



TECHNICAL SPECIFICATION

GSO Hot Chili Plot Production System

Expandable 20 m × 20 m Netted Plots with Solar Drip Irrigation for the Phnom Samkos Wildlife Sanctuary

Prepared for

GLOBAL STUDENT OUTREACH

*Food Security • Sustainable Livelihoods • Forest & Wildlife Protection • Climate Resilience — Rural
Cambodia*

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Target Cost per 20 m × 20 m Module: USD \$1,000–\$2,950 (tier-dependent)

1. Executive Summary

This specification defines an expandable open-field hot chili (*Capsicum annuum* / *C. frutescens*) production system for Global Student Outreach (GSO) community sites in and around the Phnom Samkos Wildlife Sanctuary, Cardamom Mountains, western Cambodia. The base unit is a 20 m × 20 m (400 m²) plot module, designed to be replicated side-by-side as additional households join the program, sharing a common irrigation backbone.

Each module combines an overhead shade net canopy (silver reflective or green, on a post-and-wire grid rather than an enclosed structure), a sustainable ground cover system that explicitly avoids thin black plastic film, drip irrigation fed by an elevated water tank, a solar-powered water pump, and a small shaded nursery for planting-tray seedling production.

The design responds to three climate realities of Phnom Samkos: (1) intense dry-season heat and solar radiation (Feb–Apr) that causes flower and fruit drop in unshaded chili; (2) 3,000–4,000 mm of monsoon rainfall (May–Oct) that waterlogs unmulched or plastic-covered beds and drives fungal disease; and (3) off-grid, low-infrastructure sites where irrigation must run without grid power.

This document covers site layout and expandability, shade net selection (with research-based silver-vs-green guidance), ground cover options, water storage, drip irrigation design, solar pump sizing, nursery/planting-tray production, variety selection, the Cambodia seasonal planting calendar, a full bill of materials across three cost tiers, expected yields, and current Cambodian chili market values.

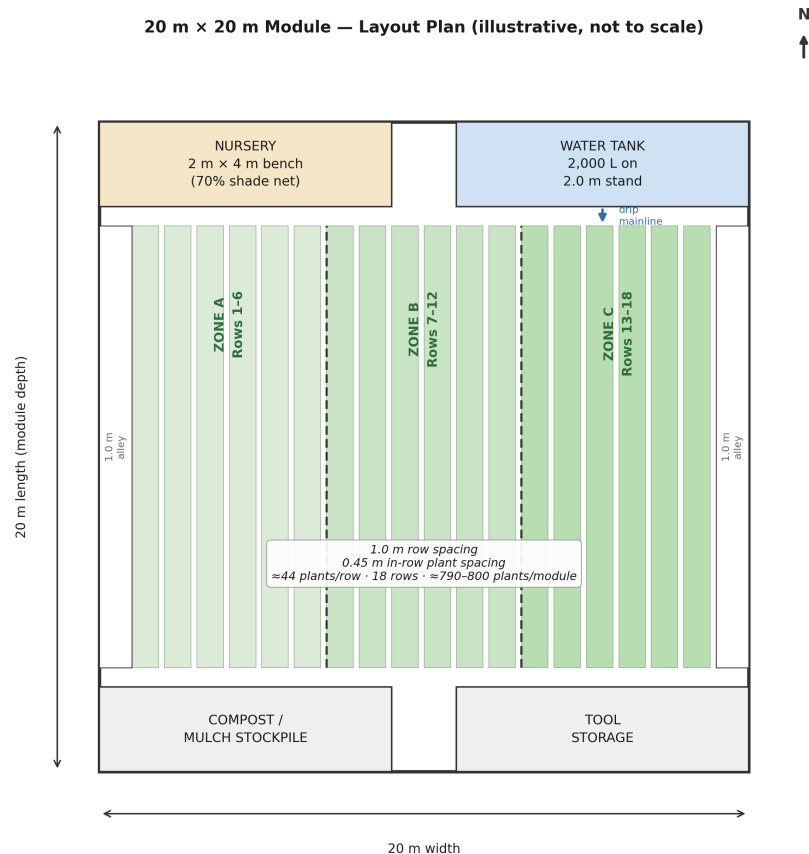
2. System Overview — Key Design Parameters

