm walls, 60mm partitions, 80-110mm roof.

PPGL both faces. Sealed corners and door frames. Wall panels 80 mm uniform across all room sizes; partition walls between rooms use 60 mm; roof thickness selected by climate zone, with 110 mm in hotter regions.

03

HVAC must be HMT class.

Non-HMT units derate badly in Indian summers. Daikin HMT R32 is the current standard. R404A is obsolete.

04

Size cooling for worst case.

5 TR for 18×30, 7 TR for 18×40, 9 TR for 18×60, 12 TR for 18×70. These are not arbitrary — they handle peak ambient with reserve.

05

Buy Indian, buy supported.

Daikin India, Naayom, GI rack manufacturers. The technology is the same. The service contracts are very different.

06

Wire for automation immediately.

Cat6 cabling, sensor conduits, actuator wiring. Doing it during construction costs almost nothing. Retrofitting costs the price of the original room.

UP NEXT / CHAPTER 05
Compost Phase 1 — The single most important stage
Turn the page

CHAPTER

05

Compost — Phase 1

Outdoor stacking, formulation, turning

Compost decides your ceiling. Every other decision sets where you land below that ceiling.

KEY NUMBER

75 °C peak

internal stack temperature that defines a successful outdoor Phase 1 composting cycle

IN THIS CHAPTER

- Why compost quality is the single largest determinant of yield
- The classic formulation: straw, manure, gypsum, urea
- Stacking, turning, watering — the four-turn schedule
- Indicators of a healthy Phase 1: temperature, ammonia, colour
- Outsource or build in-house? The economic crossover point
- What ruined compost looks like — and the point of no return

5.1

The single most important stage.

Phase 1 happens outside, under tarpaulin, smelling of ammonia, attracting flies. It does not feel like sophisticated agriculture. It is the entire foundation of the business.

Compost is not soil. It is a biologically active substrate engineered to feed Agaricus bisporus while resisting colonisation by competing fungi. The process begins outdoors on a concrete pad, with wheat straw, horse or chicken manure, gypsum and urea, and a great deal of water. Over twelve to sixteen days, microbial activity transforms this raw mixture into compost that is structurally and chemically ready for Phase 2 pasteurisation.

Phase 1 is where most first-time growers fail, and it is where most first-time growers underinvest. The reasoning is understandable — compost is messy, manual, and produces no visible output until weeks later, when its quality shows up in flush yield. By that time, the decisions are made.

The short-method formulation widely used across commercial production has not changed substantially in decades: roughly 1,000 kg of wheat straw, 400 kg of poultry manure (or 600 kg of horse manure), 30 kg of gypsum, 10 kg of urea, water to roughly 75% moisture by weight. Stack on concrete, turn on Days 4, 8 and 12. The discipline is in the turning, not in the formulation.

> *Outsourced compost is acceptable. Outsourced compost from a supplier you have not visited is not.*
> — SUPPLY DISCIPLINE

If you cannot or will not make compost, buy it from someone whose facility you have seen with your own eyes. The economics of compost trading reward shortcuts that you cannot detect from a delivered batch.

5.2

Make or buy?

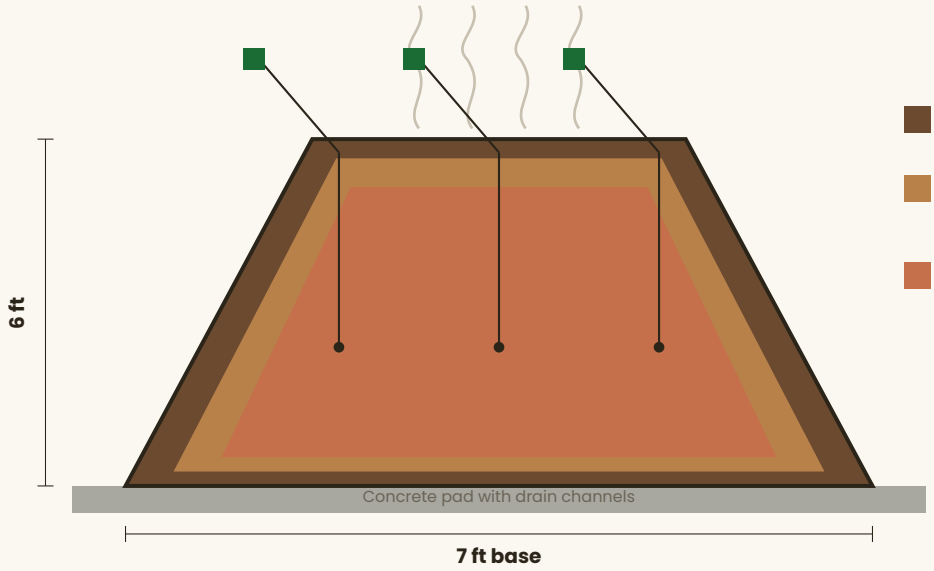
Small farms (under 100 kg/day) often buy Phase 2 compost from larger facilities. This works when the supplier is reliable, the transport distance is short, and the price is reasonable. It fails when one of those three breaks.

At larger scale, in-house composting becomes more attractive — both because the fixed cost of a small composting yard amortises across more cycles, and because the operator gains direct control over the single most important input in the business. The crossover point depends on local compost availability, transport distance, and the operator's appetite for the additional operational burden.

5.2 THE STACK

Inside a Phase 1 stack, as a cross-section.

Trapezoidal windrow, roughly 6 ft tall, 7 ft wide at base. The interior runs hot. The exterior cools, which is why turning matters — to rotate cool material into the core.



DAY 0

STACK

Combine straw, manure, gypsum, urea. Water thoroughly. Initial temperature climb begins within 24 hours.

DAY 4

TURN 1

Rotate exterior into core. Add water if dry. Stack should be steaming heavily.

DAY 8

TURN 2

Core at 70-75°C. Maintain moisture. Microbial activity peaks.

DAY 12

TURN 3

Final turn. Ammonia smell decreases. Compost ready for Phase 2 within 2-4 days.

5.3 FORMULATION & SCHEDULE

What goes in, and when you turn.

Standard short-method Phase 1 formulation for approximately one tonne of finished compost. Scale linearly for larger batches. Turning schedule is non-negotiable.

INGREDIENT / ACTION	QUANTITY / DAY	PURPOSE	WATCH
Wheat straw	1,000 kg	Cellulose backbone, water retention	Long, dry, no mould
Poultry manure	400 kg	Nitrogen source, microbial inoculum	Fresh, not cake
Gypsum	30 kg	Calcium, prevents greasy compost	Powdered, dry
Urea	10 kg	Supplemental nitrogen	Quality grade
Water	To 75% w/w	Microbial medium	Even wetting
Day 0 - Stack	Day 0	Combine and stack on concrete pad	Tall, narrow stack
Day 4 - Turn 1	Day 4	Rotate exterior into core	Steam rising
Day 8 - Turn 2	Day 8	Maintain moisture, increase aeration	70-75°C core
Day 12 - Turn 3	Day 12	Final mixing before tunnel loading	Ammonia reduces

Long-method composters extend Phase 1 to approximately 18-22 days with additional turns. Phase III bulk-pasteurisation systems compress this. The short method shown here is the most common starting point for new growers across India — it has the most forgiving error bands.

PRINCIPLE

Moisture matters more than nitrog

A stack that is too dry will not heat up regardless of nitrogen content. A wet stack with marginal nitrogen often still works. When in doubt, add water.

MISTAKE

Cake-form poultry manure.

Caked or pelletised manure does not release nitrogen at the right rate and contains less biological inoculum than fresh manure. If your supplier only sells caked product, find another supplier.

5.4 COMPOST FAILURES

Six ways Phase 1 goes wrong on you.

Most Phase 1 failures look fine until Phase 2 begins. Recognising the early signs is the only way to catch problems while they are still recoverable.

MISTAKE

Stack never heats up.

Within 24 hours the stack should be steaming visibly. If not, either moisture is too low or nitrogen ratio is wrong. Add water immediately and re-evaluate within 48 hours.

MISTAKE

Sour or vinegary smell.

Anaerobic decomposition has taken over — usually because the stack is waterlogged. Open the stack, mix in dry straw, reduce moisture. May still recover, but yield will drop.

MISTAKE

Cold spots after turning.

Indicates uneven moisture distribution or poor mixing. Each turn should produce a homogenous core. Cold spots become contamination sites in Phase 2.

PRINCIPLE

Strong ammonia smell at Day 8.

Expected and correct. Ammonia generation peaks mid-Phase-1 and should decline as you approach Day 12. Persistent ammonia at Day 12 means more Phase 2 conditioning.

PRINCIPLE

White actinomycete growth on surface.

Looks like white mould. Often misread as contamination — actually a positive sign of high-temperature bacterial activity. Do not disturb.

MISTAKE

Greasy or slimy compost.

Calcium deficiency, usually too little gypsum. Compost becomes greasy, mycelium will not colonise. Cannot be fixed downstream — write off the batch.

5.5 CHAPTER SUMMARY

Six things to carry into the next chapter.

01

Compost is the ceiling.

Every downstream decision is bounded by Phase 1 quality. There is no operational excellence that compensates for bad substrate.

02

The formulation is settled.

Wheat straw, poultry manure, gypsum, urea, water to 75%. The core proportions have not changed materially in decades. Stick to them.

03

The discipline is in the turning.

Days 0, 4, 8, 12. Each turn rotates exterior into core, mixes moisture, and resets the active surface area. Skipping turns wrecks the cycle.

04

Temperature is your daily indicator.

Core should reach 70–75°C by Day 4 and hold through Day 12. Persistent low temperatures mean moisture or nitrogen problems.

05

Buy compost only from facilities you have visited.

Compost trading rewards undetectable shortcuts. Walking the supplier's facility is non-negotiable. If they refuse, walk away.

06

Greasy or slimy compost cannot be fixed.

Calcium deficiency or anaerobic decomposition produces compost that mycelium will not colonise. Write off the batch and start over.

UP NEXT / CHAPTER 06
Compost Phase 2 — Pasteurisation and conditioning Turn the page

CHAPTER

06

Compost — Phase 2

Pasteurisation and conditioning

Phase 2 is precision under pressure. Eight hours at a wrong temperature, six days of wasted effort.

KEY NUMBER

58 °C × 8 hrs

the pasteurisation peak that separates working compost from contaminated compost

IN THIS CHAPTER

- What pasteurisation does and why 58°C is the magic number
- What conditioning does and why it is the longer stage
- Tunnel design — bulk pasteurisation systems explained
- The seven-day temperature curve in detail
- How to know compost is ready for spawning
- Why outsourcing Phase 2 is harder than outsourcing Phase 1

6.1

Two operations, one tunnel.

Phase 2 happens indoors under controlled steam injection. It performs two distinct operations on the same compost — pasteurisation and conditioning — that look similar but serve very different purposes.

Pasteurisation is the brief, hot phase. Compost is heated to 58°C and held there for eight hours. The temperature is precise — too low and you do not kill pests and pathogens, too high and you damage the compost structure and beneficial microorganisms. The eight-hour hold is the conventional international standard, validated across decades of commercial production.

Conditioning is the longer, cooler phase. Once pasteurisation completes, the compost is cooled to 48-52°C and held there for four to five days. During this period, thermophilic bacteria convert excess ammonia into bacterial protein. The ammonia is toxic to mushroom mycelium. The bacterial protein is food for it. Without proper conditioning, spawning a batch of compost is like inoculating poison.

The combined operation requires a tunnel — an insulated indoor space with steam injection, controlled air recirculation, and accurate temperature measurement at multiple depths. Small operators sometimes use insulated shipping containers. Larger operators build dedicated concrete tunnels. The principle is the same: hold a precise temperature profile across the entire compost mass for seven days.

> *Sub-58°C pasteurisation looks fine and harbours every contamination you will face later.*
>
> — THE QUIET FAILURE MODE

This is the most common silent failure in mushroom farming. The peak is briefly reached at one sensor, the operator assumes the batch is pasteurised, contamination shows up four weeks later in cropping. Trust calibrated probes, multiple depths, full eight-hour hold.

6.2

The temperature curve

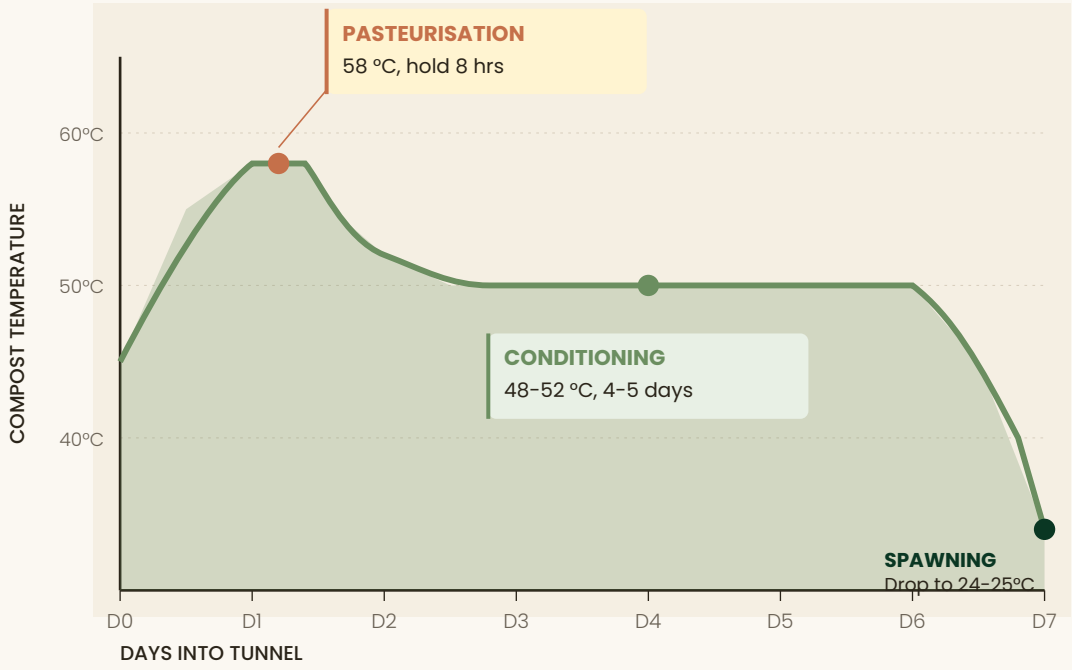
The diagram on the next page shows the full seven-day Phase 2 temperature profile. Both peaks and plateau must be reached. Both durations must be held. Neither phase can be shortened to compensate for the other.

Phase 2 outsourcing is rare because the timing windows are too tight for inter-facility logistics. Compost coming out of Phase 2 must be spawned within four hours.

6.2 THE CURVE

Phase 2 temperature curve, over seven days.

The two-stage profile: pasteurisation peak at 58 °C for 8 hours kills pests and pathogens, then conditioning at 48–52 °C for four to five days converts ammonia into bacterial protein.



WHAT THE PEAK DOES

58°C for 8 hours kills insect eggs, larvae, pathogenic fungi, weed seeds, and nematodes. Lower temperatures fail to sterilise — higher temperatures damage compost structure.

WHAT CONDITIONING DOES

At 48-52°C, thermophilic bacteria convert ammonia (toxic to mycelium) into bacterial protein (food for mycelium). Skipping this stage kills your inoculum at spawning.

HOW YOU MEASURE SUCCESS

Sweet earthy smell, no ammonia odour, free water squeeze test (a few drops), and brown chocolate colour with white actinomycete patches.

6.3 PHASE 2 BENCHMARKS

What each stage of the tunnel does.

Daily benchmarks across the seven-day Phase 2 cycle. The 'Target' column is what your controller should be holding. The 'Watch' column is what tells you it is working.

STAGE	DAY	TARGET TEMP	WHAT IS HAPPENING	WATCH
Load & warm up	D0	45 °C	Compost loaded, tunnel sealed, steam initiated	Even heat across mass
Pasteurisation	D1	58 °C	Hold 8 hours, kills pests and pathogens	Probe agreement
Cool to conditioning	D1-D2	52 °C	Controlled cooling to conditioning range	Smooth descent
Conditioning	D2-D6	48-52 °C	Bacterial ammonia conversion	Ammonia decline
Final cool down	D6-D7	30 °C target	Drop to spawning temperature	Below 28°C at probe
Ready to spawn	D7	<25 °C	Compost ready for inoculation	Sweet earthy smell

Bulk Phase 2 tunnels run the same temperature profile but on uniformly aerated compost mass, generally producing more consistent compost than batch pasteurisation. The trade-off is higher capex against lower per-tonne operating cost and tighter quality control — the crossover point depends on throughput, energy tariff, and local labour cost.

PRINCIPLE

Multiple probes, multiple depths.

A single sensor is not enough. Compost insulates from itself, so the core lags the surface by several degrees. Probes at multiple depths and multiple horizontal locations, with the controller logging the lagging probe — not the leading one — for the eight-hour hold.

MISTAKE

Trusting one calibrated reading.

Compost insulates from itself. A surface reading is several degrees warmer than the core. The eight-hour hold must be measured at the slowest depth reaching 58°C, not the average and not the fastest probe.

6.4 TUNNEL FAILURES

Six ways Phase 2 fails silently.

Phase 2 failures are usually invisible at unloading. Bad compost looks like good compost. The failures show up at spawn run and cropping — by which point the cause is buried.

MISTAKE

Pasteurisation peak too brief.

The hold is reached at one probe for one hour and the operator moves on. Surviving pathogens emerge during spawn run and cropping. Full eight hours at the slowest probe is the requirement.

MISTAKE

Conditioning compressed.

Operators rushing the cycle drop conditioning from 5 to 3 days. Ammonia residue kills inoculum at spawning. Patchy or absent spawn run is the symptom.

MISTAKE

Steam injection imbalanced.

Compost on one side of the tunnel reaches temperature, the other side does not. The unloaded batch contains zones of pasteurised and unpasteurised compost. Uneven crop is the result.

PRINCIPLE

Sweet earthy smell at unloading.

This is the single most reliable indicator of a working Phase 2. Faintly sweet, mushroomy, with notes of earth. Acrid, ammonia, or sour smells indicate problems.

MISTAKE

Compost still warm at unloading.

Above 28°C compost will kill spawn on contact. The final cool-down to 25°C is non-negotiable. If your tunnel cannot achieve it, you cannot spawn that batch on time.

MISTAKE

Calcium powder visible on surface.

Indicates gypsum did not properly integrate during Phase 1. The compost will have structural issues throughout. Cannot be corrected — affects every downstream stage.

6.5 CHAPTER SUMMARY

Six things to carry into the next chapter.

01

Two operations, not one.

Pasteurisation kills. Conditioning converts. Both must complete properly. Neither can substitute for the other.

02

58°C for 8 hours, at the slowest probe.

Not the fastest probe, not the average. The slowest point in the tunnel must spend the full eight hours at temperature. This is non-negotiable.

03

Conditioning is the longer stage.

Four to five days at 48-52°C converts toxic ammonia to bacterial protein. Skipping or compressing it makes the compost toxic to your inoculum.

04

Trust the smell.

Sweet earthy smell at unloading is the most reliable indicator of working Phase 2. Acrid, sour, or ammonia smells mean problems.

05

Spawn within four hours of unloading.

Below 25°C, sweet smell, freshly cooled. The four-hour window is real — spawn mortality climbs sharply outside it.

06

Bulk tunnels are a scale question.

At lower throughput, batch tunnels work and cost much less. At higher throughput, bulk tunnels deliver tighter consistency and lower per-tonne operating cost. The crossover is a project-specific calculation, not a universal threshold.

UP NEXT / CHAPTER 07
Spawning — one day, four critical decisions
Turn the page

CHAPTER

07

Spawning

Rate, technique, common errors

Spawning is biology measured in hours. The window does not forgive impatience or distraction.

KEY NUMBER

0.5 to 0.75%

spawn rate by weight of wet compost — the ratio that sets up the next fifty days

IN THIS CHAPTER

- What spawn is and how it is produced
- Why 0.5 to 0.75% by weight is the operating range
- Bag versus bed versus tray — the three substrate formats
- The four-hour rule between Phase 2 and spawning
- Inoculation technique and even distribution
- Common errors and how to recognise them early

7.1

Inoculating the substrate, starting the colonisation.

Spawning is the moment Agaricus bisporus enters the compost. It is the briefest active stage in the cycle — about one day — but it shapes every day that follows.

Spawn is mycelium grown on a sterilised grain carrier, usually rye or wheat. A reputable spawn lab produces it under sterile conditions, tests for contamination, and ships it cold. Quality spawn is white, dense, smells fresh, and has no visible mould or off-colour patches. Bad spawn — even from established suppliers in a bad week — kills cycles before they start.

The spawning operation itself is mechanical. Break the spawn into loose grains. Weigh it against the prepared compost. Distribute it evenly through the compost mass. Fill the chosen substrate format (bag, bed or tray). Seal and move to the spawn run room.

The art lies in the timing and the evenness. Spawn rate is conventional at 0.5 to 0.75% by wet weight of compost. Higher rates do not improve yield — they just cost more. Lower rates extend spawn run time and open the door to contamination. Even distribution decides spawn run speed: hot spots colonise too fast, cold spots not at all, and the crop reflects both.

> *Bad spawn cannot be fixed by good technique. Good spawn cannot be saved by bad technique.*
>
> — THE FIRST DEPENDENCY

This is the only stage in the cycle where vendor selection has direct, rapid, visible impact on the crop. A reliable spawn lab is the most important single supplier relationship in the business.

7.2

Substrate format

Three formats compete: polythene bags (most common in India), beds on shelves (traditional Western), and trays (industrial European). Each has trade-offs in capital cost, labour intensity, and yield consistency.