Parameter	Specification	Notes
Module footprint	20 m × 20 m = 400 m ² gross	≈340–360 m ² net planted area after 1.0 m access alleys
Expansion model	Modular — add 20 m × 20 m blocks side by side	Shared mainline, tank, and pump backbone sized with headroom for 3–4 modules
Row layout	18 rows @ 1.0 m spacing, 20 m long; 0.45 m in-row plant spacing	≈44 plants/row → ≈790–800 plants per module
Shade cover	30–40% shade, silver (aluminet-type) reflective net recommended; green net as budget/expansion option	Overhead post-and-wire grid at 2.3–2.5 m; sides open for airflow — not an enclosed house
Ground cover	Rice straw mulch (primary) ± woven UV-stabilized ground cover fabric (upgrade); no thin black plastic film	Locally abundant, biodegradable, avoids monsoon runoff and heat-stress failure modes of plastic film
Irrigation	Drip tape, 3 zones of 6 rows each, run sequentially	≈360 m tape/module; 16 mm inline tape, 1.6 L/h emitters @ 30 cm
Water storage	2,000 L elevated tank per module (5,000 L shared header tank at 3+ modules)	Stand elevation 2.0 m for gravity drip pressure
Water source & pump	Solar DC submersible/surface pump, 300–500 W panel	Sized for stream, pond, hand-dug well, or shallow borehole source
Nursery	2 m × 4 m shaded bench, 70% shade net, 128-cell planting trays	Succession seedling production for continuous cropping
Budget	\$1,000–\$2,950 per module (see Section 14 tiers)	Materials, hardware, tank, pump, and community labor

3. Site Layout & Expandability

3.1 Single-Module Layout (20 m × 20 m)

Each module is oriented with its 20 m rows running north–south where terrain allows, maximizing even light distribution under the net through the day and simplifying drip mainline routing along the shorter east or west edge.



3.2 Expansion Path

The module is deliberately designed so the water backbone — tank, pump, and mainline — is sized larger than a single module needs. This lets GSO add capacity without re-engineering the water system each time:

Stage	Modules	Planted Area	Shared Infrastructure Added
Pilot	1	≈360 m ²	Full backbone: tank, pump, mainline, nursery
Expansion 1	2	≈720 m ²	Second net canopy + drip zones; tap into existing mainline
Expansion 2	3	≈1,080 m ²	Upgrade to 5,000 L shared header tank; verify pump daily output covers all 3
Expansion 3	4	≈1,440 m ²	Second pump or larger panel array if source/TDH requires it; second nursery bench

Field note: exact module count per site depends on available flat land, water source yield, and household labor. Validate land and water availability before committing to Expansion 2+.

4. Shade Netting System

4.1 Silver vs. Green — Research-Based Selection

Shade net color is not just an aesthetic choice — it changes light spectrum, canopy temperature, and pest pressure. For hot chili in a high-heat, high-pest-pressure tropical climate like Phnom Samkos, the research supports silver (aluminized/reflective) net as the stronger default, with green net as a valid lower-cost alternative:

Net Type	Shade Factor	Effect on Heat	Effect on Pests	Relative Cost
Silver / aluminet (reflective)	30–50%	Reflects infrared; measurably cooler canopy than black or green net	Reflective/UV-scattering surface disorients and repels thrips, aphids, and whitefly — documented reductions of ~50% or more in whitefly penetration in pepper trials	Highest (~\$0.40–0.55/m ²)
Green (standard shade cloth)	40–50%	Filters light similarly to natural canopy; moderate cooling	No reflective pest-deterrent effect; relies on physical shade + biological control	Lower (~\$0.20–0.30/m ²)
Black (for reference — not recommended as primary)	30–50%	Absorbs heat; can run hotter than silver or white under full sun	No pest-deterrent effect	Lowest (~\$0.15–0.25/m ²)

GSO Recommendation: use silver/aluminet net (30–40% shade) for the pilot module and for any module in a known thrips/aphid/whitefly pressure zone. Where budget is the binding constraint, green net at 40% is an acceptable substitute — plan to pair it with the biological pest controls in Section 12 to compensate for the missing reflective deterrent.

4.2 Structure — Open Post-and-Wire Grid

Unlike an enclosed shade house, the chili plot canopy is an open-sided overhead net on a post grid, chosen to maximize airflow during the monsoon and to keep material cost per m² low across a 400 m² module.

Component	Specification	Qty	Unit Cost	Total
Perimeter/anchor posts	Treated hardwood, 12–15 cm dia, 3.0 m (angled, guy-wired)	16	\$7	\$112
Interior grid posts	Treated hardwood, 10 cm dia, 3.0 m, on 4 m grid	20	\$6	\$120

Component	Specification	Qty	Unit Cost	Total
Overhead wire grid	3 mm galvanized cable, tensioned both directions	1 set	\$70	\$70
Turnbuckles & anchors	Galvanized, for perimeter tensioning	16	\$3	\$48
Shade net — silver 30–40%	450 m ² (400 m ² + edge allowance)	450 m ²	\$0.48	\$216
— OR green net 40%	450 m ² (budget alternative)	450 m ²	\$0.25	\$113
Net clips / cable ties / hemming	UV-stabilized fasteners	1 set	\$25	\$25

Subtotal (silver net): ≈\$591. Subtotal (green net): ≈\$488. Height of 2.3–2.5 m at the post gives standing access for harvest and staking; net can be raised on the wire grid to full tension in the dry season and loosened at the edges during peak monsoon downpours to shed water and reduce wind loading.

5. Sustainable Ground Cover — No Black Plastic

Thin black polyethylene film is common in commercial vegetable production because it is cheap and suppresses weeds, but it performs poorly in the Phnom Samkos context: it degrades within a single wet season under intense UV and monsoon abrasion, contributes no organic matter, sheds water off pre-cut planting holes instead of infiltrating it (worsening runoff on sloped sanctuary land), and leaves microplastic residue in food-growing soil. Independent trials also show it can push soil temperatures high enough to stress roots in already-hot climates, and it costs \$250–300/acre with added disposal cost even where it is used. This design avoids it entirely.

5.1 Primary Ground Cover — Rice Straw Mulch

Attribute	Detail
Source	Local paddy rice straw, abundant and typically free or very low cost near Phnom Samkos rice-growing villages
Application depth	75–100 mm layer over the root zone, kept 5 cm clear of the stem
Function	Suppresses weeds, moderates soil temperature in both directions, conserves moisture between drip cycles, breaks down into organic matter and soil carbon
Replenishment	Top up at mid-season and after any period of heavy trampling or wash-out; full field re-mulch each new planting cycle
Cost (per 360 m ² planted area)	\$15–\$25 (transport/labor only if straw is sourced free from harvest waste)

5.2 Upgrade Ground Cover — Woven UV-Stabilized Fabric

Where labor to re-mulch is a binding constraint, a heavier woven ground cover fabric (not thin film) is a reasonable paid upgrade: 100–120 gsm woven polypropylene, UV-stabilized, silver- or black-faced, reusable across 3–5 seasons, and porous enough to let water and air through rather than shedding it.

Component	Specification	Qty	Unit Cost	Total
Woven ground cover fabric	100–120 gsm UV-stabilized, silver-faced, 1.2 m width rolls	360 m ²	\$0.75	\$270
Landscape staples/pins	150 mm galvanized U-pins	150	\$0.08	\$12
Planting-hole burner or punch	Shared tool, reused across modules	1	\$15	\$15

GSO Recommendation: rice straw mulch is the default for every module — it is the lowest-cost, most soil-building option and matches the sanctuary's zero-synthetic-input goals. Add woven fabric under the straw only in high-erosion or high-labor-scarcity plots, and never substitute thin black plastic film for either.

5.3 Living Mulch / Companion Ground Cover (Optional)

A low, spreading legume cover (e.g., mung bean or cowpea living mulch) can be inter-sown in access alleys between drip zones. This is optional, near-zero cost, and adds nitrogen fixation and pollinator forage without competing for drip water if kept to the alleys rather than the chili row itself.