Bags are the right starting point for first-time growers. They are the cheapest format, the most forgiving of operational error, and the easiest to discard if a single bag contaminates. Beds and trays make sense at scale, not at start.

7.2 THE PROCESS

Spawning — one day, four critical decisions.

Spawning is the only stage measured in hours rather than days. Done well, it sets up the next 50 days. Done poorly, you cannot fix it downstream.

01

RECEIVE SPAWN

Quality-tested rye-grain spawn from a trusted lab. Cold-shipped. Refrigerate if not using same day.

02

BREAK & WEIGH

Crumble spawn into discrete grains. Weigh against compost mass. Target rate: 0.5 to 0.75% by wet compost weight. Higher rates do not help.

03

MIX EVENLY

Distribute spawn through entire compost mass. Even distribution decides spawn run speed. Hot spots and cold spots are equally bad.

04

FILL & SEAL

Pack bags or beds. Compress lightly — too tight kills air exchange, too loose creates voids. Seal, label with date, move to spawn run.

TIMING DISCIPLINE

Compost out of Phase 2 below 25 °C — spawn within four hours.

Spawn mortality climbs fast above 28 °C. Cool compost is the difference between a healthy spawn run and a stalled one.

7.3 THREE SUBSTRATE FORMATS

How the formats compare, and when to choose each.

The three commercial spawning formats — polythene bags, shelf beds, and industrial trays — each suit different facility scales and operator skill levels. Most Indian operators run bags.

FORMAT	CAPEX IMPACT	LABOUR	CONSISTENCY	BEST FOR
Polythene bags	Lowest	Manual fill	Variable, recoverable	First-time growers and most Indian operators
Shelf beds	Moderate	Manual fill, mixed	More consistent	Established multi-room facilities
Industrial trays	Highest	Mechanised fill	Most consistent	Large operators with mechanised handling

Bag format dominates Indian button mushroom production for good reasons: low capital, modular failure (one bad bag is one bad bag, not a whole bed), and labour costs that make manual filling economical. Beds and trays become attractive when labour math actually shifts at scale and the operator already has a working bag-format crop behind them.

PRINCIPLE

Bag size matters.

18 to 22 kg of compost per bag is the practical optimum. Larger bags develop hot spots during spawn run. Smaller bags add labour without improving outcome.

MISTAKE

Re-using bags or trays.

Spawn run is a sterile-aspiration process. Re-used substrate containers carry contamination from previous cycles regardless of cleaning. New bags every cycle is non-negotiable for first-time growers.

7.4 SPAWNING ERRORS

Six ways spawning compromises the cycle.

Spawning errors usually show up in spawn run as patchy colonisation. By then the cause is irrecoverable. Recognising the signals before they appear is the only defence.

MISTAKE

Spawn arrived warm.

Cold-chain failure during shipment kills viability. Inspect at unboxing. If the box is warm or there is no visible cold-pack residue, refuse the shipment and order again.

MISTAKE

Compost too warm at spawning.

Above 28°C compost will kill spawn on contact. The four-hour window between Phase 2 unloading and spawning exists for this reason. No exceptions, no shortcuts.

MISTAKE

Spawn rate above 1%.

More spawn does not produce more mushrooms. It does waste money and create hot spots during spawn run. Stick to 0.5-0.75%.

PRINCIPLE

Even distribution decides everything.

Hot spots colonise faster than cold spots. The room then produces uneven flushes for the rest of the cycle. Spend the time at the spawning bench to mix thoroughly.

MISTAKE

Bags packed too tightly.

Compressed compost limits oxygen, slows mycelium, creates anaerobic pockets. Fill bags loosely — they should yield to gentle pressure, not feel hard.

MISTAKE

Bags packed too loose.

Air pockets dry out and produce voids where mycelium cannot grow. The opposite failure mode to over-packing. The correct density is firm but yielding.

7.5 CHAPTER SUMMARY

Six things to carry into the next chapter.

01

Spawn quality is non-negotiable.

Bad spawn cannot be fixed by good technique. Establish a reliable lab relationship before you build the room.

02

0.5 to 0.75% by wet weight.

More does not help. Less invites contamination. Weigh, do not estimate. Document the rate for every batch.

03

The four-hour window is real.

Compost below 25°C, sweet smell, freshly cooled. Outside this window, spawn mortality climbs fast.

04

Even distribution decides spawn run.

Hot spots and cold spots both reduce yield. The time spent mixing thoroughly is the cheapest improvement available.

05

Bags are the right starting format.

Low capital, modular failure, manual fill economics work in India. Move to beds only when scale forces the question.

06

New bags every cycle.

Re-used substrate containers carry contamination forward. The cost of new bags is rounding error against the cost of contamination.

UP NEXT / CHAPTER 08
Spawn Run — fifteen days of waiting and watching
Turn the page

CHAPTER

08

Spawn Run

Temperature, CO2, humidity targets

The most disciplined stage in the cycle. Operator action is mostly about not acting.

KEY NUMBER

14 to 16 days

the time mycelium needs to colonise the full compost mass before casing

IN THIS CHAPTER

- What happens inside the bag during colonisation
- Why 23 to 25 °C is the operating range
- The day-by-day progression — what to see, when
- How to read mycelium colour and density
- The cost of opening the room too often
- How to know spawn run is complete

8.1

Fifteen days of waiting and watching.

Spawn run is the longest single stage in the crop cycle. Nothing visibly happens for two weeks. The discipline to leave the room alone is the discipline that produces a crop.

Spawn run is the period during which Agaricus bisporus mycelium grows from the spawn grains outward into the surrounding compost, until the entire substrate mass is colonised. The temperature, humidity and CO2 envelope is held constant for two weeks. There is no harvest, no visible mushroom, no daily indicator that the room is performing.

This is the stage at which first-time growers make their most expensive mistakes. The temptation to check, to peek, to ventilate, to adjust — all of it adds variance to a stage that rewards stability. Every door opening drops humidity, raises CO2 variance, and introduces airborne contamination. The crop that emerges three weeks later carries the consequences of every interruption.

The operating envelope is narrow and verified across decades of commercial production: compost temperature 23 to 25 °C, relative humidity 90 to 95 percent, CO2 allowed to build up to 5,000 to 15,000 ppm. The high CO2 favours mycelium growth and suppresses fruiting. Air exchange is minimal. The room is kept dark or near-dark.

> *Every door opening costs you crop. Plan visits, do not improvise them.*
>
> — OPERATIONAL TRUTH

Walk-throughs should be deliberate, brief, and on a schedule. Once per day at most. The single sensor reading from outside the room tells you more than five visual inspections inside it.

8.2

Reading mycelium

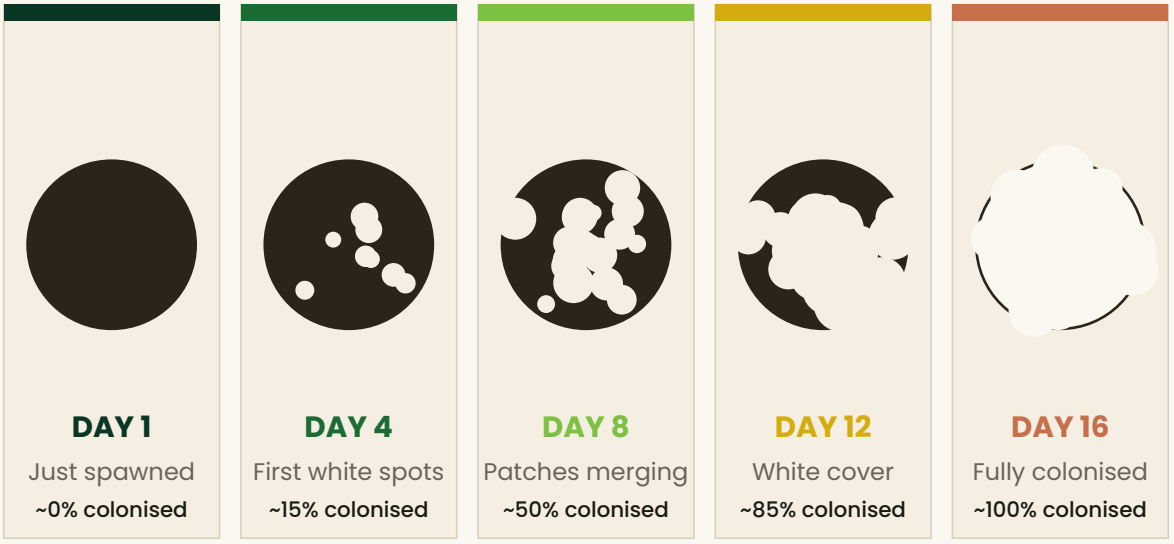
Healthy mycelium is white, dense, and woolly. It spreads outward from spawn grains in radial colonies that merge by Day 8 to 10 into a continuous web. By Day 12 the entire surface of the compost should be white. By Day 14 to 16 the mycelium has penetrated the full depth of the substrate.

Concerning signs are yellow, brown, or grey discolouration; patchy growth with bare compost still visible at Day 12; or any sour, foul, or off smell. The next page shows the visual progression you should see if the room is performing.

8.2 PROGRESSION

Mycelium colonisation, day by day.

What you should see when you look at a bag through the door. Each panel is a snapshot. Concerns are deviations from this sequence, not the sequence itself.



DAY 1
Just spawned
~0% colonised

DAY 4
First white spots
~15% colonised

DAY 8
Patches merging
~50% colonised

DAY 12
White cover
~85% colonised

DAY 16
Fully colonised
~100% colonised

MILESTONE

White cover at Day 12 is the single decisive indicator.

Patchy or yellow compost surface at Day 12 means the cycle is in trouble. Diagnose immediately rather than waiting for Day 16.

8.3 ENVELOPE & DAILY INDICATORS

What to hold, what to look for.

Spawn run envelope is held constant for the full 14 to 16 days. Daily checks are for indicators, not for adjustments. Adjust only when an indicator falls outside the normal band.

PARAMETER	TARGET	TOLERANCE	INDICATOR
Compost temp	23–25 °C	± 1 °C	Internal probe, not air sensor
Relative humidity	90–95 %	± 3 %	RH sensor at mid-height
CO2	5,000–15,000	Free build-up	CO2 sensor reading at door height
Air exchange	Minimal	Sealed room	No active ventilation
Light	Dark / near-dark	—	Brief working light only on entry
Room entries	Once per day max	Scheduled	Log every entry and reason

Envelope values are the conventional operating range used across commercial button mushroom production. Specific strain selection can shift these by 1 to 2 °C or 3 to 5 percent RH — confirm with your spawn supplier.

PRINCIPLE

Hold, do not chase.

Drift within the tolerance band is normal. Constant adjustment creates more variance than it removes. Trust the controller; intervene only when you fall outside the band.

MISTAKE

Air sensor temperature as the indicator.

Room air temperature is not compost temperature. Compost runs warmer during peak mycelial activity. The probe inside the compost is what the controller — and you — should be reading.

8.4 WHAT KILLS SPAWN RUN

Six ways to lose two weeks of work.

Most spawn run failures are operator-induced rather than biological. The mycelium is robust if left alone. The most common cause of trouble is the operator's hand.

MISTAKE

Opening the room too often.

Every entry drops RH, raises CO2 variance, and introduces airborne spores. Plan one entry per day, scheduled, with a clear reason. If there is no reason, do not enter.

MISTAKE

Temperature swings.

Drift from 23-25 °C beyond the tolerance band stresses mycelium. Above 28 °C kills it. Below 20 °C slows it past the cycle window. Calibrate sensors monthly.

MISTAKE

Yellow mycelium.

Stress response. Usually heat or moisture problem. By the time you see it, the colonisation rate has already dropped. Diagnose and correct the underlying condition immediately.

MISTAKE

Sour or off smell at Day 8 onwards.

Indicates bacterial contamination, usually a Phase 2 conditioning problem that survived into spawn run. Cycle is compromised. Decide whether to push through or write off the batch.

MISTAKE

Patchy growth at Day 8.

Either uneven spawn distribution from spawning, or uneven temperature distribution from a hot or cold spot in the room. Correct the room condition; the spawning batch cannot be fixed.

PRINCIPLE

Discipline rewards itself.

A room left properly alone for 14 days produces compost ready for casing on schedule. There is no compounding benefit to checking more often — only compounding cost from each entry.

8.5 CHAPTER SUMMARY

Six things to carry into the next chapter.

01

Spawn run is biology on its own clock.

Fourteen to sixteen days. You cannot speed it up. You can slow it down by interfering. Holding conditions steady is the entire job.

02

23 to 25 °C compost temperature.

Not air temperature. The probe inside the compost is the reading that matters. Air sensors run cooler than the colonising mass.

03

High CO2 is correct.

5,000 to 15,000 ppm. CO2 favours mycelium growth and suppresses fruiting. Active ventilation here defeats the entire stage.

04

Plan room entries.

Once per day at most. Logged. With a stated reason. Every additional entry is a tax on the crop with no offsetting benefit.

05

White cover at Day 12 is the milestone.

Continuous white mycelium across the compost surface. Patchy at Day 12 means either spawning was uneven or room conditions are drifting.

06

Yellow, grey, or sour mycelium is failure.

Catch these signs by Day 8 if possible. Correct the underlying cause for the next batch. The current batch's outcome is mostly determined by then.

UP NEXT / CHAPTER 09
Casing — the soil layer that triggers fruiting
Turn the page

CHAPTER

09

Casing & CACing

Soil prep, depth, ruffling

Casing is what convinces the mycelium it is in a hostile world and must reproduce.

KEY NUMBER

4 to 5 cm

casing soil depth that triggers fruiting hormones in colonised compost

IN THIS CHAPTER

- Why a soil layer is biologically necessary
- What goes into casing soil — and what does not
- Application depth, density and moisture
- CACing — the optional advanced technique
- Ruffling: when, why, and how to know it worked
- Six casing errors and how to recognise them early

9.1

Triggering the fruiting response.

Casing soil is not nutrition. It is a hostile environmental cue that tells the mycelium it has reached the surface of its world and must now reproduce. Without that cue, no mushrooms form.

Casing is a thin layer of soil applied on top of fully-colonised compost at the end of spawn run. The mycelium grows up through the casing, reaches its surface, and encounters conditions that signal to the organism that its current substrate is exhausted. The biological response — encoded across millions of years of evolution — is to reproduce. Fruiting bodies start forming under the casing surface.

The casing material is essential and almost never grown at the mushroom farm. Traditional Western practice uses peat moss with chalk for pH. Indian practice often uses farmyard manure (FYM) composted and sterilised, sometimes blended with coir pith, garden soil, or spent compost. What matters across all variants is water-holding capacity, structure that supports gas exchange, and an alkaline-leaning pH (typically 7.3 to 7.8).

CACing — Casing Inoculum — is the practice of mixing some colonised compost into the casing layer before application. This carries mycelium up into the casing material immediately, rather than waiting for it to grow up. The result is faster, more uniform pinning. CACing is standard at scale; first-time growers can run without it for the first few cycles.

> *Apply the casing in a single operation. Patch repairs in casing produce patchy crops.*
>
> — APPLICATION DISCIPLINE

Casing is applied across the entire bed or bag surface in one continuous operation. Topping up thin spots later, or applying in stages, produces uneven pinning across the surface. Do it once, do it evenly.

9.2

Depth, moisture, ruffling

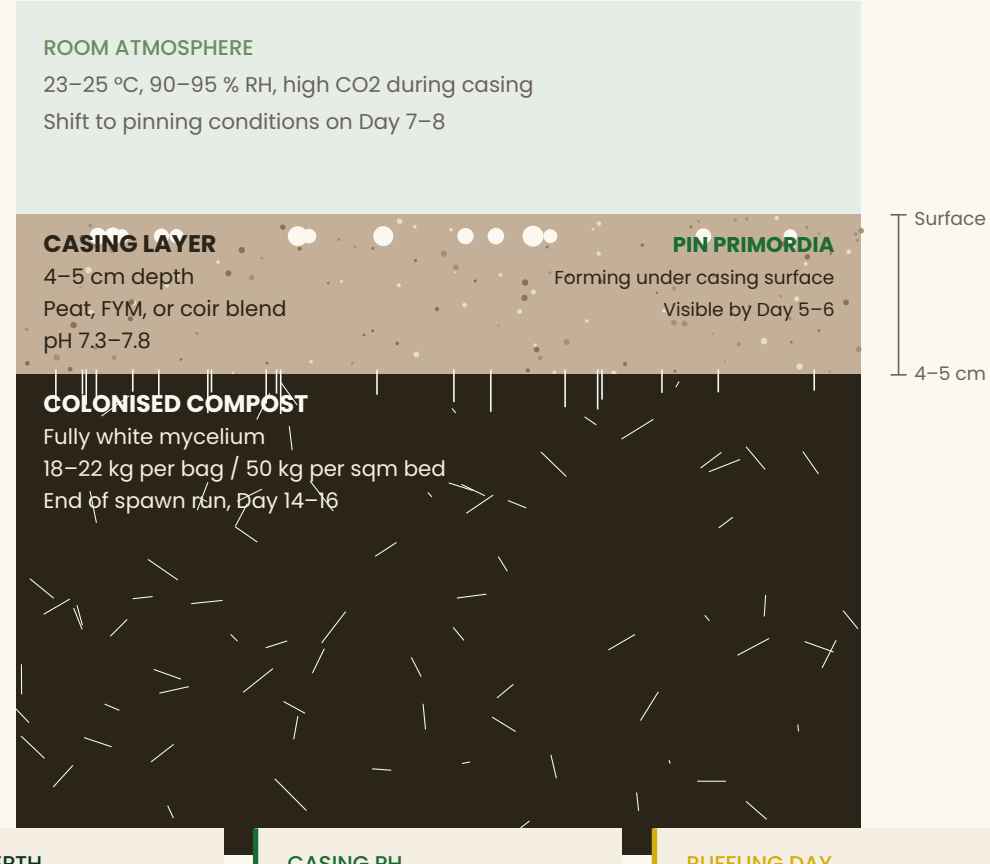
Casing depth is approximately 4 to 5 cm — thick enough to support pin development, thin enough to let mycelium reach the surface within the casing window. Moisture content should be at field capacity: casing should hold its shape when squeezed but not release water.

Ruffling, done around Day 4 to 5 after application, is a gentle mechanical mixing of the casing surface. It evens out mycelial distribution and resets the surface for uniform pin formation. Skip it and pins still form, but unevenly.

9.2 CROSS-SECTION

Inside a casing bed, in cross-section.

Casing soil on top, fully-colonised compost below, pin primordia forming under the casing surface. Depth of each layer matters for pinning quality.



CASING DEPTH

4–5 cm

Thinner — pins too early.
Thicker — pins delayed.

CASING PH

7.3–7.8

Slightly alkaline.
Chalk adjusts peat. FYM is naturally alkaline.

RUFFLING DAY

Day 4–5

Mechanical mix of casing surface.
Evens out mycelial distribution.

9.3 CASING SCHEDULE & MATERIALS

What to apply, and when to ruffle.

The seven to eight days of casing run on a tight schedule. Each day has a specific operator action or check. Materials vary by region; the schedule is the same across all variants.

DAY	ACTION	CONDITIONS	WHAT TO WATCH
Day 0	Apply casing soil, 4-5 cm	23-25 °C, 90-95 % RH	Even depth across full surface
Day 1-2	Hold conditions, water lightly	23-25 °C, 90-95 % RH	Surface stays moist, not wet
Day 3	Mycelium reaches casing surface	23-25 °C, 90-95 % RH	White threads visible in casing
Day 4-5	Ruffle the casing (if used)	23-25 °C, 90-95 % RH	Surface evened, mycelium mixed
Day 5-6	Continue holding, monitor RH	23-25 °C, 90-95 % RH	First pinheads emerging
Day 7-8	Pinning trigger — drop temp	Move to 17-18 °C, fresh air	Visible pinhead density

Casing material varies regionally. Peat-based casing is the international standard; FYM and coir-pith blends are common across India. What matters is water-holding capacity, gas exchange, and slightly alkaline pH (7.3 to 7.8). Bring casing to room temperature and pasteurise (60 °C for 2 hours) before use to suppress competing organisms.

PRINCIPLE

Casing is the trigger, not the food.

The mushrooms feed from the compost below, not the casing above. The casing's job is to signal the fruiting response. Treat casing material as a biological switch, not as nutrition.

MISTAKE

Reusing unsterilised casing soil.

Casing carries pathogens and pests between cycles. Used casing dumped near the farm or recycled without pasteurisation is the single most common source of repeat contamination across multiple crops.

9.4 CASING ERRORS

Six ways casing compromises fruiting.

Casing errors usually show up as patchy or absent pinning. By the time you see the failure, the corrective opportunity is past. Recognising the early signs is the only defence.

MISTAKE

Too thick a layer.

Above 6-7 cm, mycelium takes too long to reach the surface. Pinning delays, the crop falls behind schedule. Casing depth is one of the easiest things to control — measure it.

MISTAKE

Too thin a layer.

Below 3 cm, pins form too early before mycelium is fully recovered. Pins are sparse, fragile, and produce weak first flushes. Apply consistent depth across the full bed.

MISTAKE

Waterlogged casing.

Anaerobic conditions in the casing kill mycelium and trigger bacterial blotch later. The casing should be moist, not wet. Squeeze test: holds shape, does not drip.

MISTAKE

Dried-out casing surface.

Casing dries from the top down. Pins forming in a dry casing layer abort. Mist gently to maintain surface moisture, especially in low-RH rooms.

MISTAKE

Casing applied before mycelium ready.

If compost is not fully colonised, mycelium cannot recover into the casing. Pin formation is patchy. Wait for full white cover before casing — Day 14 minimum, Day 16 better.