6. Water Supply & Storage

6.1 Water Source Options

Source	Suitability	Notes
Spring / stream	Excellent	Gravity-fed to tank if source is above tank elevation; otherwise pumped
Hand-dug well	Good	Typical yield sufficient for one module; confirm dry-season yield before committing to 3+ modules
Pond / reservoir	Good	Requires floating or submersible intake with foot valve/strainer
Rainwater catchment	Supplementary	Roof catchment from nearby structures into the same tank; useful buffer in shoulder seasons
River (sanctuary)	Fair	Must be filtered; avoid during flood turbidity events

6.2 Water Demand

Mature hot chili under drip irrigation uses roughly 1.0–1.5 L/plant/day at peak dry-season demand (Feb–Apr). At ~800 plants/module, that is approximately 800–1,200 L/day/module in the peak dry season, dropping to 300–600 L/day supplemental demand during the monsoon when rainfall covers most requirements.

6.3 Water Tank

Component	Specification	Qty	Unit Cost	Total
Water tank	2,000 L HDPE/polyethylene tank	1	\$180	\$180
Elevated stand	Steel or concrete-block stand, 2.0 m platform height	1	\$110	\$110
Inlet float valve	Prevents overflow during pump fill cycles	1	\$8	\$8
Outlet fittings & shutoff	25 mm PVC bulkhead, ball valve, screen filter at outlet	1 set	\$22	\$22

At 800–1,200 L/day peak demand, a 2,000 L tank provides roughly 1.5–2 days of buffer, enough to smooth over a cloudy day that limits solar pump output. At the 3-module expansion stage, replace with a shared 5,000 L header tank (~\$340–380) rather than three separate small tanks — this is cheaper per liter and simplifies pump plumbing.

Tank stand elevation of 2.0 m provides enough gravity head to run the drip zones at usable pressure without a second pressure pump, provided drip tape and filtration are sized correctly (Section 7).

7. Drip Irrigation System

7.1 Design Basis

18 rows of 20 m each (360 m of drip tape per module) are split into 3 irrigation zones of 6 rows, run sequentially rather than simultaneously. This keeps the flow demand within what a 2.0 m gravity head or

a small solar-pump-charged system can deliver, and matches typical smallholder drip kit valve/filter sizing.

Parameter	Value	Basis
Drip tape	16 mm inline, 1.6 L/h emitters @ 30 cm spacing	Standard smallholder drip tape spec
Emitters per row	≈67 (20 m row ÷ 0.30 m)	—
Flow per row	≈107 L/h	67 emitters × 1.6 L/h
Flow per zone (6 rows)	≈642 L/h	6 rows run together
Zone run time (dry season)	60–75 min/zone/day, split morning + late afternoon	Delivers ≈1.0–1.3 L/plant/day at 44 plants/row
Zone run time (monsoon)	As needed, typically 2–3×/week	Supplement only, rainfall covers most demand

7.2 Bill of Materials — Drip System (per module)

Component	Specification	Qty	Unit Cost	Total
Drip tape	16 mm inline, 1.6 L/h @ 30 cm	360 m	\$0.10	\$36
Mainline pipe	32 mm PVC/PE, tank to field edge	25 m	\$0.55	\$14
Sub-main / manifold pipe	25 mm PE, zone headers	60 m	\$0.35	\$21
Zone valves	25 mm ball valves, one per zone	3	\$4	\$12
Screen/disc filter	120–150 mesh, essential to prevent emitter clogging	1	\$18	\$18
Pressure regulator (if needed)	In-line, protects tape from overpressure on pump-fed runs	1	\$9	\$9
Fittings	Tees, elbows, tape connectors, end caps, grommets	1 set	\$28	\$28

Subtotal — Drip System: ≈\$138 per module.

7.3 Pros & Cons

	Drip Irrigation (chosen system)
Pros	90%+ water-use efficiency vs. 50–70% for sprinklers; delivers water to root zone only, keeping foliage dry and reducing fungal disease in monsoon humidity; low daily labor once zones are set; works well with gravity head from an elevated tank; compatible with fertigation later if GSO wants to add liquid compost tea feeding
Cons	Higher upfront material cost than hand watering; tape can clog without a filter — filter maintenance is mandatory, not optional; tape has a 2–4 season working life and needs periodic replacement; rodents/termites can chew exposed tape at row ends

8. Solar Water Pump System

8.1 Sizing Basis

The pump must lift water from the source (well, pond, or stream) to the elevated tank. Total Dynamic Head (TDH) is the sum of vertical lift, tank elevation, and pipe friction losses.