PRINCIPLE

Pasteurise casing before use.

Casing material — whether peat, FYM blend, or coir — carries field organisms. 60 °C for 2 hours kills the worst of them. Skipping this step is the most common source of repeat contamination.

9.5 CHAPTER SUMMARY

Six things to carry into the next chapter.

01

Casing is a trigger, not nutrition.

The mushroom feeds from the compost. The casing's job is to convince the mycelium it has reached the surface and must reproduce.

02

4 to 5 cm depth, single application.

Thick enough to support pin development, thin enough to be reached. One operation, even depth — do not patch later.

03

Slightly alkaline, water-holding, structurally porous.

pH 7.3 to 7.8, holds field capacity moisture, gas-exchange-friendly. Peat, FYM blend, coir-based — formulation varies by region, properties do not.

04

Pasteurise the casing material.

60 °C for 2 hours. Casing carries pathogens and pests. Reusing unsterilised casing is the single most common source of cross-cycle contamination.

05

Ruffle around Day 4 to 5.

Mechanically mix the casing surface to even out mycelium distribution. Skip it and pins form, but unevenly across the bed.

06

CACing speeds and unifies pinning.

Mixing colonised compost into casing carries mycelium up immediately. Standard at scale; first-time growers can run without it.

UP NEXT / CHAPTER 10
Pinning to Harvest — the environmental shift
Turn the page

CHAPTER

10

Pinning to Harvest

Environmental triggers and flushes

The single biggest environmental change in the entire cycle. Get it wrong and there is no crop.

KEY NUMBER

17 to 18 °C

the fruiting temperature that pinning shock pushes the room down to

IN THIS CHAPTER

- Why pinning is a phase transition, not a stage
- The four environmental parameters that change at once
- Pin to harvest — the size progression in five stages
- How to time the shift relative to casing
- The cost of compromised pinning
- What perfect pinning looks like

10.1

The shift that makes mushrooms appear.

Pinning is not a stage. It is a transition between two stages — and the single most consequential environmental change in the entire crop cycle. Done well, dense uniform pins. Done poorly, patches or nothing.

Until pinning, the room has been held at conditions that favour mycelial growth: warm (23-25 °C), high RH (90-95 %), high CO2 (up to 15,000 ppm), minimal ventilation. These conditions are vegetative — they tell the organism that food is plentiful and the environment is stable.

Pinning conditions are the opposite. Temperature drops to 17-18 °C. CO2 falls to 800-1,200 ppm through aggressive fresh-air pulsing. Air exchange becomes continuous. Humidity drops slightly (92-95 %). The signal to the mycelium is: the environment has changed, food may be running out, reproduce now.

Within 24 to 48 hours of the shift, the first pinheads emerge under the casing surface. Within five to seven days, they develop into harvestable mushrooms. The shift itself takes hours; the consequences play out across four flushes over the next twenty-eight to thirty-two days.

> *Pin once, harvest four times. The single trigger sets up the entire cropping window.*
>
> — PINNING IS A ONE-WAY SWITCH

You cannot un-trigger pinning once it starts. The room is now in cropping mode for the rest of the cycle. The discipline of the shift — its timing and completeness — is what determines how productive that cropping window will be.

10.2

The four flushes

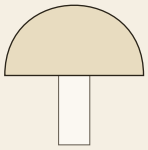
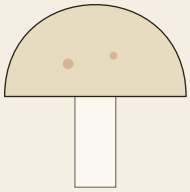
Button mushroom fruits in waves called flushes. Each flush peaks over two to three days, then declines. After each flush there is a rest of three to five days before the next flush starts. Most commercial operations harvest four flushes per cycle.

Yield distribution across flushes is consistent: first flush produces 35 to 40 % of total cycle yield, second 25 to 30 %, third 15 to 20 %, fourth 10 to 15 %. Below the fourth flush, the remaining yield rarely justifies the room cost. Strip the bed, clean the room, start over.

10.2 SIZE PROGRESSION

From pinhead to harvest, in five stages.

Mushroom growth is exponential through these stages. The window from harvestable to over-mature is roughly twelve hours during peak flush — which is why picking happens twice daily.

PIN	PRIMORDIUM	BABY BUTTON	YOUNG	HARVEST
Day 1	Day 2–3	Day 4–5	Day 5–6	Day 6–8
				
1–2 mm	3–8 mm	10–18 mm	20–30 mm	35–45 mm
Hold	Hold	Hold	Watch closely	PICK NOW

PICKING WINDOW

Twelve hours from harvestable to over-mature during peak flush

Cap closure is the grade line. Once it opens, spores release and the mushroom drops a grade. Twice-daily picking during peak — morning and evening — is the discipline.

10.3 THE ENVIRONMENTAL SHIFT

What changes, by how much, in what order.

Pinning is four parameters changing at once. The magnitude and the sequence both matter. This table is the recipe — execute it in this order, hold the new envelope steady afterward.

PARAMETER	SPAWN RUN / CASING	PINNING / CROPPING	DIRECTION & PURPOSE
Compost temp	23-25 °C	17-18 °C	Drop 6-7 °C — fruiting trigger
Relative humidity	90-95 %	85-95 %	Hold high — pin development needs
CO2	5,000-15,000 ppm	800-1,200 ppm	Drop sharply — primary pinning trigger
Air exchange	Minimal	Continuous	Open up — fresh air pulses out CO2
Light	Dark	Diffuse	Add ambient light — supports pin orientation
Bed moisture	Field capacity	Field capacity	Hold — pinning is not a watering trigger

Make the shift in a single planned operation over 6 to 12 hours, not gradually over several days. The mycelium needs an unambiguous environmental signal. A slow drift between envelopes produces a slow, uneven pinning response.

PRINCIPLE

CO2 drop is the primary trigger.

Of the four parameters, the CO2 reduction is the single strongest pinning cue. Temperature drop reinforces it; air exchange enables the CO2 drop. If the room cannot bring CO2 below 1,500 ppm, no amount of cooling will pin well.

MISTAKE

Gradual transition.

Operators worried about shocking the crop sometimes ramp temperature and CO2 down over 3-4 days. The mycelium reads this as random drift rather than a signal. Pinning is sparse, late, or absent.

10.4 PINNING FAILURES

Six ways pinning fails the crop.

Pinning failures are visible within 48 hours of the environmental shift. The corrective window is narrow. Recognising what is wrong early lets you intervene before the cycle is lost.

MISTAKE

No pins by Day 3.

Either casing was not ready or the shift was not aggressive enough. Check CO2 — if still above 1,500 ppm, push more fresh air. Push temperature down further if compost is still above 19 °C.

MISTAKE

Patchy pinning.

Pins forming in some areas, none in others. Almost always uneven casing depth or uneven mycelium colonisation. Cannot be corrected this cycle; correct casing application for next cycle.

MISTAKE

Pins forming then aborting.

Tiny pinheads visible, then turning yellow and dying. Usually a humidity crash during the shift, or bacterial blotch contamination in casing. Diagnose by smell and surface condition.

MISTAKE

Too dense pinning.

Hundreds of tiny pins, then all maturing at once into a single dense layer of small mushrooms. Lower commercial grade. Causes: casing too thick, ruffling too aggressive, or strain selection.

MISTAKE

Pinning across the bed sides, not the top.

Indicates moisture or light gradients along bed edges. Pins on side surfaces are commercially difficult to harvest cleanly. Improve room uniformity for the next cycle.

PRINCIPLE

Dense even pinheads at Day 2-3.

What success looks like. Hundreds per square metre, uniformly distributed across the top surface. By Day 5-6 these are visible button mushrooms. By Day 8-10 the first flush is ready.

10.5 CHAPTER SUMMARY

Six things to carry into the next chapter.

01

Pinning is a one-way switch.

The single most consequential environmental change in the cycle. Execute it in one operation, not over days. There is no reversing once it starts.

02

Four parameters change at once.

Temperature drops 6-7 °C. CO2 drops sharply. Air exchange opens up. Light becomes diffuse. The mycelium needs all four signals simultaneously to read the cue.

03

CO2 is the primary trigger.

Temperature reinforces; air exchange enables; CO2 reduction is the signal. If the room cannot get CO2 below 1,500 ppm, the pinning cue is incomplete.

04

Pins visible within 48 hours.

If no pinheads by Day 3 after the shift, something in the trigger sequence is incomplete. Diagnose by measurement, not by waiting.

05

Four flushes, diminishing returns.

1st: 35-40 %. 2nd: 25-30 %. 3rd: 15-20 %. 4th: 10-15 %. Beyond fourth flush, room cost outweighs remaining yield. Strip and start over.

06

Even pinning is the win condition.

Dense, uniform pinheads across the top surface by Day 2-3. Patchy pinning means uneven casing or colonisation — a problem from earlier stages, not from pinning execution.

UP NEXT / CHAPTER 11
Harvest & Cold Chain — picking and grading the crop Turn the page

CHAPTER

11

Harvest & Cold Chain

Picking, grading, packaging, shelf life

Operational discipline for twenty-eight days, then strip the bed and start over.

KEY NUMBER

4 flushes

the conventional crop window across which yield diminishes from first to last

IN THIS CHAPTER

- Harvest as daily routine — what picking actually looks like
- Grading at the bed, not at the packing table
- The flush distribution and why second flush is critical
- Cold chain integrity — from picking to retail
- Packaging formats and shelf life
- Six common harvest and post-harvest errors

11.1

Picking is a daily operating routine.

After the patience of compost and spawn run, harvest is sudden activity. Mushrooms appear, mature, and need picking within hours. The routine is what produces consistent commercial output.

Picking starts six to eight days after the pinning shift. The first flush builds over two to three days, peaks, then tapers. During peak days, the same bed may need picking twice — morning and evening — to catch mushrooms at the correct stage before caps open. After the peak, the bed enters a rest of three to five days before the second flush begins.

Picking technique is straightforward but exacting. Mushrooms are twisted gently and lifted, not pulled. The base is trimmed with a sharp knife at the casing surface. Damaged or oversized mushrooms are picked separately and graded down. The picker decides the grade at the bed; sorting at the packing table is corrective, not the primary classification step.

Cold chain begins immediately. Picked mushrooms move within minutes to a pre-cooling room held at 2 to 4 °C. Pre-cooling brings the field heat out before packaging. Packed product moves directly to cold storage, then to refrigerated transport. Any break in this chain — even thirty minutes at ambient — costs shelf life and grade.

> *Grade at the bed. Sort at the table. Pack in the cold room.*
>
> — THREE PLACES, THREE JOBS

Each step has a single responsibility. Grading at the bed catches what should not be packed. Sorting at the table catches what was missed. Packing happens at temperature, not in the picking room.

11.2

Flushes and yield arithmetic

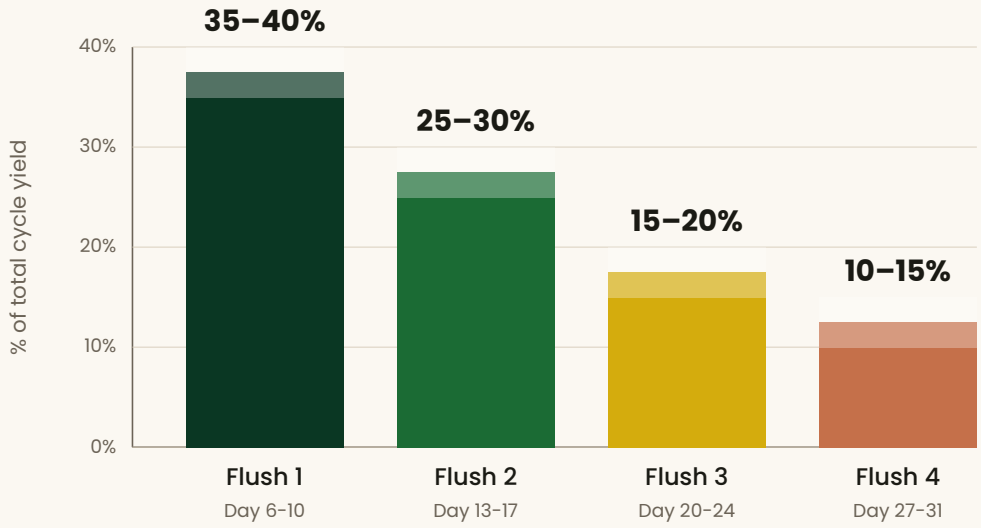
Four flushes per cycle is the commercial standard. The yield distribution is consistent across operators and decades: the first flush is the largest, each subsequent flush is smaller. The cycle ends when the next flush no longer covers the room running cost.

Understanding the flush curve matters for cash flow. A farm running a single room sees revenue in waves. A farm running overlapped rooms aggregates four flush curves into continuous output. Multi-room operation is not a vanity scale-up — it is how you get to steady cash flow.

11.2 FLUSHES & COLD CHAIN

How yield is distributed, how the crop moves.

Above: yield by flush over a single cycle. Below: the cold chain from picking bench to retail shelf. Each link is capable of downgrading the product if temperature breaks.



11.2.B COLD CHAIN FLOW

PICK	PRE-COOL	PACK	STORE	TRANSPORT	RETAIL
Field heat	Forced air	Cold room	Cold storage	Refrig truck	Cold display
18-22 °C	2-4 °C	2-4 °C	2-4 °C	2-4 °C	2-4 °C
0 min	30 min	1-2 hr	Day 0-1	Day 1-2	Day 2-7

Yield bands are conventional ranges across commercial button mushroom production. Specific facility performance varies by compost quality, environmental control discipline, and strain selection.

11.3 GRADES & COLD CHAIN

What sells where, and at what temperature.

Grade decides price, cold chain decides shelf life, and the two compound. A Grade A mushroom that breaks cold chain becomes Grade B by the time it reaches the retailer.

GRADE	SPEC	CHANNEL	STORAGE TEMP
Grade A	Cap closed, 30-45 mm, no blemishes	Organised retail, hotels, branded	2-4 °C
Grade B	Slight bruising or open cap, 25-50 mm	Wholesale mandi, QSR, food service	2-4 °C
Grade C	Mature open cap, irregular, minor damage	Processing — slicing, canning	2-4 °C until processed
Reject	Heavy damage or contamination	Compost or feed	Discard within 24 hours

Cold chain temperatures hold across grades — Grade B and Grade A both lose shelf life equally if warmed. Pre-cool within 30 minutes of picking, pack at 2-4 °C, transport at 2-4 °C, retail at 2-4 °C. Each link is independently capable of downgrading the product.

PRINCIPLE

Pre-cooling is non-negotiable.

Field-heat removal in the first hour determines shelf life from that point onward. A mushroom picked at 18 °C and packed at 18 °C loses two days of retail life regardless of subsequent cold storage.

MISTAKE

Mixing grades in packaging.

A single Grade B in a Grade A pack downgrades the entire pack. Retail buyers reject the lot, not the individual unit. The cost of one missed cull is the cost of the entire box.

11.4 HARVEST ERRORS

Six ways harvest loses you money already earned.

Harvest errors are particularly expensive because the crop already happened. The cost has been paid; the only question is realisation. Errors here reduce the realisation against costs that are now sunk.

MISTAKE

Picking too late.

Caps open, spores release, contamination risk for the room rises. Mushroom moves from Grade A to Grade B in twelve hours. Twice-daily picking during peak is not optional.

MISTAKE

Twisting too hard.

Bruising shows within minutes as discolouration around the base. Grade drops. The technique is gentle rotation, not pulling. Train pickers on technique before paying by output.

MISTAKE

Inadequate pre-cooling.

Mushroom packed at ambient temperature loses 30-50 percent of its shelf life. The fix is a dedicated pre-cool tunnel between picking and packing — not air-conditioning the packing room.

MISTAKE

Breaking cold chain in transport.

Ambient transport, even for thirty minutes, undoes the cold chain. Refrigerated transport is the cost of selling at Grade A prices. Without it, you compete on wholesale margins.

MISTAKE

Mixing grades in pack.

A single Grade B in a Grade A pack costs you the whole pack at retail rejection. Grade strictly. Pack strictly. Audit randomly.

PRINCIPLE

Harvest is operating discipline.

The crop is grown by Phase 1 through pinning. From flush one onward, the only variable is how much of what you grew you successfully realise. Do not lose what is on the bed.

11.5 CHAPTER SUMMARY

Six things to carry into the next chapter.

01

Pick before the cap opens.

Cap closure is the grade line. Once it opens, spores release and the mushroom moves down a grade. Twice-daily picking during peak is the discipline.

02

Grade at the bed, sort at the table, pack in the cold.

Three steps, three jobs, three places. Mixing the jobs across places is how grade leaks.

03

Four flushes, diminishing yield.

1st: 35-40 %. 2nd: 25-30 %. 3rd: 15-20 %. 4th: 10-15 %. Each flush peaks over 2-3 days then tapers. Plan picking labour around the peaks.

04

Cold chain starts within thirty minutes.

Field heat must come out before packaging. Pre-cool to 2-4 °C immediately. Hold across packing, storage, transport, retail. Every break costs shelf life.

05

Grade A premium pays for the cold chain.

The price premium for closed-cap, blemish-free, cold-chain-protected mushroom funds the infrastructure that produces it. Skip the cold chain and you are competing on wholesale margins.

06

Strip and reset after the fourth flush.

Beyond the fourth flush, room cost outweighs marginal yield. Strip the casing, clean the room, sanitise, and start the next cycle. The discipline is in stopping, not in extracting one more flush.

UP NEXT / CHAPTER 12
Pests and Diseases — what you face and what to do
Turn the page

CHAPTER

12

Pests & Diseases

Sciarids, Trichoderma, bubble diseases

Pest management is a system. By the time you are treating an outbreak, the system has already failed.

KEY NUMBER

Nine pathogens

the recurring set of pests and diseases that account for nearly all commercial crop losses

IN THIS CHAPTER

- Why pest management is mostly sanitation and prevention
- The nine pathogens worth knowing by name and symptom
- When each pathogen typically appears in the cycle
- Integrated pest management — cultural, biological, chemical
- Regulatory framework: what is and is not allowed in India
- Where new growers usually go wrong

12.1

Pest management is system design, not treatment.

A mushroom farm that controls pests through spraying is a mushroom farm that has lost. Effective control is achieved upstream — in sanitation, exclusion, and environmental discipline — long before any pathogen becomes visible.

Pests and diseases on a mushroom farm are not isolated events. They are populations that build up across cycles, that survive on residual compost and casing, that fly in through gaps in the building, that hitch a ride on worker boots and incoming materials. By the time an outbreak is visible in a cropping room, the population has been growing on-site for weeks or months.

This is why the most experienced operators spend far more on sanitation, exclusion screens, dedicated boots, and clean-out protocols than on any chemical control. The economics are direct: preventing an outbreak costs a fraction of treating one, and the treatment in any case rarely fully clears the underlying population. Pest control on a mushroom farm is mostly about denying the pathogen a substrate to grow on between crops.

The pathogens worth knowing fall into four categories. Fungal competitors (Trichoderma, Verticillium, Mycogone, Cladobotryum) compete with Agaricus for substrate or attack the fruiting bodies directly. Bacterial blotch (Pseudomonas tolaasii) attacks the cap surface. Insect pests (sciarid and phorid flies, mites) damage mycelium and fruit bodies and vector other pathogens. Mushroom Virus X infects mycelium and causes yield collapse with no obvious external symptom.

> *Treating a visible outbreak is paying twice — once for the crop, once for the chemical that may not work.*
> — THE ECONOMICS OF PREVENTION

Quarantining incoming materials, screening doorways and air intakes, dedicated footwear and tools per room, and rigorous between-cycle sanitation are not nice-to-have. They are the single largest determinant of long-term crop reliability.

12.2

Regulatory note

Pesticide use on edible mushroom in India is regulated by the Central Insecticides Board and Registration Committee (CIB&RC). Not every product labelled for general agricultural use is permitted on mushroom. Residue tolerances are strict and enforced for export channels.

This guide describes pathogens and the principles of integrated management. Specific chemical recommendations vary by region, year, and registration status. Confirm any pesticide application with current CIB&RC labelling and your state agriculture department before use.

12.3 FUNGAL PATHOGENS

Six fungal competitors and what they do.

Fungal pathogens compete with Agaricus for substrate or attack the fruiting bodies directly. They share common control approaches but each has distinct visual signatures. Learn these before they appear.

MISTAKE

Trichoderma (green mould).

Bright green patches in compost or casing. Most common and most economically damaging fungal competitor. Cause: poor Phase 2 conditioning or contaminated casing. Affected batches are not

MISTAKE

Verticillium fungicola (dry bubble).

Mushroom caps deform into dry, leathery, irregular shapes. Stems develop tilted growth. Spreads through casing and on worker hands. Removes affected mushrooms and quarantine the bed.

MISTAKE

Mycogone perniciosa (wet bubble).

Mushrooms develop into shapeless, wet, white masses oozing amber liquid. Distinct from dry bubble by the wet, decomposing appearance. Cull aggressively and disinfect the surrounding casing.

MISTAKE

Cladobotryum dendroides (cobweb).

White cottony growth spreading across casing surface and over young mushrooms. Engulfs fruit bodies. Cover affected areas with damp paper towel and salt; remove rather than disturbing.

MISTAKE

Pseudomonas tolaasii (bacterial blotch).

Brown, sunken spots on cap surface, slimy when wet. Triggered by free water on cap surface. Reduce surface moisture, improve ventilation, lower humidity slightly during cropping.

PRINCIPLE

Visual ID is the first line of defence.

Train every picker to recognise the four fungal symptoms above. Early identification — within hours rather than days — is the difference between containing one bed and losing the room.

12.4 INSECT & VIRAL PESTS

Three insect threats, one viral one, two principles.