Head Component	Assumed Value	Notes
Source lift (shallow well/pond/stream)	5–15 m	Site-specific — confirm actual source depth before purchase
Tank elevation	2.0 m	Fixed by stand height (Section 6.3)
Pipe friction & fittings allowance	≈3 m equivalent	Standard planning allowance for 25–32 mm pipe runs under 30 m
Design TDH (planning figure)	15–20 m	Use the higher end if source depth is

Head Component	Assumed Value	Notes
		unconfirmed

8.2 Recommended Pump & Panel

Component	Specification	Qty	Unit Cost	Total
Solar panel array	300–400 W monocrystalline, ground or pole mounted	1	\$130	\$130
DC submersible/surface pump	24V DC, rated ≈2,000–3,000 L/h at 10 m head (≈1,000–1,500 L/h at 20 m head)	1	\$180	\$180
Pump controller/MPPT	Matched to pump, with dry-run protection	1	\$35	\$35
Float switch (tank + source)	Auto-stop on full tank / low source	2	\$8	\$16
Cabling, conduit, mounting hardware	Panel-to-pump run, weatherproof	1 set	\$35	\$35
Intake foot valve/strainer (pond/stream source)	Prevents sediment/debris ingestion	1	\$12	\$12

Subtotal — Solar Pump System: ≈\$408 per module (shared across future modules at the expansion stage, see 3.2).

8.3 Expected Output

At the design TDH of 15–20 m and 4.5–5.5 peak sun hours typical of Cambodia's Cardamom Mountains, this pump class delivers roughly 5,000–7,500 L/day at the low end of the head range, or 4,000–6,000 L/day at the higher end — well above the 800–1,200 L/day module demand calculated in Section 6.2, giving margin for a cloudy day, evaporation loss, and eventual expansion to a second module on the same pump before an upgrade is needed.

8.4 Pros & Cons

	Solar Pump (vs. diesel or grid pump)
Pros	Zero fuel cost and no grid connection required — matches off-grid sanctuary sites; near-zero maintenance beyond panel cleaning and periodic pump seal checks; runs automatically during daylight with float-switch control; 15–20 year panel life
Cons	Higher upfront cost than a simple hand pump; output drops in the rainy season's overcast stretches, right when it matters least (rain supplies water) but also during any dry-season cloud cover; requires a battery or larger tank buffer if watering must happen outside sun hours; DC pump and controller need sourcing from a specialist supplier, not general hardware stores

9. Nursery — Planting Trays & Seedling Production

A small shaded nursery bench produces transplant-ready seedlings ahead of each planting cycle, allowing staggered/succession planting so the module is never fully fallow between harvests.

Component	Specification	Qty	Unit Cost	Total
Nursery bench frame	Bamboo or treated timber, 2 m × 4 m, 0.8 m working height	1	\$35	\$35
Nursery shade net	70% shade, fine mesh, protects tender seedlings	10 m ²	\$0.50	\$5
Planting trays	128-cell polystyrene/plastic seedling trays	15	\$1.50	\$23

Component	Specification	Qty	Unit Cost	Total
Seedling potting mix	Coco coir + compost + rice husk char blend	3 sacks	\$6	\$18
Hand mister / watering can (fine rose)	For gentle seedling watering	1	\$8	\$8

Subtotal — Nursery: ≈\$89 per module.

At 15 trays × 128 cells (≈1,920 cells) against a per-module planting need of ≈800 plants, this nursery capacity supports both the main planting and a buffer for gap-filling transplant losses and staggered succession sowing every 3–4 weeks through the growing season.

10. Chili Variety Selection for Phnom Samkos Climate

Variety choice should balance market demand (Khmer cuisine favors small, very hot fruit), heat tolerance, and resistance to monsoon fruit rot. The following are well suited to the Cardamom foothills climate:

Variety	Type	Days to Harvest	Notes
Mrech Kraham (Khmer red bird's eye)	Capsicum frutescens	75–90 days	Local market staple; small, very hot fruit; strong heat tolerance; good monsoon disease resistance
Bird's Eye / Thai chili (Prik Kee Nu type)	C. frutescens / C. annuum	80–100 days	High regional demand incl. Thai export market; consistent yield under 30–40% shade
Cayenne (long, medium-hot)	C. annuum	70–85 days	Higher yield per plant; suited to both fresh and dried market
Demon / Super Hot hybrids	C. annuum hybrid	85–100 days	Premium price point for specialty/export buyers; needs more consistent fertigation

GSO Recommendation: plant Mrech Kraham and Bird's Eye types as the primary crop for household/local market sale, with 1–2 rows of Cayenne or a hybrid as a trial for higher-value buyers once the module is established.