Insects damage mycelium and fruit bodies and can vector fungal pathogens between rooms. The viral pathogen has no external symptom — it is diagnosed by yield collapse without visible disease.

MISTAKE

Sciarid flies (Lycoriella).

Small dark flies; larvae tunnel through compost eating mycelium. Most economically significant insect pest. Yellow sticky traps for monitoring, exclusion screens on intakes.

MISTAKE

Phorid flies (Megaselia).

Small humpbacked flies running on surfaces rather than flying. Larvae damage mycelium similarly to sciarids. Same monitoring and exclusion approach as sciarids.

MISTAKE

Mushroom mites (Tarsonemus, Tyrophagus).

Tiny crawling pests on casing surface. Damage developing mushrooms and vector pathogens. Heat treatment of casing pre-application is the primary control.

MISTAKE

Mushroom Virus X (MVX) and La France.

Viral infection of mycelium. No external symptom on healthy-looking compost; presents as yield collapse, irregular cap shapes, or off colours. No chemical treatment.

PRINCIPLE

Sticky traps quantify what spraying cannot.

Yellow sticky traps at room entries, near vents, and inside cropping rooms give weekly population counts. Threshold-based decisions outperform calendar spraying.

PRINCIPLE

Sanitation between cycles outpaces any chemical.

Steam-cookout of empty rooms, complete casing and compost removal, scrub-and-disinfect of walls and floors. Two-day clean-down beats any in-crop treatment regime.

12.5 WHEN EACH PATHOGEN APPEARS

What to watch for, at which stage.

Most pathogens have a characteristic stage in the cycle where they first become visible. Watching for the right symptom at the right time is faster than watching for everything everywhere.

PATHOGEN	FIRST VISIBLE	WHERE	EARLIEST INDICATOR
Trichoderma	Spawn run	Compost surface	Green patches, fast-spreading
Sciarid / phorid flies	Spawn run onward	Air, walls, traps	Adult flies in traps
Mites	Casing onward	Casing surface	Tiny crawling specks
Cobweb (Cladobotryum)	Casing / early cropping	Casing surface	White cottony patches
Dry bubble (Verticillium)	Cropping	Fruit bodies	Deformed, tilted mushrooms
Wet bubble (Mycogone)	Cropping	Fruit bodies	Wet white masses, amber ooze
Bacterial blotch	Cropping	Cap surface	Brown sunken spots, slime
MVX / La France	Cropping	No external sign	Yield collapse, irregular caps

Watching for the right pathogen at the right stage outperforms general surveillance. Spawn run watch is for green mould and adult flies. Casing watch is for cobweb and mites. Cropping watch is for bubble diseases and blotch. Adjust the inspection routine to the stage the room is in.

PRINCIPLE

Different stages, different threats.

Pest management routine should not be uniform across the cycle. Spawn run needs surface inspection and trap counts. Casing needs ruffle-time inspection. Cropping needs daily picker-led ID of fruit body symptoms.

MISTAKE

One inspection routine for all stages.

Walking the room with the same checklist regardless of stage misses stage-specific symptoms. The picker who learns to recognise dry bubble at flush 1 catches what the casing inspector cannot see.

12.6 CONTROL APPROACHES

Cultural, biological, and chemical — in that order.

Integrated pest management on a mushroom farm runs three layers. Cultural controls (sanitation, exclusion, environment) carry most of the load. Biological controls handle specific organisms. Chemical control is the last resort, not the first.

APPROACH	WHAT IT COVERS	WHERE IT WORKS	LIMITS / CAUTIONS
Cultural	Sanitation, exclusion, environmental control	Every pathogen above	Requires discipline; cheapest
Mechanical	Sticky traps, screens, footbaths	Insect pests primarily	Monitoring data, not eradication
Biological	Beneficial nematodes, predatory mites	Specific insect pests	Slower-acting; requires planning
Chemical	Pesticides per CIB&RC labels; pasteurisation	Specific outbreaks, severe	Regulated; residue tolerance
Regulatory	CIB&RC labelling and traceability	Legal foundation for use	Non-compliance risks crop seizure

Indian regulatory framework: Central Insecticides Board and Registration Committee (CIB&RC) controls what is permitted on edible mushroom. State poisons licence required for many products. Residue tolerances enforced for export. Confirm current labelling before any chemical application — registration changes year to year.

PRINCIPLE

Prevention, not treatment.

The cost ratio of prevention to treatment is roughly one to ten across a multi-cycle operation. Sanitation budgets returned to crop reliability outperform chemical budgets returned to outbreak control.

MISTAKE

Calendar-based pesticide application.

Applying chemical control on a schedule rather than to a documented threshold selects for resistance, breaks residue tolerances, and treats nothing useful. Treat populations, not calendars.

12.7 IPM ERRORS

Six common pest-management failures.

Most pest management failures are not biological — they are operational. Routines lapse, sanitation shortcuts compound, and small populations become outbreaks. Recognising the patterns prevents the next outbreak.

MISTAKE

Treating symptoms, not causes.

An outbreak of Trichoderma is treated by spraying. The underlying cause — incomplete Phase 2 conditioning — continues into the next cycle. The outbreak repeats. Find the upstream cause.

MISTAKE

Skipping between-cycle sanitation.

A room turned around in 24 hours, with old casing dragged outside the doorway, is a contamination factory. Two-day full clean-down between cycles is the cost of long-term crop reliability.

MISTAKE

Ignoring small infestations.

Three flies in a trap is treated as not worth acting on. Three flies become three hundred within two cycles. Population thresholds are exponential — small interventions early are cheaper.

MISTAKE

Wrong pathogen identification.

Treating cobweb as bacterial blotch (or vice versa) means the wrong control approach. The pathogen continues spreading. Visual ID training for every operator pays back permanently.

MISTAKE

Reusing casing or compost across rooms.

Sharing materials between rooms shares pathogens. Once a pathogen is established in one room, sharing turns it into a facility-wide problem. Compartmentalise.

PRINCIPLE

Sanitation discipline is the largest single ROI.

More than any chemical, environmental, or building upgrade — disciplined between-cycle sanitation produces the largest reduction in crop loss over multi-year operation. Cheapest too.

12.8 CHAPTER SUMMARY

Six things to carry into the next chapter.

01

Pest management is system design.

Sanitation, exclusion, environmental discipline. Treatment happens after prevention has failed. Build the prevention, then worry about the treatment.

02

Know the nine names.

Trichoderma, Verticillium, Mycogone, Cladobotryum, bacterial blotch, sciarids, phorids, mites, virus. Visual ID for each is non-negotiable training for every operator.

03

Different stages, different threats.

Spawn run watch is for green mould and flies. Casing watch is for cobweb and mites. Cropping watch is for bubble diseases and blotch. Adjust the routine to the stage.

04

Sticky traps are your data.

Weekly counts of adult flies in traps give you population trend lines that visual inspection cannot. Threshold-based decisions outperform calendar spraying.

05

Sanitation between cycles is the largest ROI.

Two-day clean-down with steam, scrubbing, disinfection. Outperforms any chemical regime during a crop. Cheapest intervention you can run.

06

Regulatory compliance is not optional.

CIB&RC labelling controls what is allowed on edible mushroom. State poisons licence required for many products. Confirm before use; document for traceability.

UP NEXT / CHAPTER 13
Economics — what a working facility actually earns
Turn the page

CHAPTER

13

Economics

Capex bands, opex, payback per room size

Mushroom is a margin business, not a volume business. The discipline that grows the crop is the same discipline that earns the money.

KEY NUMBER

3 to 4 years

indicative payback band for a well-run standalone mushroom facility — shorter with subsidy

IN THIS CHAPTER

- What a mushroom facility actually costs to build
- What it actually costs to run, month after month
- What it actually earns, by channel and grade
- Payback bands — standalone and subsidised
- Where the working capital goes during ramp-up
- Six economics mistakes that turn good projects into bad ones

13.1

What a facility costs, what a facility earns.

The numbers in this chapter are bands, not projections. Any specific project will fall somewhere inside a band depending on land cost, fit-out specification, market access, and operator discipline.

Mushroom farm economics are unusual within Indian agriculture. Most crops produce revenue once or twice a year. A button mushroom facility produces revenue across the entire calendar — six to seven cycles per room per year, with continuous output once two or more rooms are overlapped on cycle calendars.

The capex is front-loaded and substantial relative to most farm investments. A single 18 × 40 ft commercial room comes in around sixteen to twenty-two lakh rupees fully fitted, with PUF, HVAC, racks, automation and ancillaries. A facility producing fifty kg per day runs the same band; a hundred kg per day facility is roughly double; capital scales linearly with output up to about five hundred kg per day, after which economies on shared services (compost, cold storage, packing line) reduce the marginal cost per additional kilogram.

The opex is dominated by three line items: compost, electricity, and labour, in that order at most scales. Spawn and casing materials are smaller. Maintenance, packaging, and overheads are smaller still. None of these line items are unusual — they are agriculture inputs combined with light industrial operating cost. The art is in keeping them in proportion as the operation scales.

> *Capex bands are conservative. Revenue projections in DPRs tend not to be.*
>
> — ON BANKABLE NUMBERS

The bands shown across this chapter are indicative ranges across commercial Indian operations. Any single project will land somewhere inside the band based on land cost, local labour, market access and operator discipline. A DPR shows a single number; reality is a band.

13.2

Three views of the money

The next pages show three perspectives. Capex by room and by facility scale, using bands that reflect what MushroomWale has seen across multiple projects across the country. Then opex structure as principles rather than line items — actual numbers depend heavily on local input prices.

Finally a payback view that combines capex, achievable revenue, and the substantial impact of subsidy schemes. The same project can have a five-year payback standalone and a two-year payback with a properly-stacked subsidy.

13.2 WHERE THE MONEY GOES

Capex composition, by share of project total.

Indicative shares of total capex across components for a mid-scale commercial mushroom project. Specific projects vary; the order and approximate magnitude is consistent.

0% 100% of project capex

PUF & insulation ~18–22%
80mm walls, 60mm partitions, 80–110mm roof; PPGL bo

Civil works ~12–18%
Foundation, shell, drainage; client scope typical

HVAC & refrigeration ~18–25%
Daikin HMT; sized for peak summer ambient

Racks & fittings ~8–10%
GI 7-tier; standard supplier

Automation ~5–8%
Naayom controllers, sensors, actuators

Compost facility ~8–12%
If in-house; 0% if buying compost in

Cold chain ~5–8%
Pre-cool, packing, cold storage

Contingency ~5–10%
Spec changes, vendor variations, ramp issues

PRINCIPLE

Insulation and HVAC are the irreversible spend.

Together roughly 40 percent of capex, and the components you cannot upgrade later without rebuilding. Spec them generously on day one; save on civil, racks, and contingency if you must.

13.3 CAPEX BANDS

What a build actually costs, by room and by facility.

Capex bands across commercial Indian projects, ex-GST, fitted but excluding land and civil works. The lower end is a value spec; the upper end is a premium spec with full automation and contingency.

CONFIGURATION	DAILY OUTPUT	INDICATIVE BAND	NOTES
Single 18 × 30 ft room	~30 kg/day	Rs 12-16 lakh	Entry-level scale
Single 18 × 40 ft room	~50 kg/day	Rs 16-22 lakh	Commercial standard
Single 18 × 60 ft room	~80 kg/day	Rs 24-32 lakh	Larger single-room
Single 18 × 70 ft room	~100 kg/day	Rs 36-46 lakh	Premium single-room
Multi-room — 100 kg/day	100 kg/day	Rs 36-46 lakh	2 rooms, overlapping
Multi-room — 200 kg/day	200 kg/day	Rs 80 L - 1.05 Cr	4 rooms, shared
Multi-room — 500 kg/day	500 kg/day	Rs 1.95 - 2.25 Cr	Established farm
Multi-room — 1000 kg/day	1000 kg/day	Rs 3.85 - 4.50 Cr	Regional operation

Bands exclude land cost (which varies by location), civil/foundation works (client scope), and working capital (typically 2-3 months of opex). Higher band reflects premium HVAC, full automation, comprehensive contingency. Lower band is operationally sound but requires the operator to take on more variability.

PRINCIPLE

Linear scaling up to 500 kg/day.

Up to roughly five hundred kg per day, capex scales roughly proportionally with output. Above that, shared services reduce the marginal capex per kg. The crossover where in-house compost makes sense is in the same scale range.

MISTAKE

Capex set by budget, not spec.

The cheapest configuration that bankers will accept is rarely the most profitable across five years. Cheap PUF, hand-built racks, undersized HVAC — all save capex and cost cycle yield.

13.4 OPEX STRUCTURE

Where the money goes, month after month.

Indicative opex structure for a steady-state commercial operation. Specific percentages vary by scale, region, automation level, and input prices. The order of magnitude across line items is consistent.

LINE ITEM	SHARE	WHAT DRIVES IT	WHERE TO OPTIMISE
Compost	25-35%	Largest single input by cost	In-house at scale; supplier discipline
Electricity	18-25%	HVAC 24x7, lighting, automation	HMT efficiency; insulation
Labour	15-22%	Picking, casing, sanitation	Process discipline; trained pickers
Spawn	6-10%	Recurring input at 0.5-0.75% by weight	Supplier reliability
Casing material	4-7%	Per cycle; pasteurised on-site	In-house pasteurisation
Packaging & cold chain	5-8%	Crates, films, refrigerated transport	Channel mix; pack format
Maintenance & spares	3-5%	HVAC service, sensor calibration	AMC contracts
Overheads	5-8%	Admin, regulatory, financing	Lean ops during ramp-up

Percentages are indicative ranges across mid-scale commercial operations. Compost typically dominates at smaller scales (buying in) and shifts toward electricity and labour at larger scales (in-house composting consolidates the input).

PRINCIPLE

Top three are 60-80% of opex.

Compost, electricity, labour. Optimisation effort should land here — not on spawn pricing or packaging procurement. Save five percent of compost cost and you have saved more than eliminating an entire smaller line item.

MISTAKE

Negotiating the wrong line items.

Spawn supplier renegotiation is a popular target — it is also typically less than 10 percent of opex. Compost discipline, electricity efficiency, and labour productivity move the needle.

13.5 REVENUE & PAYBACK

What it earns, how soon it pays back.

Revenue arithmetic for a steady-state facility. Payback bands assume operator discipline at the upper end of typical performance. Subsidy stacks substantially compress payback periods.

CONFIGURATION	REVENUE BAND	STANDALONE	WITH SUBSIDY
18 × 40 single (50 kg/day)	Rs 18-26 lakh/yr	3-4 years	1.5-2 years
100 kg/day (2 rooms)	Rs 36-52 lakh/yr	3-4 years	1.5-2 years
200 kg/day (4 rooms)	Rs 72 L - 1.04 Cr/yr	3-4 years	1.5-2 years
500 kg/day commercial	Rs 1.8 - 2.6 Cr/yr	3-4 years	1.5-2 years
1000 kg/day regional	Rs 3.6 - 5.2 Cr/yr	3-4 years	1.5-2 years

Revenue bands assume a Rs 100-150/kg wholesale gate price and 300-330 productive days per year per room. Branded retail with cold chain can fetch Rs 200-300/kg but requires packaging, cold logistics, and distribution capex not in these bands. Payback ranges are indicative.

PRINCIPLE

Subsidy reshapes the project.

A 30-50 percent capex subsidy through stacked NABARD, NHB, MIDH and PMEGP schemes can pull payback from 3-4 years down to 1.5-2 years. Chapter 16 covers the schemes in detail.

MISTAKE

Modelling at peak capacity.

DPRs often assume 100 percent capacity from month one. Reality is a 6-12 month ramp during which yields climb and operations stabilise. Conservative model: 60 percent year one, 80 percent year two, 90 percent year three onward.

13.6 ECONOMICS MISTAKES

Six ways the numbers go wrong on paper.

Most failed mushroom projects were failed on paper before construction started. The arithmetic was wrong, the assumptions were optimistic, and the buffers were absent. Recognising the patterns prevents the project from becoming one of them.

MISTAKE

Capex set by budget, not by spec.

The project pencils at Rs 16 lakh; the operator caps the build at Rs 16 lakh; the build delivers a Rs 16 lakh outcome regardless of what was needed. Spec first, then size the budget.

MISTAKE

Revenue at peak from day one.

Models that assume full capacity from month one are wishful. Ramp is real: 6-12 months to steady state. Build a conservative ramp into the DPR or the project misses first-year bank obligations.

MISTAKE

No working capital buffer.

Operations consume working capital for 60-90 days before consistent revenue starts. Two to three months of opex held aside is not optional; without it the project pauses at the worst moment.

MISTAKE

Optimising the wrong line items.

Negotiating spawn pricing while compost is 30% of opex. The proportionality matters more than the absolute saving. Optimise top items first; small items only after.

MISTAKE

Treating subsidy as guaranteed.

Subsidies arrive months after disbursement; documentation must be complete and process-compliant. Model the project standalone first; treat subsidy as a payback compressor.

PRINCIPLE

Conservative model, aggressive operation.

Underwrite on conservative numbers — modest revenue, full opex, slow ramp. Run the operation aggressively against discipline targets. Pleasant surprises are easier to manage than negative ones.

13.7 CHAPTER SUMMARY

Six things to carry into the next chapter.

01

Capex bands are bands, not points.

A specific project lands inside the band based on land cost, spec, and operator preference. DPR shows one number; reality is the band.

02

Top three = 60-80% of opex.

Compost + electricity + labour. Optimisation effort should focus here. Save 5% of compost cost and you have saved more than eliminating a smaller item entirely.

03

Standalone payback 3-4 years.

Well-run mid-scale commercial mushroom operation, no subsidy, conservative ramp assumed. Faster paybacks reported are usually optimistic models or post-subsidy.

04

Subsidy compresses payback to 1.5-2 years.

Stacked NABARD + NHB + MIDH or PMEGP schemes covering 30-50% of capex change the project profile materially.

05

Working capital is 2-3 months of opex.

Held aside, not deployed in capex. Without it, operations pause at the first margin shortfall.

06

Model conservatively, operate aggressively.

Underwrite on slow ramp, modest revenue, full opex. Run the operation against tight discipline targets. Surprises should be pleasant.

UP NEXT / CHAPTER 14
Top Fifteen Failure Modes — what kills projects
Turn the page

CHAPTER

14

Top 15 Failure Modes

Where beginners actually lose money

Failure is mostly not exotic. It is the same fifteen patterns, repeated, by people who did not know they were patterns.

KEY NUMBER

15 patterns

the recurring failure modes that account for most of the money lost in first-year mushroom projects

IN THIS CHAPTER

- Synthesis of the failure modes from every previous chapter
- Ranked by financial impact, not by frequency
- What each failure looks like at the symptom level
- Why each one happens — the operator psychology behind it
- How to design the project to prevent each one
- Where to look first when something starts going wrong

14.1

The same fifteen mistakes, year after year.

Every failed first-year mushroom project MushroomWale has investigated traces back to one of fifteen recurring patterns. The next pages are not theoretical risk analysis — they are the patterns themselves.

If the previous thirteen chapters described how to build and run a mushroom facility correctly, this chapter inverts the question. What does failure look like, where does it come from, and why does the same set of failures keep recurring across different operators in different states with different scale ambitions?

The patterns are not exotic. They are not biological mysteries. They are operational and economic — the result of underestimating capital requirements, overestimating personal discipline, compressing timelines that should not be compressed, and trusting vendors or partners that the operator had not properly evaluated.

The next three pages list fifteen failure modes ranked by typical financial impact. Not by frequency — frequent small failures are easier to absorb than rare large ones. The ranking reflects what actually ends projects.

> *Most projects do not fail because the biology was difficult. They fail because the operator was unprepared.*
> — THE COMMON ROOT

Compost discipline, climate-control discipline, cold-chain discipline. These are habits, not skills. They are learned by running cycles, not by reading about them. The fifteen failure modes are the cost of skipping the habits.

14.2

How to use this chapter

Read the fifteen entries before you start a project; refer back to them when something feels off during operations. Most of the entries describe what the failure looks like and where it usually originates upstream.

A working facility going wrong rarely shows the failure at the point where the failure is occurring. Phase 2 conditioning problems show up at cropping. Compost supplier problems show up at spawn run. Trace symptoms backward, not forward.

14.3 FAILURE MODES 1-5

The five most expensive ways to lose money.

These five failure modes account for the largest share of failed-project losses MushroomWale has documented. They are upstream — meaning they show up at later stages but originate at construction or early operations.

MISTAKE

01. Undersized HVAC.

Cooling sized for average load, not peak summer ambient. Room cannot hit 17-18 °C pinning trigger; the whole cycle disrupts. Discovered in flush 1 of cycle 1, fixable only by replacing the system.

MISTAKE

02. Cheap PUF or unsealed corners.

Insulation specification is irreversible. Inadequate PUF or leaky seals cause cycle-after-cycle temperature drift, raising electricity cost and dropping yield. Five-year impact exceeds the saving.

MISTAKE

03. Compost supplier without site visit.

Outsourcing Phase 2 compost is acceptable; doing so without visiting the supplier's facility is not. Bad supplier compost shows up in spawn run, weeks after the spawning decision was made.

MISTAKE

04. Skipping between-cycle sanitation.

Two-day clean-down compresses to two hours under deadline pressure. Pathogen populations carry across cycles, escalating until a full outbreak forces extended downtime.

MISTAKE

05. Pinning shift gradual, not sharp.

Operator afraid of shocking the crop transitions environment over days. Mycelium reads it as drift, not signal. Pins sparse, late, or absent. The cause looks biological but is operational.

14.4 FAILURE MODES 6-10

The middle five — operational discipline.

These failure modes are usually catchable in real time, if the operator is paying attention. They are the difference between a 70 percent yield realisation and a 90 percent one across the same crop.

MISTAKE

06. Breaking cold chain in transport.

Refrigerated truck breaks down; product moves at ambient for two hours; arrives Grade B against Grade A invoice. Buyer rejects the lot. Single biggest unforced realisation loss across mid-scale farms.

MISTAKE

07. Picking too late during peak flush.

Caps open between morning and evening pick; mushroom drops a grade. Twice-daily picking during peak is the discipline; once-daily is the failure. Costs roughly 15 percent of cycle realisation.

MISTAKE

08. Mixing grades in packaging.

Single Grade B in a Grade A box loses the whole box at retail rejection. Grading at the bed, sorting at the table, packing in the cold. Three jobs in three places; merging them is how grade leaks.

MISTAKE

09. Inadequate pre-cooling.

Mushroom packed at field temperature loses days of retail shelf life regardless of subsequent cold storage. The dedicated pre-cool space is small infrastructure with disproportionate yield impact.

MISTAKE

10. Casing too thick or too thin.

Above 6-7 cm pinning delays past schedule; below 3 cm pins form before mycelium is ready and produce weak flushes. Measure, do not estimate, on every bed.

14.5 FAILURE MODES 11-15

The final five — compounding mistakes.

These failure modes are smaller per occurrence but compound across cycles. Recurring small losses across multiple cycles add up to the same impact as a single large failure — and are easier to overlook.

MISTAKE

11. Modelling at peak capacity from day one.

DPR assumes full output from month one. Ramp realities are 6-12 months. Cash flow misses bank obligations, project enters distress in the first year despite a sound underlying operation.

MISTAKE

12. Treating subsidy as guaranteed.

Capex budgets assume subsidy disbursement on schedule. Documentation incomplete, approvals delayed, working capital exhausted. Model standalone; treat subsidy as a compressor.

MISTAKE

13. Hand-built racks from local fabricators.

Saves 30 percent on rack capex. Racks rust at welds, flex under weight, need replacement in three years. Standard GI rack pays back across one avoided replacement.

MISTAKE

14. Reusing casing across rooms.

Old casing dragged from one room to another carries pathogens. A single room's problem becomes a facility-wide problem. Compartmentalise materials, dedicated tools per room.

PRINCIPLE

15. Building without an AMC plan.

HVAC, automation, sensors all need scheduled service. AMC contracts cost less than the downtime they prevent. Build the AMC into the project budget from day one.

14.6 CHAPTER SUMMARY

Six things to carry into the next chapter.

01

Most failure is upstream of the symptom.

Phase 2 problems show up at cropping. Compost problems show up at spawn run. Trace symptoms backward to find the cause.

02

Capital decisions are irreversible.

HVAC, PUF, civil — these set the ceiling. Cycle discipline can land you below the ceiling but cannot lift it. Spec carefully on day one.

03

Operational discipline is daily.

Sanitation, picking timing, cold chain integrity. None of these are skills; they are habits. Habits are learned by running cycles, not by reading about them.

04

Subsidy is a compressor, not a capital component.

Model the project standalone. Subsidy improves payback when it arrives; treating it as committed capital is how projects fail in the first year.

05

Ramp is real. Plan for it.

6-12 months to steady state. Build conservative cash flow into the financing model. The first-year obligations are met against ramped-up output.

06

The fifteen patterns are predictable.

Every failed first-year project lands in one of these patterns. Reading them in advance is the cheapest insurance available.

UP NEXT / CHAPTER 15
Hobby to Business — when to scale and what changes Turn the page

CHAPTER

15

Hobby to Business

Scaling milestones and what changes

Most mushroom businesses started as somebody's curiosity. The transition from curiosity to business has stages, and each stage has its own discipline.

KEY NUMBER

Five stages

the recognisable path from kitchen-counter experiment to regional-scale commercial operation

IN THIS CHAPTER

- The five stages of mushroom-farming progression
- When to move from one stage to the next
- What changes operationally at each transition
- What changes financially at each transition
- How to know if you should not advance further
- The honest version of each stage's economics

15.1

Five stages, honest about each.

The progression from hobbyist to commercial operator is not linear and not inevitable. Some operators stop at stage three deliberately and run a profitable lifestyle business. Some skip stages and regret it.

Mushroom farming attracts a wide range of operators. Engineers who want a productive sideline. Agriculture-college graduates looking for a specialised crop. Established farmers diversifying into climate-controlled production. Returning NRI families looking for a land-anchored small business. Each starts at a different point. The shape of the path is more consistent than the starting point.

Stage one is the kitchen-counter or backyard experiment. Five or ten grow bags, usually oyster mushrooms because they are less demanding than button. Aim is to learn the biology and the rhythm. Investment is a few thousand rupees. The output does not pay back; that is not the point.

Stage five is regional commercial operation. Ten or more rooms, continuous output, branded distribution, dedicated cold chain, compost supply integrated or contracted. Investment is in crore. The discipline that produced cycle one at the kitchen counter is the same discipline that produces cycle ten thousand at this scale — but the systems around the discipline are entirely different.

> *Each stage rewards different skills. Stage one's expert is often not the operator who runs stage five.*
> — ON HONEST SELF-ASSESSMENT

Most operators have a natural stage. Some are happiest at stage three running a 50 kg/day single-room operation with their own hands. Some only feel comfortable above 500 kg/day with managers and systems. Both are valid. Neither is automatic.

15.2

Reading the milestones

The infographic on the next page shows the five stages and the operational transitions between them. The transitions are where most operators stall — not in any single stage. The stage-three operator who tries to jump to stage five without going through stage four is the most common cautionary story.

Each transition is a different business. Stage four requires delegation; stage five requires distribution networks. These are not naturally adjacent skills. Plan the path, and plan the learning curve at each transition.

15.2 MILESTONE PATH

Five stages from kitchen counter to commercial.

Each stage is a different business — different capital, different operating model, different skills. The transitions are where most operators stall.

01	02	03	04	05
HOBBYIST	**PILOT**	**COMMERCIAL**	**ESTABLISHED**	**REGIONAL**
5-50 bags	250-500 bags	50 kg/day	100-200 kg/day	500+ kg/day
Rs 5-25 K	**Rs 2-5 L**	**Rs 16-22 L**	**Rs 36L-1 Cr**	**Rs 1.95 Cr+**
capex	capex	capex	capex	capex

WHERE OPERATORS STALL

Stage 3 to Stage 5 directly is the most common cautionary story.

Stage 4 is where the operator learns delegation, scheduling, and multi-channel sales. Skipping it means encountering those problems at scale rather than at smaller risk.

15.3 STAGE-BY-STAGE

What each stage actually looks like, financially.

Indicative scale, investment, and operating reality at each stage. The transitions between stages typically take 12-24 months — they are project decisions, not weekly ones.

STAGE	TYPICAL SCALE	INVESTMENT BAND	OPERATING MODEL
1. Hobbyist	5-50 grow bags	Rs 5-25 thousand	Backyard or balcony. Oyster typical. Self-consumption only.
2. Pilot	1 room, 250-500 bags	Rs 2-5 lakh	Half-time effort. Farmer-market sales. Learn the rhythm.
3. Commercial	18×40 room, 50 kg/day	Rs 16-22 lakh	Full-time owner-operator. Wholesale or retail. Bankable DPR.
4. Established	2-4 rooms, 200 kg/day	Rs 36 L - 1.05 Cr	Owner manages, employs crew. Multi-channel sales.
5. Regional	10+ rooms, 500+ kg/day	Rs 1.95 Cr+	Owner is CEO; managers run ops. Brand and distribution.

Investment bands are capex only — exclude land, working capital, and brand-building spend at the higher stages. Stage 4 to Stage 5 transition typically requires either compost integration (in-house compost facility) or a long-term compost supply contract with a reliable Phase 3 producer.

PRINCIPLE

Stop where the operator fits.

Not every operator should advance to Stage 5. A Stage 3 operation run with discipline is a profitable lifestyle business — often more profitable per owner-hour than a poorly-managed Stage 5. Honest self-assessment is the cheapest expansion-decision input available.

MISTAKE

Skipping Stage 4.

Stage 3 to Stage 5 directly is the most common cautionary story. Multi-room operations require delegation, scheduling, multiple channels — skills not developed at Stage 3. Pass through Stage 4 first.

15.4 TRANSITION TRAPS

Six ways scaling goes wrong.

Each transition between stages has characteristic failure patterns. Recognising the trap before the transition is the difference between a successful scale-up and a write-off.

MISTAKE

Jumping stages.

Hobbyist directly to commercial. Pilot directly to multi-room. The intermediate stage is where the operator learns whether the next stage is desirable at all.

MISTAKE

Scaling before profitable.

Stage 3 not yet profitable; operator believes scale will fix it. Scale amplifies whatever is happening — including loss. Achieve profitability at the current stage first.

MISTAKE

Operator-attached operations.

Stage 3 operation that only works when the owner is on site. Stage 4 requires the owner to step back from daily picking; if the operation cannot run without owner presence, it cannot scale.

MISTAKE

Underestimating distribution.

Stage 4 to Stage 5 is largely a distribution problem, not a production problem. Building supply without demand leaves rooms running below capacity at the worst time.

MISTAKE

Compost dependency at scale.

Buying compost works at Stage 3 and often Stage 4. At Stage 5, dependency creates fragility — single-supplier failure halts production. Multi-supplier or in-house.

PRINCIPLE

The honest stop point.

Some operators stop at Stage 3 and run a satisfying lifestyle business. This is not failure — it is fit. Knowing your stop point in advance is the cheapest insurance against over-scaling.

15.5 CHAPTER SUMMARY

Six things to carry into the next chapter.

01

Five stages, not one path.

Hobbyist, pilot, commercial single, established multi, regional. Each stage is a different business. Each transition is a separate project.

02

Pass through every stage.

Skipping stages is the most common scaling failure. The skipped stage is where operators learn whether the next stage is desirable at all.

03

Profitability before scale.

Scale amplifies whatever is happening at the smaller stage — including loss. Achieve profitability first, then expand.

04

Operator-attached operations cannot scale.

If Stage 3 requires owner presence every day, Stage 4 will fail. Build delegation and process discipline at Stage 3 before transitioning.

05

Stage 4 to Stage 5 is distribution.

Production scaling is solved by capex and process. Distribution scaling is solved by channels, relationships, and brand. Different problem, different timeline.

06

Stopping is a valid choice.

Stage 3 operations run well are profitable lifestyle businesses. The operator who recognises their natural stage and stops there outperforms the operator who over-scales.

UP NEXT / CHAPTER 16
Bank Finance & Subsidy — DPRs and schemes
Turn the page

CHAPTER

16

Bank Finance & Subsidy

DPRs, schemes, what banks want to see

Subsidy can reshape a project's economics. Subsidy management can also wreck the timeline of a project that depends on it.

KEY NUMBER

30-50% capex

the indicative subsidy band achievable through properly stacked central and state schemes

IN THIS CHAPTER

- What a bankable DPR contains, and how banks read it
- The major subsidy schemes — NABARD, NHB, MIDH, PMEGP
- How schemes stack — credit-linked, capital, interest subvention
- Documentation discipline through the application cycle
- Working capital alongside term loan
- Six application mistakes that delay or disqualify projects

16.1

Financing is its own operational discipline.

A mushroom project that pencils standalone becomes attractive with subsidy. A project that depends on subsidy to pencil is fragile. The distinction matters — and shapes how the application should be structured.

Financing a commercial mushroom facility in India typically combines three sources. A term loan from a scheduled commercial bank, NBFC, or co-operative bank, covering 60-75 percent of capex. A capital subsidy through one or more central and state schemes, covering 25-40 percent depending on stacking and category eligibility. And the operator's own contribution — equity — typically 15-25 percent.

The schemes worth knowing are limited in number. NABARD operates credit-linked subsidies for agricultural infrastructure including climate-controlled cultivation. NHB (National Horticulture Board) runs schemes specifically supportive of post-harvest infrastructure including cold storage and packhouse facilities. MIDH (Mission for Integrated Development of Horticulture) covers state-channelled horticulture support including mushroom cultivation in many states. PMEGP (Prime Minister's Employment Generation Programme) is available for first-time entrepreneurs at smaller scales.

Eligibility, subsidy percentages, and documentation requirements shift year to year. State-level implementation varies. This guide describes the structure and the principles; specific current rates and ceilings should be confirmed with the lending bank, state agriculture department, and MushroomWale's DPR team at project stage.

> *Banks fund operations, not optimism. A DPR that reads as a sales pitch is a DPR that gets rejected.*
>
> — ON DPR REALISM

The DPR's job is to convince the bank that the project will service its loan obligations from realistic cash flows. Conservative ramp, full opex, modest revenue, working capital buffer — these are not pessimism. They are bankability.

16.2

What the bank actually reads

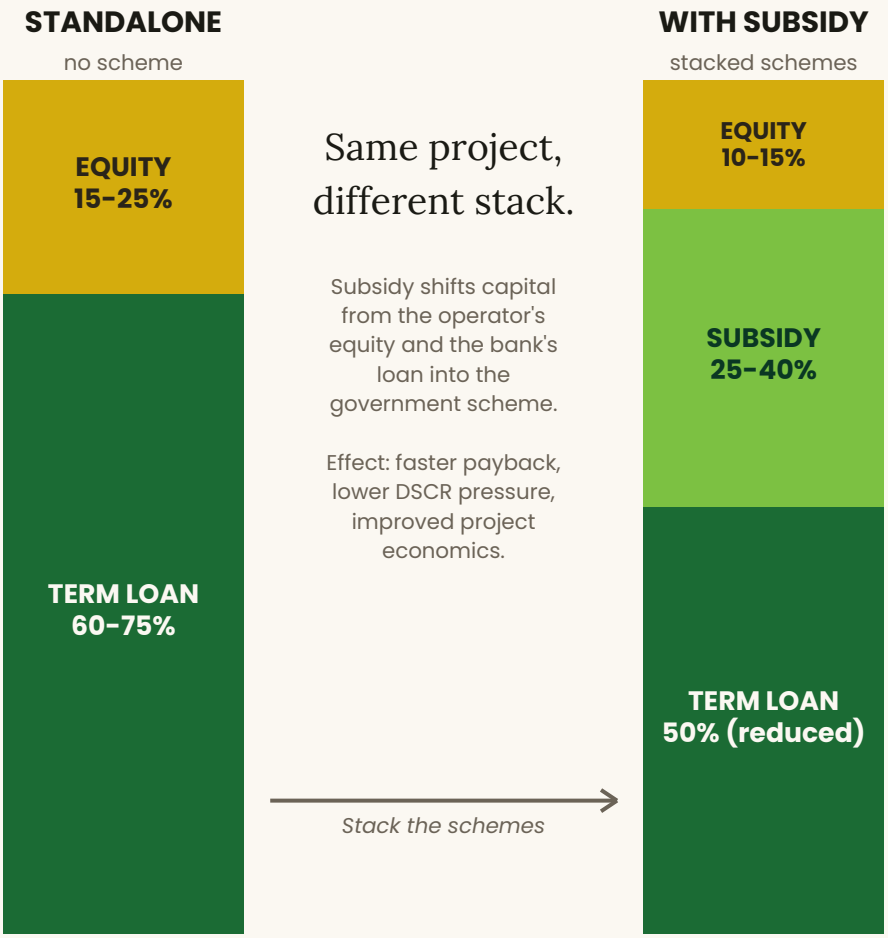
A bank credit officer reading a mushroom DPR scans for specific signals. Realistic capex breakdown. Conservative ramp assumption in revenue. Working capital separately identified. Specific subsidy schemes identified by name, not by hope. Vendor credentials for HVAC, PUF, automation.

The infographic on the next page shows how the financing stacks in a typical commercial application. The table after that summarises the major schemes. The error grid lists the application mistakes that delay or disqualify applications.

16.2 THE FINANCING STACK

How a mushroom project is actually financed.

Three components — operator equity, bank term loan, capital subsidy. The subsidy reduces operator effective contribution; it does not arrive as cash at signing.



WHAT TO STACK

NABARD + NHB + MIDH + state schemes + category top-ups.

Multiple schemes can stack on a single project. Eligibility, percentages, and ceilings change year to year. MushroomWale's DPR team confirms current stacking eligibility before submission.

16.3 MAJOR SCHEMES

What is available, and how to apply.

The major central schemes supporting commercial mushroom infrastructure in India. State-level schemes exist in addition and vary by state. Confirm current rates, ceilings, and eligibility with the implementing agency at project stage.

SCHEME	VIA	SCOPE	APPLY THROUGH
NABARD	Banks, RRBs, co-ops	Credit-linked subsidies for climate-controlled	Bank routes to NABARD
NHB	National Horticulture	Post-harvest infrastructure including mushroom unit	NHB regional office; bank co-applies
MIDH	State horticulture dept.	Mushroom cultivation and compost units	District horticulture officer
PMEGP	KVIC, KVIBs, DICs	First-time entrepreneurs; typically below Rs 25 lakh	Online portal; nodal agency
State	State agri / horticulture	Varies by state — top-ups on central schemes	State portal; varies by state

Specific subsidy percentages, ceilings, and eligibility criteria change year to year. Some schemes are restricted to specific operator categories — women entrepreneurs, SC/ST applicants, north-east region, first-time entrepreneurs. MushroomWale's DPR team confirms current rates and stacking eligibility before submission.

PRINCIPLE

Stack carefully, document fully.

Multiple schemes can stack on a single project — central plus state plus category-specific. The discipline is in the documentation: every scheme has its own paperwork, every scheme has its own timeline, and one missing document delays the entire stack.

MISTAKE

Treating subsidy as fast money.

Subsidies are credit-linked and disbursed against milestones; they do not arrive at signing. The project consumes working capital for months before subsidy reaches the operator's account.

16.4 WHAT A DPR CONTAINS

The document banks read, the sections that decide approval.

A bankable DPR follows a conventional structure. Each section answers a specific question for the credit officer. Missing or weak sections are why applications stall.

SECTION	WHAT BANKS LOOK FOR	COMMON WEAKNESS
Executive summary	Capex, revenue, payback, ask, security	Inflated revenue, hidden assumptions
Project background	Promoter credentials, prior experience	Generic CV, no domain experience
Technical specification	PUF, HVAC, racks, automation — vendor named	Vague specs, no vendor commitment
Capex breakup	Itemised, dated quotes from vendors	Round numbers without supporting quotes
Opex projection	Realistic by line item, conservative ramp	Underestimated electricity, peak-day revenue
Revenue projection	Channel mix, grade mix, ramped utilisation	Single price, full utilisation day one
Cash flow & DSCR	Debt service coverage > 1.4 across tenure	Tight DSCR, no buffer for ramp shortfall
Subsidy stack	Schemes named, eligibility documented	Subsidy treated as committed capital
Risk & mitigation	Specific risks, specific mitigations	Generic risks, no operator-specific

DPR pages typically run 60-90 pages for a Rs 16-22 lakh single-room project, 150-200 pages for a Rs 1 crore+ multi-room project. Length is not the goal; completeness and bankability are.

PRINCIPLE

DSCR above 1.4 is the gate.

Debt service coverage ratio below 1.4 invites further scrutiny or rejection. Above 1.4 across the loan tenure signals comfortable repayment even under stressed conditions. The buffer is what banks are buying.

MISTAKE

Borrowed DPR templates.

Generic mushroom DPR templates floating online are usually built for older rate cards, optimistic ramps, and incomplete subsidy stacks. Submission of a template DPR is a major reason for delayed approvals.

16.5 APPLICATION MISTAKES

Six common financing failures.

Most subsidy delays and disqualifications are documentation failures, not project failures. The underlying project is sound; the paperwork is not. Recognising the patterns saves months of delay.

MISTAKE

Incomplete documentation submitted.

Missing land documents, missing quotes, missing promoter KYC. The application is rejected at intake or returned for re-submission. Each round of return costs 2-4 weeks. Front-load completeness.

MISTAKE

Aggressive revenue assumptions.

DPR projects Rs 200/kg blended pricing and 100% utilisation from month one. Credit officer downgrades the projection internally and rejects on DSCR shortfall. Conservative numbers close faster.

MISTAKE

Vendor quotes without commitments.

Capex breakup uses public list prices; bank asks for executed quotes; project pauses while quotes are obtained. Vendor-stamped quotations from the start reduce friction.

MISTAKE

Subsidy double-counted.

Capex shown net of subsidy in one section, gross in another. Inconsistency triggers credit officer scrutiny. Subsidy belongs in a separate line; the capex breakup stays gross.

MISTAKE

Working capital ignored.

Term loan covers capex only; working capital is the operator's problem. Two to three months of opex held aside is the right number. Without it, ramp stalls at the first cash crunch.

PRINCIPLE

Engage a domain-experienced DPR consultant.

A DPR consultant who has closed mushroom projects through the relevant bank knows the credit officer's filters. The fee is small against the time saved on resubmissions.

16.6 APPLICATION TIMELINE

How long it actually takes, from intent to disbursement.

Indicative timeline for a Rs 20-50 lakh commercial mushroom project from initial bank approach to first disbursement. Subsidy disbursement typically follows construction milestones, not at signing.

PHASE	TYPICAL DURATION	WHAT HAPPENS	OPERATOR ACTION
DPR preparation	3-5 weeks	Site survey, BOQ, financial model	Provide docs
Bank submission & query	2-4 weeks	Branch review, technical query rounds	Respond to queries
Credit committee approval	2-6 weeks	Sanction letter issued	Negotiate terms
Documentation & disbursement	2-4 weeks	Loan agreement, mortgage, first draw	Sign documents
Construction & milestones	12-20 weeks	Building, PUF, HVAC, fit-out	Milestone drawdowns
Subsidy claim & disbursement	8-16 weeks	Claim submission to scheme	Submit completion docs

Total from DPR start to working facility with subsidy received: typically 8-14 months. Faster timelines exist but require everything going right. Build a 12-month timeline into project planning and treat shorter as upside.