Shade note: 30–40% shade net reduces blossom drop and sunscald in peak dry-season heat while still providing enough light for fruit set — deeper shade (>50%) measurably reduces yield in chili and should be avoided.

11. Seasonal Calendar & Planting Schedule

Month	Season	Nursery / Field Activity	Irrigation Focus	Management Focus
Jan–Feb	Cool dry	Sow nursery trays; transplant late-Jan for Mar harvest window	Daily drip, 2 zones/day	Bed prep, mulch application, tank/pump inspection
Mar–Apr	Hot dry (peak heat)	Main transplanting window; succession sowing every 3 weeks	Peak demand — both drip cycles daily; monitor tank buffer	Full shade net deployed; scout for thrips/aphids
May–Jun	Early monsoon	Continue succession planting; first harvests from Jan/Feb sowing	Reduce drip; supplement only after 3+ dry days	Check drainage at row ends; re-mulch after heavy rain wash-out
Jul–Aug	Peak monsoon	Minimal new transplanting; focus on	Drip mostly idle; rainwater sufficient	Fungal disease scouting; ensure net is loosened for

Month	Season	Nursery / Field Activity	Irrigation Focus	Management Focus
		harvest and disease watch		airflow; clear tank overflow
Sep–Oct	Late monsoon	Re-establish beds after flood/wash-out; resume succession sowing	Resume light drip as rainfall tapers	Compost turn; replace any washed-out mulch; net re-tensioning
Nov–Dec	Post-monsoon / cool	Main second-cycle transplanting for Jan–Feb harvest	Moderate — 1 zone cycle/day	Heavy composting; seed saving from best plants; equipment check before dry season

Two overlapping planting cycles per year (Jan–Feb sow → Mar–May harvest; Sep–Oct sow → Dec–Feb harvest) are achievable with succession nursery production, giving near-continuous market supply outside the peak monsoon lull.

12. Soil, Fertility & Natural Pest Management

12.1 Bed Preparation

Rows are raised 15–20 cm above native soil to improve monsoon drainage, amended with 100–150 mm of mature compost (crop residue, rice husk, and where available chicken/duck manure from adjacent GSO livestock projects) worked into the top 200 mm before mulching.

12.2 Natural Pest Management

Pest	Primary Control	Secondary / Chemical-Free Backup
Thrips, aphids, whitefly	Silver reflective net (Section 4.1)	Neem oil 1% spray weekly; companion basil/marigold borders
Caterpillars / fruit borer	Physical scouting + hand removal	Bt (<i>Bacillus thuringiensis</i>) spray, safe for beneficials
Fungal fruit/root rot (monsoon)	Drip irrigation keeps foliage dry; mulch prevents soil splash	Improve airflow (loosen net sides); remove infected fruit immediately
Slugs/snails (monsoon)	Duck patrol if integrated with adjacent livestock project	Beer traps at bed edges

13. System-Wide Pros & Cons

	Assessment
Pros	Modular design lets GSO start with one \$1,000–\$2,950 module and expand without rebuilding the water backbone; drip + mulch + silver net combination directly targets the three biggest failure modes in the local climate (heat stress, monsoon disease, plastic waste); no synthetic pesticide dependency; solar pump removes fuel cost and grid dependency; chili has strong, consistent regional export demand (Cambodia → Thailand)
Cons	Higher upfront cost than open-field unshaded planting; solar pump and drip filtration require basic technical upkeep (filter cleaning, seasonal net re-tensioning) that needs a trained household member; woven ground cover and silver net both carry a real cost premium over the cheapest (and discouraged) black plastic option; yield and payback depend heavily on consistent watering and pest scouting discipline

14. Bill of Materials & Cost Tiers (per 20 m × 20 m module)

Three cost tiers are offered so GSO can match investment to pilot-stage risk tolerance and site water

access. All tiers use rice straw mulch as the ground cover baseline and green shade net as the budget default; silver net and the woven ground cover upgrade are priced as add-ons in the Standard and Premium tiers.