PRINCIPLE

Subsidy is post-completion.

Subsidy disbursement typically follows construction completion and operational verification. The operator runs cycles, pays bills, and services the term loan for months before subsidy money arrives. Plan cash flow accordingly.

MISTAKE

Construction faster than financing.

Operators occasionally start construction before loan sanction, assuming sanction is automatic. Banks reject DPRs that show construction already underway.

16.7 CHAPTER SUMMARY

Six things to carry into the next chapter.

01

Subsidy is a compressor, not a foundation.

Model the project standalone. Treat subsidy as payback compression when it arrives. Projects that need subsidy to pencil are fragile.

02

Four schemes worth knowing.

NABARD, NHB, MIDH, PMEGP. State schemes stack on top. Eligibility and rates shift year to year — confirm at project stage.

03

DPR is a banking document, not a sales pitch.

Conservative ramp, full opex, modest revenue, working capital buffer. DSCR above 1.4 across the tenure. This is what closes.

04

Subsidy stacks need documentation discipline.

Every scheme has its own paperwork and timeline. One missing document delays the entire stack. Front-load completeness.

05

Working capital is the operator's problem.

Term loan covers capex. Two to three months of opex must be held aside. Banks will not solve this after disbursement.

06

8-14 months end to end.

From DPR start to subsidy disbursement. Plan project timelines around 12 months. Faster timelines exist as upside, not as base case.

UP NEXT / CHAPTER 17
Working with an EPC — turnkey versus piece by piece Turn the page

CHAPTER

17

Working with an EPC

Turnkey versus piece by piece

Building a mushroom facility piece by piece is cheaper on paper. Building it through an EPC is faster, more predictable, and usually less expensive across five years.

KEY NUMBER

Single ownership

the structural difference between an EPC engagement and managing multiple vendors directly

IN THIS CHAPTER

- What an EPC actually delivers
- Where EPC pricing comes from
- When piece-by-piece is the right choice
- How to evaluate EPC alternatives
- What to expect during a typical engagement
- Six EPC mistakes — yours and theirs

17.1

What turnkey actually delivers — and does not.

EPC stands for Engineering, Procurement, Construction. In mushroom farming, it means a single contractual owner of the build outcome — from site survey through commissioned operating rooms producing the first crop.

The choice between EPC engagement and managing multiple vendors directly is the most consequential commercial decision in a mushroom project. It shapes the timeline, the budget, the risk profile, and — most importantly — who is responsible when something does not work as specified at handover.

Under EPC, a single firm takes ownership of the integrated outcome. The civil contractor, the PUF supplier, the HVAC vendor, the rack fabricator, the automation integrator — all are sub-engaged through the EPC. The operator has one contract, one project manager, and one source of accountability if the room does not hold 17 °C at handover.

Under direct procurement, the operator runs the project. The civil contractor builds the shell. PUF goes up under a separate contract. HVAC is sized and installed by a third vendor. Racks by a fabricator. Automation by an integrator. Each contract is the operator's, each timeline is the operator's, each coordination failure is the operator's.

> *Piece by piece is cheaper on the quote sheet. It is not cheaper on the calendar.*
>
> — THE HIDDEN COST OF COORDINATION

EPC pricing typically includes a coordination margin — the EPC's compensation for owning the integrated outcome. Operators who compare a piece-by-piece quote against an EPC quote often miss the value of that coordination ownership. The piece-by-piece savings are absorbed by delays, re-work, and the operator's own time.

17.2

When direct procurement is right

Direct procurement makes sense when the operator has prior experience building climate-controlled facilities, has existing vendor relationships, and has time to project-manage. For first-time operators, direct procurement is almost always a false economy.

The engagement model infographic on the next page shows how EPC and direct procurement compare across the project life cycle. The mistakes grid that follows covers what goes wrong in both models.

17.2 ENGAGEMENT MODELS

EPC versus direct, across the project lifecycle.

Same project, two engagement models. EPC consolidates accountability; direct procurement distributes it. The right choice depends on operator experience and timeline pressure.

EPC ENGAGEMENT single contractual owner	DIRECT PROCUREMENT operator manages vendors
Site & Spec EPC handles survey, BOQ, DPR support	**Site & Spec** Operator handles or hires consultant
Civil works EPC's civil contractor	**Civil works** Operator's civil contract
PUF & insulation EPC's PUF supplier, coordinated	**PUF & insulation** Operator's PUF supplier
HVAC EPC sizes, sources, installs	**HVAC** Operator hires HVAC vendor
Racks & fittings EPC's rack supplier	**Racks & fittings** Operator's rack supplier
Automation EPC's integrator, pre-configured	**Automation** Operator's automation vendor
Coordination EPC manages all interfaces	**Coordination** Operator manages all interfaces
Commissioning EPC owns acceptance criteria	**Commissioning** Operator validates each vendor
AMC Contracted alongside build	**AMC** Negotiated separately per vendor

DEFAULT RECOMMENDATION

First-time, bank-funded projects typically choose EPC.

Outcome certainty for the bank, time to focus on operations, single accountability at handover. The coordination margin is small against the value of those three outcomes.

17.3 EPC VS PIECE-BY-PIECE

How the two models compare, across what actually matters.

Side-by-side view of the two procurement models across the dimensions that determine project outcomes. Neither model is universally correct — the right choice depends on operator experience, project complexity, and timeline pressure.

DIMENSION	EPC (TURNKEY)	DIRECT PROCUREMENT	BETTER WHEN
Sticker price	Higher (includes coord. margin)	Lower per line item	Direct: low complexity
Total delivered cost	Predictable	Variable (re-work, delays)	EPC: first-time
Timeline	Defined, contractually owned	Operator-managed, often slips	EPC: financing on clock
Accountability	Single contract	Distributed across vendors	EPC: first-time
Operator time	Reviews & approvals only	Daily project management	Direct: experienced
Customisation	Standard with options	Fully customised possible	Direct: unusual specs
Commissioning risk	EPC carries it	Operator carries it	EPC: outcome certainty

EPC pricing typically includes a coordination margin — compensation for owning the integrated outcome. The right question is not 'which is cheaper on quotes' but 'which produces a working facility on schedule and on spec.' That answer depends on the operator's experience and the project's complexity.

PRINCIPLE

First-timer? Choose EPC.

A first-time operator with a financed project has two reasons to choose EPC: outcome certainty for the bank, and time to focus on operations rather than project management. The coordination margin is small against the value of those two outcomes.

MISTAKE

Apples to oranges comparison.

Comparing three EPC quotes against a direct-procurement budget is a flawed comparison — the direct procurement number is unrealistic because it excludes coordination cost. Either compare EPCs against EPCs, or build a realistic direct-procurement number.

17.4 EPC MISTAKES

Six ways the engagement goes wrong.

EPC engagements that fail rarely fail because the EPC delivered poorly. They fail because the engagement was set up poorly. Recognising the patterns prevents disappointment on both sides.

MISTAKE

Selecting on price alone.

Three EPC quotes; lowest selected. Lowest quote often reflects spec corners cut or contingency removed. Evaluate scope before evaluating price; align scope across quotes before comparing.

MISTAKE

Ambiguous spec, contested deliverables.

DPR-level spec used as EPC contract; specific HVAC tonnage, PUF thickness, automation scope left to interpretation. Disagreement at handover. Spec tightly, contract precisely.

MISTAKE

No commissioning acceptance criteria.

Handover is loose: room exists, HVAC runs. Acceptance criteria — does the room hold 17 °C against peak ambient, does automation produce the agreed envelope — should be contracted in advance.

MISTAKE

AMC not built into the engagement.

Commissioning concludes the EPC contract; operator alone with the facility. AMC for HVAC, automation, sensors should be contracted alongside the build, not deferred.

MISTAKE

Operator absent during construction.

EPC builds; operator visits at handover. Construction-time decisions — door placement, sensor positioning, drainage — made without operator input. Weekly site presence is the norm.

PRINCIPLE

Choose the EPC that asks questions.

An EPC asking detailed questions about cycle calendar, channel mix, AMC, future expansion is invested in the outcome. One that just quotes the BOQ is a contractor, not a partner.

17.5 CHAPTER SUMMARY

Six things to carry into the next chapter.

01

EPC versus direct is about ownership, not price.

EPC owns the integrated outcome; direct procurement leaves coordination with the operator. The right choice depends on operator experience and project complexity.

02

First-time operators should engage EPC.

Outcome certainty for the bank, time to focus on operations, single accountability. The coordination margin is small against these outcomes.

03

Compare EPCs on scope first, then on price.

Lowest-price EPC often reflects spec corners cut. Align scope across quotes before comparing price. Cheap EPC is the most expensive EPC across five years.

04

Tight spec, precise contract, defined acceptance.

Acceptance criteria for HVAC performance, automation scope, commissioning thresholds — all contracted in advance. Loose spec at signing is contested deliverables at handover.

05

AMC alongside the build.

Contract HVAC, automation, sensor AMC at the same time as the build. Deferring it leaves the operator alone with the facility from day one of operations.

06

Present during construction.

Weekly site visits, decisions about door placement, sensor positioning, drainage — these are operator decisions. Absentee operators get builder-default outcomes.

UP NEXT / CHAPTER 19
Building at Scale — integrated facilities
Turn the page

CHAPTER

19

Building at Scale

Integrated 500 kg/day and 1 TPD facilities

This chapter is for operators evaluating whether to build at integrated scale rather than as a series of standalone rooms. Both models work; this lays out where one fits better than the other.

KEY NUMBER

500-1000 kg/day

the scale at which integrated facilities change the project's economics, risk profile, and financing options compared to standalone room-by-room builds

IN THIS CHAPTER

- What 'integrated' actually means at 500 kg/day and 1 TPD
- Component-by-component anatomy of an integrated facility
- Capex bands, revenue characteristics, payback ranges
- Standalone versus integrated — where each fits
- Honest trade-offs in both directions
- Phased build approach — seventy to one hundred twenty days
- How to decide which model is right for you

19.1

Standalone, or integrated. Two routes, two profiles.

Most Indian mushroom projects are built room by room and grown incrementally. A smaller number are built integrated from day one. This chapter lays out what each route looks like at 500 kg/day and 1 TPD scale, without recommending either.

There is a familiar progression in Indian mushroom cultivation. An operator starts with one or two rooms, buys compost from a supplier, sells to wholesale, learns the rhythm. After a year or two of cycles, they add rooms. After three or four years, they may bring compost in-house. This route works. Many of India's profitable mushroom businesses were built this way.

The alternative is to build integrated from the start. A 500 kg per day facility with in-house compost, multiple grow rooms running overlapping cycles, dedicated cold storage and pre-cooling, and established cold chain. Indicative capex Rs 1.9 to 3.2 crore. Indicative revenue Rs 1.8 to 2.6 crore per year at maturity. Payback ranges typically two to three years with subsidy, three to four years without. This route also works. It is different.

The 1 TPD integrated facility sits at Rs 3.6 to 5.8 crore capex and Rs 3.6 to 5.2 crore annual revenue. At this scale, the operation runs more like an industrial food-production asset than a farm. Banks finance these differently. Buyers contract differently. Talent retention requirements are different. Neither scale is inherently better — they are different commitments.

> *An integrated project is not a bigger version of a small project. It is a different category of asset.*
> — ON THE CATEGORY DIFFERENCE

This chapter walks through what an integrated 500 kg/day to 1 TPD facility actually contains, what it costs, what it earns, what the risks look like, and how the build phases out. The numbers are indicative bands across commercial Indian projects — any specific project will land inside the band based on land cost, market access, and operator preferences.

19.2

How to read this chapter

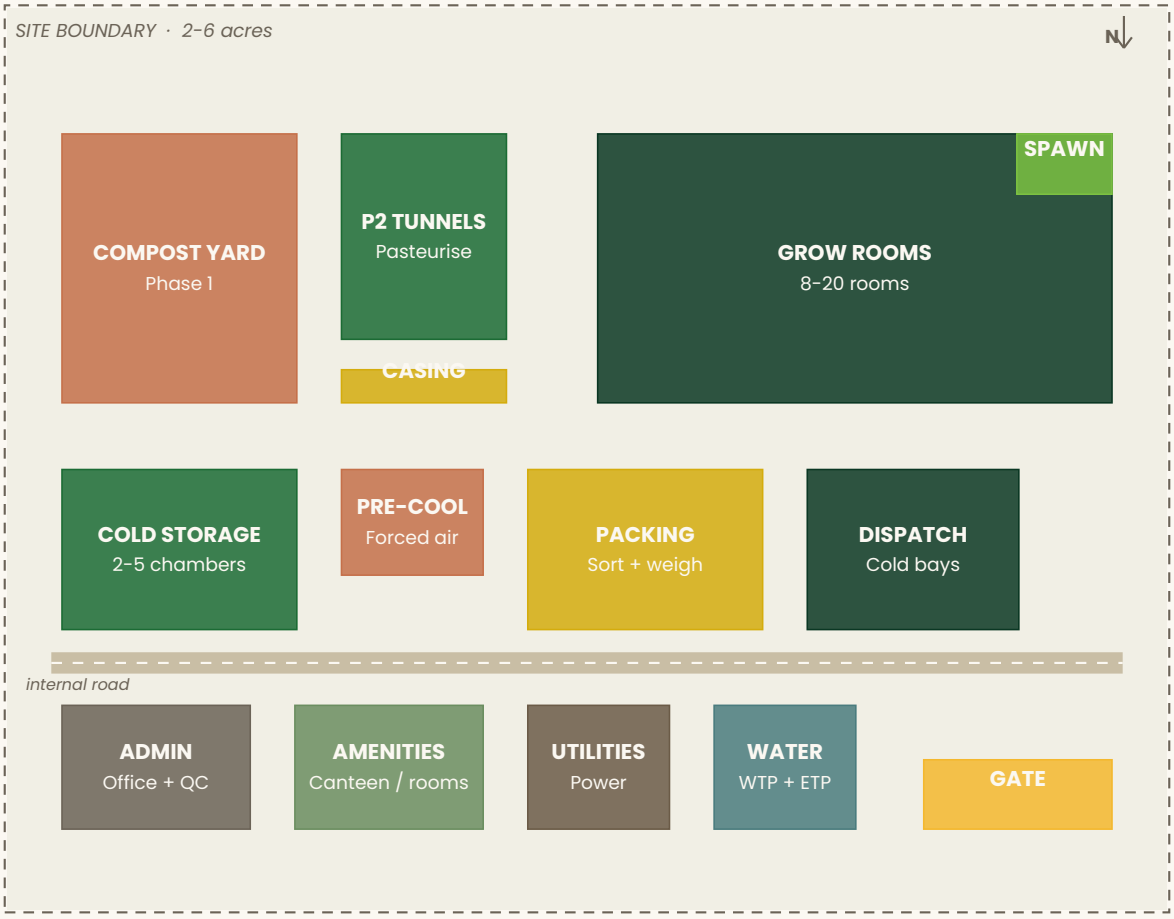
Use it to decide whether the integrated route fits your situation. Bigger capex commits more before you have learned your specific market and operating discipline. Smaller capex defers learning costs to later expansion rounds.

The pages that follow cover components, capex anatomy, comparison, build timeline, and trade-offs in both directions. Decide based on your situation.

19.2 FACILITY COMPONENT MAP

What an integrated facility looks like.

Top-down view of a typical 500 kg/day to 1 TPD integrated facility. Each block is a discrete function; all blocks sit on the same site, run on the same calendar, and report to the same operations head.



FOOTPRINT

Land: 2-4 acres for 500 kg/day, 4-6 acres for 1 TPD.

Site layout above is illustrative. Specific arrangements depend on plot shape, prevailing wind direction, access road location, and the operator's preference for traffic and process flow. MushroomWale finalises the site plan at survey stage.

19.3 INSIDE AN INTEGRATED FACILITY

What is built, what is operated, what is owned.

Component-by-component view of a 500 kg/day to 1 TPD integrated mushroom facility. Some components are optional at the lower scale and standard at the higher scale; all are included in a fully integrated build.

BLOCK	PURPOSE	CAPACITY	500 KG/D | 1 TPD
Compost yard (Phase 1)	Outdoor stack and turn	150-300 tonnes / cycle	Standard | Standard
Phase 2 tunnels	Pasteurise and condition	2-4 tunnels	2-3 tunnels | 4-6
Grow rooms	Spawn run + cropping	50-100 kg/day each	8-10 rooms | 16-20
Cold storage chambers	Grade A and B/C, transit	5-15 tonnes capacity	2-3 chambers | 3-5
Pre-cooling room	Field heat removal	2-3 hour throughput	Standard | Standard
Packing & sorting	Grading, weighing, packaging	500-1000 kg/shift	Standard | Larger
Spawn lab	Mother culture and grain spawn	Self-supply or partial	Optional | Recommended
Casing pasteuriser	Sterilise casing material	1-2 tonnes per cycle	Standard | Standard
Cold dispatch bay	Refrigerated truck loading	2-3 bays	1-2 bays | 2-3
Admin & quality lab	Office, QC, batch records	—	Standard | Larger
Worker amenities	Canteen, change rooms, restrooms	20-40 workers | 60-90	Standard | Larger
Power infrastructure	Genset, transformer, panels	150-300 kVA | 400-600	Standard | Larger
Water & effluent	Treatment, storage, disposal	20-40 KLD | 60-90 KLD	Standard | Larger
Boundary & security	Wall, gate, weighbridge	2-4 acres | 4-6	Standard | Standard

Component sizes are indicative ranges for typical Indian projects. Specific sizing depends on cycle calendar, channel mix, climate zone, and operator preference. MushroomWale's DPR team finalises the BOQ at site survey stage.

PRINCIPLE

Integration is in the connections.

Each block above exists in a non-integrated operation too — but across different vendors, locations, and contracts. Integration is what happens when all of them sit on the same site, run on the same calendar, and report to the same operations head.

CONSIDERATION

The spawn lab decision.

At 500 kg/day, spawn can usually be sourced reliably from suppliers. At 1 TPD, volume and timing risk shifts the calculation — many operators bring spawn in-house. Decide before construction; retrofitting later is expensive.

19.4 CAPEX ANATOMY

What it actually costs, by component.

Indicative capex bands for fully integrated 500 kg/day and 1 TPD projects, ex-GST, excluding land. Land is typically 2-4 acres for 500 kg/day and 4-6 acres for 1 TPD; cost varies with location.

COMPONENT	500 KG/D BAND	1 TPD BAND	NOTES
Civil & PEB	Rs 40 L - 63 L	Rs 76 L - 1.2 Cr	Foundation, shell, drainage
PUF & insulation	Rs 34 L - 54 L	Rs 64 L - 1.0 Cr	80mm walls, 60mm partitions
HVAC & refrigeration	Rs 43 L - 63 L	Rs 80 L - 1.2 Cr	Daikin HMT class
Racks & fittings	Rs 17 L - 25 L	Rs 32 L - 48 L	GI 7-tier standard
Automation (Naayom)	Rs 12 L - 20 L	Rs 21 L - 37 L	Controllers + sensors
Compost facility	Rs 29 L - 50 L	Rs 60 L - 95 L	Phase 1 + Phase 2
Cold chain block	Rs 14 L - 25 L	Rs 32 L - 51 L	Pre-cool, storage, dispatch
Spawn lab	Optional	Rs 16 L - 27 L	Recommended at 1 TPD
Utilities & power	Rs 20 L - 34 L	Rs 41 L - 68 L	Genset, transformer
Working capital	Rs 17 L - 34 L	Rs 37 L - 75 L	2-3 months opex held aside
Contingency (8-12%)	Rs 14 L - 29 L	Rs 32 L - 60 L	Spec changes, vendor variations
Total band	Rs 1.9 - 3.2 Cr	Rs 3.6 - 5.8 Cr	Ex-GST, excluding land

Capex bands are indicative ranges across recent Indian projects. Specific configurations will land inside the band based on climate zone, soil and groundwater conditions, distance to main roads, and the operator's preference between value-spec and premium-spec components. The lower end is operationally sound but requires more operator discipline; the upper end carries the variability.

PRINCIPLE

Working capital is non-negotiable.

At this scale, two to three months of opex held aside is what keeps the project alive during the 6-12 month ramp. Banks fund capex, not working capital. Build it into the equity or arrange a separate cash credit facility before the first crop.

MISTAKE

Underbudgeted utilities.

Genset, transformer, panel boards, water treatment, effluent handling — these are easily 10-15 percent of capex and routinely underestimated in first-pass DPRs. Get vendor quotes for utilities before signing.

19.5 THE INTEGRATION ARGUMENTS

Five things integration is supposed to fix.

Five arguments commonly made for building integrated. Each is worth understanding on its merits; the counter-arguments appear on page 122. Decide based on your specific situation, not on the strength of either side in isolation.

PRINCIPLE

01. Compost capacity at scale.

Both standalone and integrated MushroomWale builds include in-house Phase 1+2 compost. At integrated scale, the compost facility is sized for overlapping cycles across multiple grow rooms.

PRINCIPLE

02. Margin capture across value chain.

A standalone operation captures growing margin only. An integrated operation can additionally capture cold-chain and branded-retail margin — typically improving realised price per kg.

PRINCIPLE

03. Operating cost characteristics.

Multi-room overlapping cycles spread fixed HVAC and supervisory cost. Shared cold storage and packing reduce per-kg overhead. Larger compost batches reduce per-tonne preparation cost.

PRINCIPLE

04. Bankability profile.

Banks generally find integrated projects easier to underwrite: clearer risk profile, more security, end-to-end traceability. Subsidy stacks can layer more easily on larger qualifying projects.

PRINCIPLE

05. Channel positioning.

At 500 kg/day and above, branded distribution and organised retail become feasible counterparties. Standalone tends to sell into wholesale mandi at standard prices.

PRINCIPLE

These are arguments, not conclusions.

Each argument has a counter on page 122. None is sufficient alone to justify the capex premium; whether they collectively justify it depends on the specific project, market, and operator.

19.6 STANDALONE VS INTEGRATED

Same daily output, different structure.

Side-by-side comparison of a standalone 500 kg/day multi-room operation and an integrated 500 kg/day facility producing the same daily output. The two models trade capex against operational structure; neither is universally correct.

DIMENSION what changes between the two models	STANDALONE 500 kg/day multi-room Rs 1.95 - 2.25 Cr	INTEGRATED 500 kg/day full facility Rs 1.9 - 3.2 Cr
Compost supply	In-house Phase 1+2 (small)	**In-house Phase 1+2 (large)**
Compost scale	1-2 tunnels, 2-3 cycles/mo	**3-6 tunnels, overlapping cycles**
Cold storage	Shared / leased	**Dedicated 2-3 chambers**
Spawn supply	Bought from supplier	**Optional in-house lab**
Channel access	Wholesale mandi typical	**Wholesale + branded retail**
Revenue at maturity	Rs 1.8-2.6 Cr/yr	**Rs 2.4-3.4 Cr/yr indicative**
Payback (with subsidy)	2-3 years	**2-3 years**
Operational risk	Compost timing tight	**End-to-end controlled at scale**
Bank underwriting	Standard ag-infra loan	**Larger composite project**
Branded retail access	Limited at this scale	**Feasible at this scale**
Five-year exit value	Asset depreciates	**Asset + brand together**

THE CAPEX-MARGIN TRADE

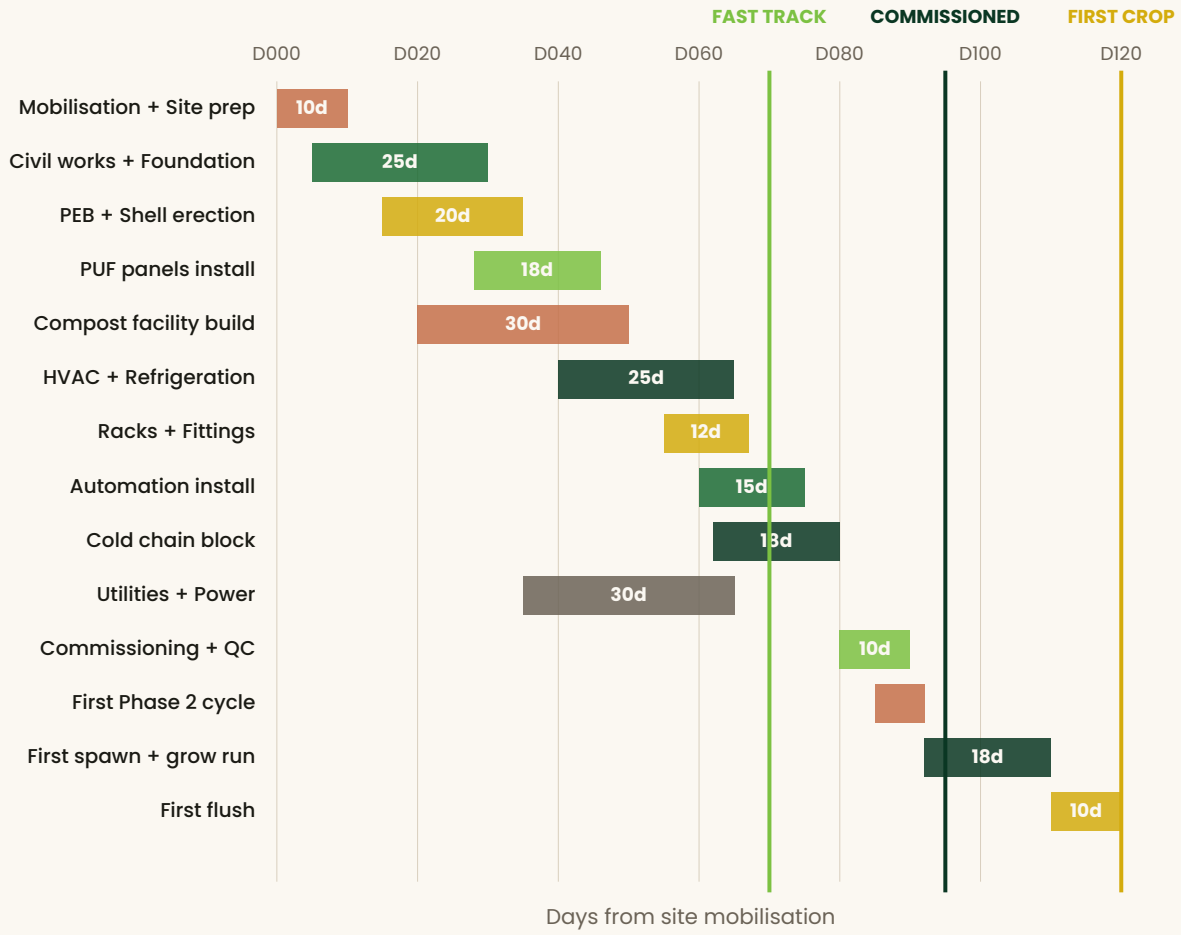
~40% more capex, ~30-50% revenue uplift.

The integrated model deploys more capital upfront. The revenue uplift comes from larger compost capacity, branded retail access, and dedicated cold chain — outcomes that depend on the operator successfully executing the larger model. The trade-off is real; the result is not automatic.

19.7 PHYSICAL BUILD TIMELINE

70 to 120 days from mobilisation to first crop.

Physical build and commissioning window — measured from site mobilisation, not from DPR start. Smaller and simpler projects complete near 70 days; larger and more complex integrated builds run closer to 120 days.



DETERMINANTS OF THE WINDOW

Size, scale, location, complexity shift the window.

70 days for single-room or duplicate-room dry-season builds. 120 days for full integrated 1 TPD in monsoon or remote locations. DPR and financing time is separate, upstream of this window.

19.8 THE HONEST TRADE-OFFS

What integration costs that standalone does not.

Reasons the integrated model is harder than its component parts suggest. None are blockers; all add to the project's risk and operating complexity. Reading these alongside the integration arguments on page 119 is the honest decision view.

MISTAKE

Larger capital, less flexibility.

Rs 1.9-5.8 crore deployed in a single asset. If the project underperforms, the operator cannot pivot easily. A smaller standalone facility lets you exit or pause at lower cost.

MISTAKE

Longer time to first revenue.

An integrated physical build takes 70-120 days from mobilisation to first crop, but DPR, sanction, and financing take additional time upstream. A single-room standalone is operational faster overall.

MISTAKE

Management depth required.

Integrated facilities need a CEO, ops head, compost manager, cold-chain manager. Owner-operator alone does not scale to 500 kg/day. Hiring this team is its own project.

MISTAKE

Higher labour requirement.

20-40 workers at 500 kg/day, 60-90 at 1 TPD. Wages, training, attrition, statutory compliance — all become serious operational considerations.

MISTAKE

Regulatory and compliance overhead.

Factory licence, pollution clearances, food safety, FSSAI, fire NOC, labour compliance, GST returns at scale. None are blockers; all require attention.

MISTAKE

Single-asset concentration.

Crore-scale capex tied to one location, one operator, one market region. A bad early year is harder to absorb than across a portfolio of smaller projects built sequentially.

19.9 EVALUATING AN EPC PARTNER

What to look for in any EPC at this scale.

An integrated 500 kg/day or 1 TPD build is too large to manage by hand. Most operators engage an EPC. These are the six things to verify in any EPC candidate, regardless of brand.

ENGINEERING REFERENCES

Built it before.

How many integrated mushroom facilities at 500 kg/day+ has the firm actually delivered? Ask for project addresses, dates, current operator references. Generic infra experience is not enough.

VENDOR DEPTH

Direct vendor relationships.

Daikin or equivalent HVAC, PUF supplier, GI rack fabricator, automation integrator — direct relationships at named-account level. Sub-contracted vendor stacks add cost and reduce accountability.

CONTRACTING MODEL

Single accountable contract.

One contract covering civil through commissioning, with acceptance criteria written in. Pricing surprises and scope gaps are the failure mode of multi-vendor builds at this scale.

OPERATING HANDOVER

Working system at day one.

SOPs, cycle calendars, QC records, sanitation protocols set up before handover. A built facility without operating systems is half a project. Ask to see a previous client's documentation.

DPR AND FINANCING

Bank-track-record DPRs.

Has the EPC's DPR team closed loans through SBI, PNB, BOI, NABARD at this scale? Ask for credit officer references. Generic templates close at much lower rates than bank-known formats.

AFTER HANDOVER

AMC, training, expansion path.

Annual maintenance for HVAC and automation; operator training through commissioning; structured expansion support. The EPC's value extends past handover or you are alone at year two.

IF YOU WANT TO TALK TO MUSHROOMWALE

Site visit and feasibility within two weeks of contact.

Call +91 75-7999-7333 or +91 84396-56800. Email info@mushroomwale.com. We visit the site, assess operational fit, and produce a bankable DPR within four to six weeks. No commitment required at site visit stage. Apply the same evaluation criteria above to us and to any other candidate.

19.10 CHAPTER SUMMARY

Six things to carry out of this guide.

01

Integration is a category change.

A 500 kg/day integrated facility is not a bigger single-room operation. It is a different asset, with different economics, different financing, and different management depth.

02

Capex bands: Rs 1.9–3.2 Cr or Rs 3.6–5.8 Cr.

500 kg/day integrated or 1 TPD integrated, ex-GST, excluding land and working capital. Final number lands inside the band based on site and spec preferences.

03

Five arguments in favour, six counter-considerations.

Compost scale, margin capture, opex, bankability, channel positioning argue for integration. Capital concentration, ramp time, management depth, labour, compliance, single-asset risk argue against. The decision is project-specific.

04

Physical build: 70 to 120 days.

Civil first, then PEB, then PUF and HVAC, then cold chain. Sequence matters. 70-day track is for fast-execution dry-season builds; 120-day window for full integrated 1 TPD or monsoon-impacted regions. DPR and financing time is upstream and separate.

05

Trade-offs are real, not theoretical.

Larger capital, longer ramp, deeper management, higher labour. All are real costs of the integrated route. Plan for them in advance or they become problems during execution.

06

Evaluate the EPC against the same six criteria.

References, vendor depth, contracting model, operating handover, DPR track record, after-handover support. The page 123 checklist applies to any EPC candidate, including MushroomWale.

UP NEXT / CHAPTER 20
Selling Mushroom — channels, pricing, and brand
Turn the page

CHAPTER

20

Selling Mushroom

Channels, pricing, and brand discipline

The crop pays for itself only if it gets to a buyer in spec, on time, and at the right channel. Selling is the second half of the business; this chapter is its operational map.

KEY NUMBER

Rs 100-300/kg

the realised price band across India for fresh button mushroom — operator's job is to land at the top of the band, not the middle

IN THIS CHAPTER

- Five buyer channels — wholesale, retail, modern trade, HoReCa, export
- Pricing dynamics by channel and grade
- Cold chain economics — what each extra hour costs
- Brand positioning at the small and mid-scale
- Building a customer base — direct sales and consignment
- When to refuse a deal — five red flags in buyer terms

20.1

The sale starts in the room, not at the gate.

What you pick, how you grade, how fast you cool, and how cleanly you pack determines the price band before any buyer is contacted. This chapter is operational — it covers what to do, not what to say.

Grade A button mushroom in India fetches Rs 200-300/kg in branded retail and modern trade. Grade B fetches Rs 100-150/kg in wholesale mandi. Grade C, where caps have opened or stems are tough, drops to Rs 50-80/kg and is taken by processors at best. The difference between Grade A and Grade B realisation is not biology — it is timing and cold chain discipline.

Most first-year operators lose 15-30 percent of potential realisation to channel mismatch, broken cold chain, or weak grading. The crop was there; the price was not. Recovering this margin is the single fastest improvement available to most farms — faster than improving yield, faster than reducing opex, and cheaper than scaling capacity.

Channels in order of price (high to low): branded retail with cold chain, modern trade chains, HoReCa direct supply, wholesale mandi, processors. Each has its own minimum volume, payment terms, rejection rules, and packaging standard. Working multiple channels spreads risk; chasing only the highest-price channel starves the farm of cashflow.

> *Yield is what you grow. Realisation is what you sell. They are not the same number.*
>
> — ON THE TWO METRICS

Yield is measured per square metre of bed. Realisation is measured per kg of crop sold. A 90 percent yield with 60 percent realisation pays less than a 75 percent yield with 90 percent realisation. Most operators track only the first.

20.2

How the rest of this chapter works

Next pages cover channels and their economics, then the grade ladder and what each grade actually means to a buyer, then negotiation patterns and red flags, then the brand question at small and mid scale.

None of this requires a marketing department. It requires discipline at the picking table, the packing line, and the phone. Build those three habits and the sales side of the business takes care of itself.

20.3 CHANNEL ECONOMICS

Five channels, five economic profiles.

Indicative pricing, volume, and payment terms across the five buyer channels for fresh button mushroom in India. Specific numbers vary by region, season, and operator relationship; ranges shown are typical at mid-scale (50-200 kg/day).

CHANNEL	INDICATIVE PRICE	MIN VOLUME / PAY TERMS	DISCIPLINE REQUIRED
Branded retail	Rs 200-300/kg	50+ kg/day, T+15 to T+30 payment	Cold chain, branded pack, grade A only
Modern trade chains	Rs 180-250/kg	100+ kg/day, T+30 payment	Listing fees, returns clause, cold logistics
HoReCa direct	Rs 150-220/kg	10-50 kg/day, T+7 to T+15	Daily delivery, consistent grade
Wholesale mandi	Rs 100-150/kg	Any volume, often cash on delivery	Single-grade lot, morning delivery
Processors (canned)	Rs 50-80/kg	Volume-based, T+45 to T+60	Grade C acceptable, bulk delivery

Price bands are indicative. Branded retail and modern trade carry listing fees, return clauses, and stricter rejection criteria — net realised price is often lower than gross. Wholesale mandi cash-on-delivery has hidden discount: buyers negotiate down at the gate based on visible quality. Processors take consistent lower-grade volume — a useful floor when flushes overlap.

PRINCIPLE

Run two channels minimum.

Single-channel exposure is fragile — one buyer's payment delay can stop the farm. Wholesale plus one branded outlet, or HoReCa plus mandi, gives revenue stability. The price-optimal mix shifts month to month; the resilience principle stays.

MISTAKE

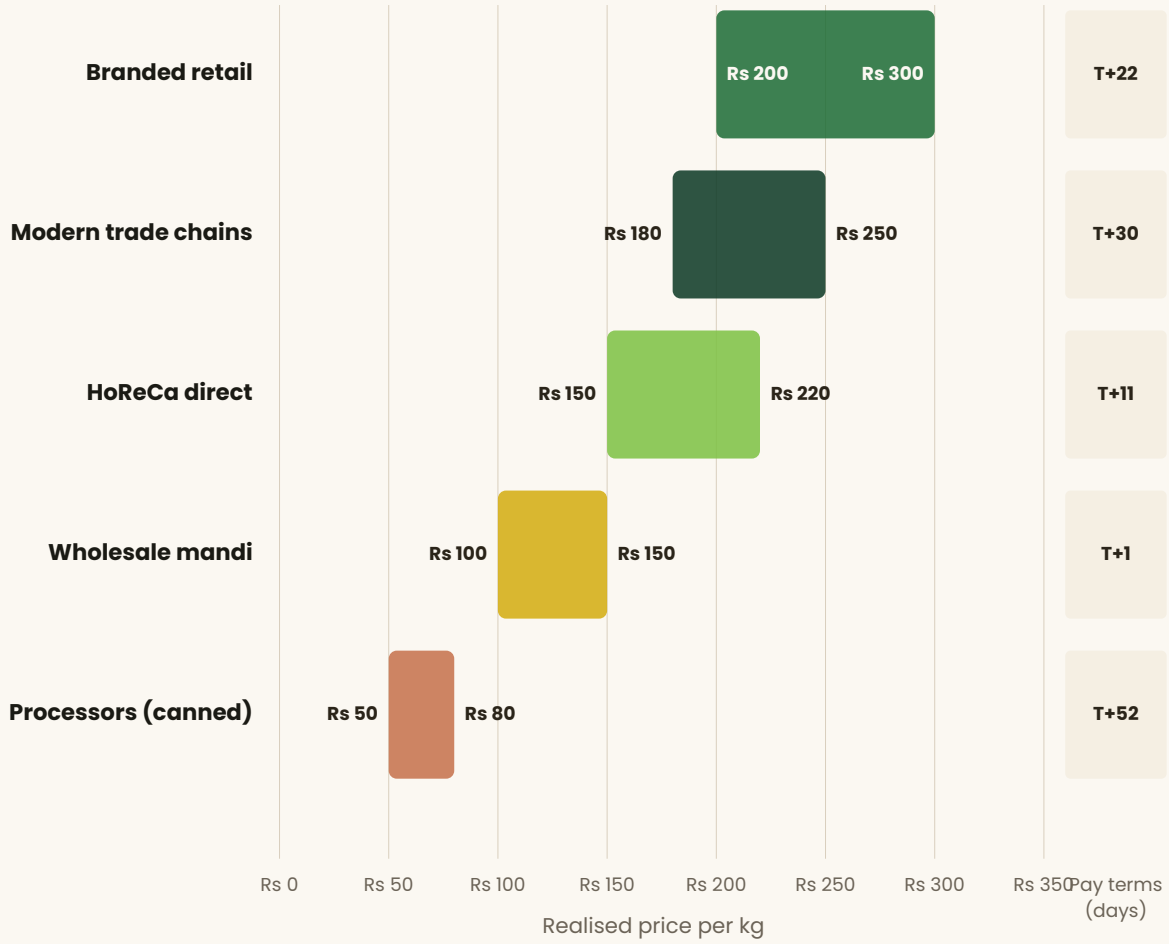
Chasing only top-price retail.

Listing in a branded chain looks attractive — Rs 250/kg headline. Reality: listing fees, slotting fees, weekly return windows, and 30-day payment cycles consume 20-30 percent of the gross. A balanced channel mix outperforms single-channel chasing at the same volume.

20.3.5 CHANNEL ECONOMICS, AT A GLANCE

Price band, payment day, and operator burden — visualised.

The same channel table on the previous page, in chart form. Bar shows realised price band; marker shows typical payment day; right-side label is the discipline the channel demands.



WHAT TO READ HERE

Higher price = longer payment + more discipline.

Branded retail pays Rs 200-300/kg on T+30 terms. Wholesale mandi pays Rs 100-150/kg same day. Working capital cost often eats the price premium. Match channel to cashflow, not price.

20.4 ANNUAL SALES CALENDAR

Which channel to push, in which month.

Mushroom demand and price in India varies by season. The same crop earns different rates depending on the month you sell it. This calendar shows where the demand sits at each point in the year — built for North India and adjustable for other regions.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Branded retail	HIGH	HIGH	HIGH	MED	LOW	LOW	LOW	LOW	MED	HIGH	HIGH	HIGH
Modern trade	HIGH	HIGH	MED	MED	LOW	LOW	LOW	LOW	MED	HIGH	HIGH	HIGH
HoReCa direct	MED	MED	HIGH	HIGH	MED	LOW	LOW	MED	HIGH	HIGH	MED	MED
Wholesale mandi	MED	MED	MED	HIGH	HIGH	HIGH	HIGH	HIGH	MED	MED	MED	MED
Processors	LOW	LOW	LOW	MED	HIGH	HIGH	HIGH	HIGH	MED	LOW	LOW	LOW

FOCUS INTENSITY — HIGH | MED | LOW | –

PATTERNS WORTH PLANNING AROUND

Winter peak: retail. Summer floor: processors.

Oct-Mar: retail and modern trade peak — wedding season, festival demand, cool months. Apr-Aug: heat and monsoon push fresh demand down; mandi takes surplus; processors absorb the rest.

20.5 NEGOTIATION PLAYBOOK

What buyers say, what to say back.

Real conversations operators face in price and term negotiations. Each buyer line on the left is something genuinely said in Indian mushroom trade; the operator response on the right is the position that protects margin without losing the relationship.

BUYER SAYS	YOU SAY
"Your price is too high, I can get mushroom at Rs 90."	*"At Rs 90 you are buying Grade B from a non-cold-chain supplier. My Grade A at cold chain is a different product."*
"I will take everything you produce — give me a discount."	*"Volume welcome, but I cannot run on single-buyer exposure. Agree a maximum percentage of weekly output; rate stays at the channel norm."*
"You missed yesterday's delivery — I will deduct from this lot."	*"A missed delivery is a breach on my side; we should discuss it. Deductions need agreed compensation rates set in advance, not unilateral cuts."*
"Your competitor is offering same quality at Rs 20 less."	*"If the quality is genuinely the same, that operation is not sustainable at that rate. Either the quality differs, or that supplier will not be there next year."*
"Payment in 60 days is industry standard, do not negotiate."	*"60 days is one standard; T+15 is another. If 60 days is firm, the price needs to reflect three months of working capital cost — in writing."*
"This lot does not meet our quality standard, return it."	*"Quality dispute means I inspect within 24 hours. Photos are not enough. If the dispute holds, we agree the cause; if not, we reissue and continue."*

20.6 THE GRADE LADDER

What each grade means to the buyer.