14.1 Tier 1 — Basic (\$1,000–\$1,150)

Category	Item	Cost (USD)
Shade net (green, structure)	Post/wire grid + 40% green net (Section 4.2)	\$488
Ground cover	Rice straw mulch, full season	\$20
Irrigation	Hand watering can + 1,000 L gravity drum (no drip, no pump)	\$95
Nursery	Bench, trays, potting mix	\$89
Soil & fertility inputs	Compost inputs, bone/fish meal	\$15
Tools & seed	Hoe, trowel, seed stock, neem oil	\$45
Community labor	4 people, 4 days	\$160
Contingency (10%)	—	\$90

TOTAL — Tier 1 (Basic): \$1,002

14.2 Tier 2 — Standard (\$2,050–\$2,300)

Category	Item	Cost (USD)
Shade net (silver, structure)	Post/wire grid + 30–40% silver net (Section 4.2)	\$591
Ground cover	Rice straw mulch + spot woven fabric at row ends	\$60
Water tank	2,000 L tank + 2.0 m stand (Section 6.3)	\$320
Drip irrigation	Full 3-zone drip system (Section 7.2)	\$138
Solar pump	300 W panel + DC pump + controller (Section 8.2)	\$408
Nursery	Bench, trays, potting mix	\$89
Soil & fertility inputs	Compost inputs, bone/fish meal	\$15
Tools & seed	Hoe, trowel, seed stock, neem oil	\$45
Community labor	4 people, 5 days	\$200
Contingency (10%)	—	\$187

TOTAL — Tier 2 (Standard): \$2,053

14.3 Tier 3 — Premium / Expansion-Ready (\$2,700–\$2,950)

Category	Item	Cost (USD)
Shade net (silver, structure)	Post/wire grid + 30–40% silver net (Section 4.2)	\$591
Ground cover	Rice straw mulch + full woven ground cover fabric (Section 5.2)	\$297
Water tank	5,000 L shared header tank sized for expansion + 2.0 m stand	\$460
Drip irrigation	Full 3-zone drip + pressure regulator + spare tape allowance	\$165
Solar pump	400 W panel + higher-output DC pump + controller, expansion-sized	\$470
Nursery	Bench, trays, potting mix (double capacity)	\$140
Soil & fertility inputs	Compost inputs, bone/fish meal	\$15
Tools & seed	Hoe, trowel, seed stock, neem oil, extra hand tools	\$65
Community labor	5 people, 6 days	\$260
Contingency (10%)	—	\$246

TOTAL — Tier 3 (Premium): \$2,709

Totals above already include a 10% contingency line. Add a further 5–10% local buffer for site-specific transport and minor land grading not captured in the community-labor line.

15. Cost Reduction Strategies

Strategy	Saving
Use green net instead of silver on non-priority modules	≈\$100 saved per module
Source rice straw free from village paddy harvest instead of purchasing	\$15–\$20 saved
Skip woven ground cover fabric upgrade; rely on rice straw only	\$255–\$270 saved
Delay solar pump purchase — use gravity-fed hand watering can for pilot module	\$408 saved (Tier 1 model)
Family labor instead of hired community crew	\$100–\$150 saved
Bulk-purchase drip tape and shade net across multiple modules at once	\$40–\$80 saved per module at 3+ modules
Build nursery bench from scrap bamboo instead of purchased timber	\$20–\$25 saved

16. Operations & Maintenance

16.1 Daily Schedule

Time	Task	Duration
06:00	Visual pest scan; check tank level and pump status	15 min
06:30	Drip Zone A cycle (dry season)	20–25 min
07:00–09:00	Harvest mature fruit; remove diseased material; nursery care	1–1.5 hr
09:00	Drip Zone B cycle	20–25 min
16:00	Drip Zone C cycle	20–25 min
17:00	Close/tension net sides before evening weather; log harvest weight	20 min