Grading at the picking table determines channel access and realised price. The classifications are not arbitrary — buyers in each channel reject below their grade and discount within their grade.

GRADE	CAP DIAMETER	VISUAL CRITERIA	CHANNEL FIT
Grade A — Extra	30-50 mm closed	Pure white, tight cap, clean stem cut, no spots	Branded retail, modern trade, premium HoReCa
Grade A	30-55 mm closed	White, closed cap, clean cut, minor stem variation	Branded retail, modern trade
Grade B	40-65 mm semi-open	Mild surface mark or single small spot	Wholesale mandi, HoReCa, secondary retail
Grade C	Any, opened	Veil broken, gills visible, stem tough or marked	Processors (canned, sliced, dried)
Reject	Any	Bruising, mould, insect, slimy, off-smell	Compost — never sold

Grading is done at the picking table, not at the packing line. Pickers should carry two collection trays — A and B — and drop into the right one as they pick. Sorting at packing is twice the labour and lets bruising spread. Reject mushroom goes back to the compost yard immediately, not into any sale lot.

PRINCIPLE

Pick early, pick often, pick clean.

Peak flush days require twice-daily picking — early morning and late afternoon. Caps open between picks; a Grade A at morning becomes a Grade B by evening. Discipline at picking saves more realisation than any negotiation later.

MISTAKE

Mixed-grade lots.

A single Grade B in a Grade A box is grounds for whole-box rejection at retail. The Rs 250/kg lot becomes Rs 100/kg overnight. Grade discipline at the table is the difference between channel access and channel loss.

20.7 RED FLAGS IN BUYER TERMS

Five ways a buyer deals quietly cost you money.

Buyers have written terms and unwritten terms. The written ones look reasonable; the unwritten ones consume margin. Recognising these five patterns saves operators from contracts that look profitable on paper and are not.

MISTAKE

Open-ended return windows.

Buyer takes the lot; if it doesn't sell by a stated date, the return is your problem. Either the date is tight enough to force you to refuse, or it is loose enough to be unusable for the buyer too. Pin it down.

MISTAKE

Variable pricing tied to mandi rate.

Buyer offers 'mandi rate plus 10 percent.' The buyer chooses which mandi and which day — typically the cheapest. Fix the rate per grade, weekly or monthly.

MISTAKE

60-day or 90-day payment cycles.

Standard for modern trade in India. Operator funds working capital across the gap. A Rs 5 lakh/month operation needs Rs 10-15 lakh just to bridge.

MISTAKE

Rejection without inspection right.

Lot rejected based on buyer's photos or quality team's notes. Always include the right to inspect rejected lots within 24 hours and dispute classification.

MISTAKE

Exclusive channel commitments.

Buyer demands operator does not sell to competing chains, paired with attractive headline price. Removes operator leverage in the next negotiation.

PRINCIPLE

When in doubt, ask 'who has the leverage?'

Read the contract from the buyer's side. If the buyer can change terms, delay payment, reject lots, or end the relationship without cost, you carry the risk.

20.8 CHAPTER SUMMARY

Six things to carry into the next chapter.

01

Realisation, not yield, pays bills.

A 75 percent yield with 90 percent realisation outearns 90 percent yield with 60 percent realisation. Track both metrics. Optimise the second one first.

02

Five channels, five economic profiles.

Branded retail through processors. Each has price, volume, terms, and discipline requirements. Mix at least two; never run on one channel alone.

03

Grade at the table, not the line.

Pickers carry two trays. A goes to A, B goes to B, anything wrong goes to compost. Sorting after the fact is twice the labour and spreads damage.

04

Cold chain is part of the sale.

Field heat to 2-4°C within 30 minutes. Cold transport to point of delivery. Break the chain and Grade A becomes Grade B in transit — same crop, half the price.

05

Buyer terms have written and unwritten parts.

Read for who carries return risk, who funds working capital, who controls inspection, who has the right to exit. The unwritten side usually puts the operator in the weaker position.

06

Refusing a deal is a strategy.

Headline-attractive contracts that lock the operator into single-channel exposure or unwinnable terms cost more than they pay. Saying no preserves leverage for the next round.

UP NEXT / CHAPTER 21
Marketing MushroomWale — how we present
Turn the page

CHAPTER

21

Marketing MushroomWale

How this company presents its work

If selling mushroom is operator discipline, selling EPC capability is institutional discipline. This chapter is about how MushroomWale presents what it does — short, honest, no bigger than it needs to be.

KEY NUMBER

Project, not product

what MushroomWale actually sells — turnkey integrated mushroom infrastructure built once, properly, against agreed acceptance criteria

IN THIS CHAPTER

- Who MushroomWale builds for
- What the engagement actually involves
- How we price, and what we do not charge for
- References, recent work, and verification

21.1

We build mushroom facilities, not mushroom companies.

MushroomWale is an EPC firm. We design, procure, construct, and commission climate-controlled mushroom infrastructure. We do not operate the facility; that is the operator's job. Knowing the line matters.

Where MushroomWale fits is the engineering, procurement, and construction of a working mushroom facility — from initial site survey through commissioned operating rooms producing the first crop. Single-room standalone builds, multi-room standalone expansions, and integrated 500 kg/day to 1 TPD greenfield facilities are the three project shapes we handle.

Project shape varies; the engagement shape is consistent. Site survey and feasibility within two weeks of contact. Bankable DPR in four to six weeks. Construction and commissioning in 70 to 120 days from site mobilisation, depending on size, scale, location, and complexity. Documented handover with SOPs, cycle calendars, and AMC plans in place.

We do not run the operation after handover. We provide AMC for HVAC, automation, and sensors; we provide expansion support when the operator scales up. The day-to-day picking, packing, channel relationships, and cycle discipline belong to the operator. This split is intentional; institutional EPC firms that also operate facilities have conflicts neither side wins.

> *The work is one project at a time. The discipline is the same every time.*
>
> — ON HOW WE WORK

Every project is unique — site, climate, operator team, market access, financing structure. The engineering principles that produce a working facility are not unique; they are the same set applied to each set of project-specific constraints. Consistency comes from the principles, not from forcing every project into the same template.

21.2

What we are good at

Integrated facility design where component selection and sequencing decisions interact across disciplines. Bankable DPR writing that closes with major Indian banks at first or second version. Vendor relationships at named-account level.

What we are not is a builder of single-room hobby facilities. Below 30 kg/day, the project does not need an EPC. We say so.

21.3 HOW WE PRICE

What the contract actually contains.

EPC pricing is the most opaque part of the industry. MushroomWale's pricing principles are stated here, in advance, so the operator can compare like-for-like with any other candidate.

PRINCIPLE

Fixed-scope, fixed-price.

BOQ-based pricing locked at contract sign. Material price escalation absorbed by us, not passed on. Scope changes — operator-requested additions — are priced at agreed rate cards from the same BOQ.

PRINCIPLE

Civil works as client scope.

Foundation, drainage, road work, boundary, gate, security — delivered by client's local contractor. We design and supervise; we do not mark up civil work.

PRINCIPLE

GST as billed.

Intrastate UP: CGST 9% + SGST 9%. Interstate: IGST 18%. Some Naayom items at 5% GST. Itemised on the BOQ; never bundled into one tax line.

PRINCIPLE

Transport at actuals.

Cooling equipment, PUF panels, racks ship to site. Transport billed at actuals against carrier invoices, not a notional percentage. Saves 30-50 percent versus bundled freight.

PRINCIPLE

Payment terms.

50 percent advance, 40 percent on dispatch milestones, 10 percent on installation. No retention beyond installation. We do not ask operators to fund our working capital.

MISTAKE

What we do not charge for.

DPR consultation. Initial site visit. Vendor coordination calls. Three rounds of design iteration. Banking liaison through sanction. Part of the engagement, not separate billables.

21.4 CHAPTER SUMMARY

Four things to know about working with us.

01

EPC, not operator.

Design, procure, build, commission, hand over with documented operating systems. After that, the operator runs the facility. We provide AMC and expansion support; we do not run cycles.

02

Three project shapes.

Single-room standalone (limited engagement). Multi-room standalone expansion. Integrated 500 kg/day to 1 TPD greenfield. The third is where we add the most value.

03

Fixed-scope, fixed-price, no escalation.

BOQ-based pricing locked at contract. Scope changes priced from same rate cards. Material price risk on us, not on the operator.

04

70 to 120 days from mobilisation.

Physical build plus commissioning. DPR and financing are upstream and separate. Size, scale, location, complexity shift the specific window.

UP NEXT / CHAPTER 22
Why MushroomWale — references and credentials
Turn the page

CHAPTER

22

Why MushroomWale

References, recent work, credentials

Choose an EPC partner the same way you would choose any other counterparty: references, track record, transparent terms. This chapter answers the verifiable questions.

KEY NUMBER

Since 2018

the operating history of Agrimotion Engineering Pvt Ltd, trading as MushroomWale across India

IN THIS CHAPTER

- Company structure, registration, and operating history
- Project track record by scale and region
- Vendor and partner relationships
- How to verify everything in this section

22.1

The company, in verifiable terms.

Everything below can be confirmed against MCA records, GST portal, bank verification, and site visits to completed projects. Take the time to verify before commercial commitment.

MushroomWale is the trading identity of Agrimotion Engineering Private Limited, a company incorporated in India and registered for GST under number 09AAZCA0158R1ZP. The registered office is at 91 Aroan Road, ByPass NH19, opposite Praveen Resort, Sirsaganj, Firozabad, UP 283151.

The company was established in 2018 and has focused on climate-controlled mushroom infrastructure since the first project. Banking is through Axis Bank, Shikohabad/Firozabad branch — account 920020058426613, IFSC UTIB0001801. The company files quarterly GST returns and annual income tax returns; both are verifiable through the public MCA portal and GST search facility.

Key personnel: Mahendra Pal Singh (Director, Sales) and Chirag Deep Singh (Program Head and Partner). Direct phone numbers for both are published on every page of this document and on the company website. We do not use intermediaries or agency channels for first-line client contact.

> *Verify everything. The company that asks you to verify is usually the company you can.*
>
> — ON DUE DILIGENCE

Any EPC engagement at integrated scale runs into eight figures of capex. Investing two weeks in due diligence — MCA search, GST verification, site visits to two or three completed projects, credit officer references at named banks — is a small price against the capex commitment.

22.2

What this chapter contains

Next page covers project track record by scale and region. After that, the partner and vendor relationships we rely on. Final page is contact information and how to start the engagement — including a published bar on what we will not agree to.

All of it can be independently verified. None of it relies on the operator taking our word. That is the standard we hold ourselves to and the standard we suggest you apply to any EPC candidate you evaluate.

22.3 TRACK RECORD AND PARTNERSHIPS

What we have built, and who we build it with.

Project track record is summarised by scale band rather than client name to respect client confidentiality. Specific references — operator name, location, project details — are provided on request and can be visited before commercial commitment.

PRINCIPLE

Single-room standalone projects.

Multiple projects across UP, Punjab, Haryana, Maharashtra, Karnataka. 18×40 ft format with 50 kg/day output is the most common configuration. References and site visits arranged on request.

PRINCIPLE

Multi-room standalone expansions.

Projects ranging from 2-room (100 kg/day) to 6-room (300 kg/day) overlapping-cycle facilities. Site visits to running operations available across multiple regions.

PRINCIPLE

Integrated 500 kg/day projects.

Greenfield builds with in-house Phase 1+2 compost, multi-room growing block, dedicated cold chain. Reference projects with operator permission for prospective client site visits.

PRINCIPLE

Vendor relationships at named-account level.

Daikin (HVAC), established PUF panel manufacturers, GI rack fabricators, Naayom Tech (automation). Direct relationships, not sub-contracted. Pricing and delivery hold.

PRINCIPLE

DPR closures through major Indian banks.

Sanction track record with SBI, PNB, BOI, NABARD subsidy schemes. Credit officer references available; ask for them before commercial commitment.

PRINCIPLE

Singapore office for international engagements.

72 Anson Road, #11-01B, Anson House, Singapore. International clients exploring Indian mushroom infrastructure engage through the Singapore entity.

22.4 HOW TO START

Four steps from contact to feasibility.

01

Call or email.

Phone +91 75-7999-7333 or +91 84396-56800. Email info@mushroomwale.com. Initial conversation is no-commitment; we discuss the operator's situation, scale ambition, and project shape.

02

Site visit within two weeks.

One of the partners visits the proposed site, assesses location, soil, water, power, and access. Operator pays site visit travel; everything else in the initial engagement is at our cost.

03

Bankable DPR in four to six weeks.

If the project is viable, MushroomWale produces a DPR built to bank credit officer specifications. Conservative ramp, full opex, DSCR above 1.4, subsidy stacks identified by name. No commitment required at this stage.

04

What we will not agree to.

Projects pitched as get-rich-quick schemes. Operators with no prior agricultural or industrial operating experience and no plan to acquire it. Buyers who refuse to verify the company. We say no and explain why.

UP NEXT / CLOSING
About MushroomWale — brand, company, colophon Turn the page

ABOUT

MushroomWale.

The Mushrooming Expert.

MushroomWale is the brand under which Agrimotion Engineering Private Limited delivers turnkey climate-controlled mushroom farms across India. Engineering, procurement, construction — from site survey through commissioned operating rooms producing the first crop.

The company exists because mushroom cultivation in India sits awkwardly between two domains: agriculture and light industrial infrastructure. Most agricultural EPC contractors do not understand climate-controlled cultivation. Most industrial contractors do not understand the biological constraints of a button mushroom crop. MushroomWale sits at the intersection — engineering discipline applied to a biological process.

The work is one project at a time, on operator land, with operator people, against operator-set economics. A 50 kg/day single-room facility in Punjab. A 200 kg/day multi-room operation in Maharashtra. A regional 500 kg/day build in Uttar Pradesh. Same engineering standards, same biological respect, same commitment to a working facility at handover.

This guide is part of the work. Mushroom cultivation in India has more would-be operators than experienced ones. The asymmetry of information is the largest single cost of entry. Documenting the decisions, the trade-offs, the patterns of failure and the patterns of success is the cheapest thing MushroomWale can offer to the operators of the next decade — and the most useful.

Built one project at a time, since the first one.

mushroomwale.com

THE COMPANY

Agrimotion Engineering Private Limited.

The legal entity behind the MushroomWale brand. Incorporated in India; operating across multiple states; banked through Axis Bank; GST-compliant for B2B engagements.

LEGAL & FINANCIAL

ENTITY	Agrimotion Engineering Pvt Ltd
BRAND	MushroomWale™
TAGLINE	The Mushrooming Expert™
GSTIN	09AAZCA0158R1ZP
PAN	AAZCA0158R
BANK	Axis Bank, Shikohabad branch
ACCOUNT	920020058426613 (Current)
IFSC	UTIB0001801

REACH US

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KEY PERSONNEL

Chirag Deep Singh Program Head, Partner
Project execution, technical specification, client delivery

Mahendra Pal Singh Director, Partner (Sales)
Commercial relationships, regional partnerships

Engineering discipline applied to a biological process.

COLOPHON

How this guide was built.

Production notes for the Button Mushroom Grower's Guide. Fonts, tools, and acknowledgements for what went into the deliverable you are reading.

TYPOGRAPHY

Body	Lora (Cyreal) — serif typeface designed for extended reading.
Display & UI	Poppins (Indian Type Foundry) — geometric sans-serif.
Accents	Lora Italic for pull quotes and brand voice.

TOOLS

PDF generation	Python 3 with ReportLab canvas API.
Visual QA	pdftoppm at 100-130 DPI per page.
Illustrations	Custom ReportLab path drawing throughout.
Logo processing	PIL/NumPy for transparent overlay handling.

CONTENT DISCIPLINE

Verified data	Capex bands, environmental envelopes, room dimensions, and Naayom pricing drawn from MushroomWale's project archive.
Industry standard	Pest pathogens, flush distributions, refrigeration specifications drawn from published commercial production literature.
Where uncertain	Framed as principle, not as specific number. Flagged as 'indicative.'

WHAT THIS IS NOT

Not a DPR	Project-specific economics require site-specific underwriting.
Not legal advice	Regulatory references should be verified at the project's current date.
Not the field	Reading about cycle one is not the same as running it.

Now go build something.

— MushroomWale, Sirsaganj

CHAPTER

23

Glossary & Reference

Terms and standard conversions

Knowing the language is the precondition to using the guide. These pages are the index, not the chapter.

KEY NUMBER

Reference

the technical vocabulary used across this guide, condensed for quick lookup

IN THIS CHAPTER

- Technical terms in plain language
- Conversions and standard specifications
- Where to look things up that change year to year

23.1 GLOSSARY

Technical terms, in one place.

Terms used in commercial button mushroom cultivation and related infrastructure.

Agaricus bisporus
Button mushroom species — white, off-white, brown variants.

AHU
Air Handling Unit. Cooling and ventilation component.

AMC
Annual Maintenance Contract.

BOQ
Bill of Quantities — itemised materials and equipment.

Casing
Soil layer on colonised compost, triggers fruiting. 4-5 cm peat or FYM.

CIB&RC
Central Insecticides Board — regulates pesticide use.

Cold chain
Continuous refrigeration from picking to retail, 2-4 °C.

Compost
Engineered substrate: straw, manure, gypsum, urea, ~75% water.

Conditioning
Phase 2 stage: 48-52 °C, 4-5 days. Converts ammonia.

CO2
Carbon dioxide. Spawn run 5,000-15,000 ppm; cropping 800-1,200 ppm.

Cropping
Pinning trigger to last harvest. 28-32 days.

Daikin HMT
High Ambient Temperature refrigeration, sized for Indian summer.

DPR
Detailed Project Report. Bankable document for loan and subsidy.

DSCR
Debt Service Coverage Ratio. Banks require above 1.4.

EPC
Engineering, Procurement, Construction — turnkey contract model.

Flush
A wave of fruiting. Four typical: 35-40% / 25-30% / 15-20% / 10-15%.

FYM
Farmyard manure — composted cattle manure.

HMT
High Ambient Temperature refrigeration class.

HVAC
Heating, Ventilation, Air Conditioning.

MIDH
Mission for Integrated Development of Horticulture — state scheme.

Mycelium
Vegetative fungal body — white threads colonising compost.

NABARD
National Bank for Agriculture and Rural Development — credit-linked subsidies.

Naayom
Indian automation supplier — NWC 1000, NWC 2000 controllers.

NHB
National Horticulture Board — post-harvest infrastructure schemes.

Pasteurisation
Phase 2 stage: 58 °C, 8 hours. Kills pests and pathogens.

PEB
Pre-Engineered Building — factory-fabricated structural shell.

Phase 1 / Phase 2
Compost prep stages. Phase 1: 12-16 days outdoors. Phase 2: 7 days indoors.

Pinning
Environmental shift triggering pinhead formation.

PMEGP
Prime Minister's Employment Generation Programme — KVIC scheme.

PPGL
Pre-Painted Galvalume — steel sheet finish on PUF panels.

Pre-cooling
Forced-air cooling within 30 minutes of picking.

PUF
Polyurethane Foam panels. 80mm walls, 60mm partitions, 80-110mm roof.

R32 / R404A
Refrigerants. R32 standard; R404A being phased out.

RH
Relative Humidity. 85-95% across most stages.

Sciarid
Lycoriella species — most economically significant insect pest.

Spawn
Mycelium on sterile grain — used to inoculate compost.

Spawn run
Mycelium colonisation. 14-16 days, 23-25 °C.

TR
Ton of Refrigeration. 1 TR = 3.517 kW.

Trichoderma
Green mould — most common fungal competitor.

Wholesale gate
Farm-gate bulk price — Rs 100-150/kg typical.

23.2 CONVERSIONS & STANDARDS

Reference values, for quick lookup.

Conversions and standard specifications used throughout this guide.

Temperature
1 °C = 1.8 °F. Spawn run 23-25 °C, pinning 17-18 °C, cropping 16-18 °C.

Length
1 foot = 304.8 mm. Standard rooms 18×30, 18×40, 18×60, 18×70 ft.

Area
1 sqm = 10.764 sqft. Room areas 540 / 720 / 1080 / 1260 sqft.

Mass
1 quintal = 100 kg. 1 tonne = 1000 kg. Bag: 18-22 kg compost.

Indian numbering
1 lakh = 100,000. 1 crore = 10,000,000.

TR to kW
1 TR = 3.517 kW. 18×30 = 5 TR. 18×40 = 7 TR. 18×60 = 9 TR. 18×70 = 12 TR.

PUF density
40 kg/m³. Walls 80mm, partitions 60mm, roof 80-110mm by climate.

CO2
Ambient ~400-500 ppm. Spawn run 5,000-15,000 ppm. Cropping 800-1,200 ppm.

Cycle calendar
Phase 1: 12-16d. Phase 2: 7d. Spawn run: 14-16d. Casing: 7-8d. Cropping: 28-32d.

Flush distribution
1st: 35-40%. 2nd: 25-30%. 3rd: 15-20%. 4th: 10-15%.

Grade pricing (indicative)
A: Rs 200-300/kg retail. B: Rs 100-150/kg wholesale. C: Rs 50-80/kg.

GST classification
Fresh: 0% (NIL). Processed/canned: 5% or 12%.

Project timelines
DPR 3-5 weeks. Sanction 4-10 weeks. Physical build 70-120 days.

Integrated capex bands
500 kg/d: Rs 1.9-3.2 Cr. 1 TPD: Rs 3.6-5.8 Cr. Ex-GST, ex-land.

Standalone capex bands
500 kg/d multi-room: Rs 1.95-2.25 Cr. 1 TPD: Rs 3.85-4.50 Cr.