16.2 Weekly & Monthly Tasks

Frequency	Task
Weekly	Clean drip filter screen; inspect net for tears; weed alleys; top up mulch at wash-out spots
Weekly	Pest scouting count per row; log to identify pressure trends
Monthly	Clean pump intake strainer and solar panel face; check float switch operation
Monthly	Turn compost pile; side-dress beds; record harvest and market sale data

16.3 Seasonal Tasks

Season	Task
Pre-monsoon (Mar–Apr)	Re-tension net and guy wires; clear drainage at row ends; stock neem oil and Bt
Post-monsoon (Oct–Nov)	Repair wash-out damage; replenish mulch; replant beds; check tank for sediment
Dry season (Dec–Feb)	Maximize drip run time; deep-mulch to conserve moisture; clean solar panel weekly

17. Expected Yields & Market Economics

17.1 Annual Production (per 360 m² planted module)

Metric	Value	Basis
Plant population	≈790–800 plants	18 rows × 44 plants/row
Yield per plant (season)	0.4–0.8 kg fresh fruit	Typical smallholder hot chili yield range under shade + drip management
Total fresh yield per module	≈320–640 kg/season	Two overlapping cycles per year can push annual total toward the higher end
Dried chili equivalent	≈80–160 kg/season	Fresh-to-dried ratio ≈4:1 for typical hot chili

17.2 Cambodian Market Values

Fresh chili farmgate and wholesale prices in Cambodia have run in the \$1.20–\$1.55/kg range in recent years (Phnom Penh and Battambang provincial markets), with strong and growing export demand — Cambodia's fresh chili exports to Thailand have risen from roughly 1,000 tonnes in 2015 to over 55,000 tonnes annually in recent years. Dried chili commands a materially higher per-kg price than fresh due to concentration and export/processing demand, though it requires drying infrastructure and labor GSO should budget separately if pursued.

Market Channel	Indicative Price (USD/kg, fresh)	Notes
Local household/village market	\$1.00–\$1.30	Lower price, no transport cost, immediate cash
Provincial wholesale (Battambang/Pursat)	\$1.20–\$1.55	Higher volume, some transport cost
Export-oriented buyer (Thailand-bound supply chain)	\$1.30–\$1.80+	Price varies with season and export demand; requires quality grading

17.3 Economics Summary (Tier 2 — Standard module)

Metric	Value
Initial investment	\$2,050–\$2,300
Annual operating cost	\$60–\$100 (seeds, neem oil, minor drip tape replacement)
Annual gross revenue (market sale, ≈500 kg fresh @ \$1.30 avg)	≈\$550–\$700
Household consumption value	\$50–\$80
Net annual cash profit	≈\$400–\$550
Payback period	≈4–5.5 years

Yields assume consistent drip watering, weekly pest scouting, and monthly composting. Payback improves materially at the 3–4 module expansion stage once the shared tank/pump backbone cost is amortized across more planted area, and further if dried-chili processing captures the higher per-kg dried price.

18. Safety & Conservation Alignment

- **No black plastic film:** the ground cover system deliberately avoids single-season plastic mulch, eliminating a recurring source of agricultural plastic waste inside the sanctuary's community zone.
- **No chemical pesticide dependency:** silver reflective net, companion planting, neem oil, and Bt provide layered pest control without synthetic residues in sanctuary soil or waterways.
- **Water discipline:** drip irrigation at 90%+ efficiency, combined with mulch-conserved soil moisture, minimizes draw on shared community water sources versus flood or overhead

irrigation.

- **Solar power:** the pump runs on solar with no fuel storage or diesel spill risk on sanctuary land.
- **Soil building:** rice straw mulch and compost inputs build organic matter and reduce erosion risk on sloped community-zone plots.
- **Community zone only:** plot construction is restricted to existing fallow or degraded community-zone land — no forest clearance required.
- **Seed saving:** households are trained to save seed from the best-performing open-pollinated plants each cycle, reducing dependency on purchased seed stock over time.

19. Revision & Contact

This is a planning-stage specification (Rev. 1.0) intended to guide pilot chili module construction across the first GSO community cohort in Phnom Samkos. Local material prices, shade net and drip component availability, and water source yield should be validated on the ground in Pursat or Battambang province before scaling beyond a single pilot module.

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