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The Little Legon Mushroom Farm: Building Around Nature, Feeding Households, and Demonstrating a Replicable Model for Backyard Agro-Enterprise in Ghana

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ABSTRACT

This article documents the design, construction, cost, and productive performance of the Little Legon Mushroom (LLM) Farm, a small-scale oyster mushroom (Pleurotus ostreatus) growing facility established in Little Legon, Greater Accra, Ghana. The farm was deliberately constructed around existing Leucaena leucocephala (white lead) trees, incorporating living vegetation into the structural and environmental design of the growing house — a strategy that simultaneously eliminates structural timber costs, provides natural shade, improves microclimate conditions, and enhances the aesthetic character of the facility. The article presents the complete construction process, itemised material costs, and a comparative materials analysis contrasting conventional-timber and tree-integrated construction approaches. It develops a detailed financial analysis at current market prices of GH₵55–75 (~$5.1–6.9) per kilogram of fresh oyster mushrooms, demonstrating that the LLM facility — producing 60–85 kg per harvest cycle with four to five cycles per year — generates annual gross revenue of GH₵13,200–21,250 (~$1,214–1,955) with a conservative net return that compares favourably with land-based agricultural investments of comparable capital requirement. The article further addresses the farm's role in household nutrition, its integration with animal husbandry through by-product feed for poultry, birds, and rabbits maintained on-site, and its employment-creation potential at two persons per facility. The LLM Farm is explicitly framed as an experiment in replication: the article presents a scalable model — from the household single-unit growing house to village-cluster enterprise networks — and identifies the research gaps that must be addressed to realise mushroom cultivation's full potential as a food security and income-generation intervention in sub-Saharan Africa.

1. Introduction

Food insecurity and protein deficiency remain persistent challenges in urban and peri-urban Ghana, despite decades of agricultural development investment. The Greater Accra Region — Ghana's most densely populated zone, with a population exceeding 5.4 million in the 2021 Population and Housing Census — is paradoxically among the most food-insecure urban environments in West Africa, characterised by high dependence on imported and processed protein sources, limited access to affordable fresh produce in low-income neighbourhoods, and a near-complete absence of small-scale food production within the built fabric of the city (Ghana Statistical Service, 2021). Animal protein in particular has become a luxury commodity for a large fraction of Accra's population: retail beef prices

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exceed GH₵80 (~$7.4) per kilogram, eggs cost GH₵2–3 (~$0.18–0.28) each, and fresh fish has been subject to sharp price escalation driven by declining ocean catches and rising fuel costs. Against this backdrop, mushroom cultivation offers an extraordinary nutritional and economic opportunity that has been almost entirely overlooked in urban and peri-urban food policy in Ghana. Oyster mushrooms (Pleurotus ostreatus) contain 19–35% protein on a dry weight basis — comparable to many animal protein sources and far exceeding the protein content of most vegetables — along with essential amino acids, B-vitamins, ergosterol (a Vitamin D precursor), and beta-glucans that support immune function (Chang & Miles, 2004; Manzi et al., 1999). They can be cultivated on agricultural waste substrates — sawdust, rice chaff, corn cobs — that are freely available and otherwise discarded, making the protein they deliver genuinely low-cost at the system level even when retail prices appear elevated. They require no soil, no arable land, and no chemical fertiliser. A single 1.5 kg substrate bag, costing about GH₵6 (~$0.55) to prepare, can produce 300–400 g of fresh mushrooms — a protein-yield-per-input ratio superior to any conventional livestock system. Yet despite these advantages, the research literature reveals significant gaps that explain why mushroom cultivation has not become the household food-production intervention its biology would support. First, there is almost no published guidance on the construction of growing facilities that is appropriate to Ghanaian material, skill, and budget realities. The available construction literature addresses large-scale controlled-environment facilities in temperate Asia and Europe, which bear no resemblance to the constraints and opportunities of backyard construction in peri-urban Accra (Chen et al., 2022; Lee et al., 2017). Second, there is a near-complete absence of published financial analysis of mushroom enterprises at the household and micro-enterprise scale in Ghana, leaving aspiring producers without benchmarks for planning and investment decisions. Third, the potential for integrating mushroom production with animal husbandry — using substrate by-products as high-protein animal feed — has not been documented or promoted in the Ghanaian context, despite the significant nutritional and economic value of this integration. Fourth, no published replication model exists that specifies the design, cost, and operational parameters of a mushroom growing facility in sufficient detail to enable systematic reproduction across diverse socio-economic contexts. The Little Legon Mushroom (LLM) Farm, the subject of this article, was established precisely to address these gaps. It is not merely a production facility: it is a deliberately designed experiment in replication, constructed with the intention of documenting every design decision, construction cost, and production parameter in sufficient detail to enable any household or community with the means and the motivation to reproduce the enterprise. This article presents the full documentation of that experiment.

2. The Little Legon Mushroom Farm: Concept and Site

The LLM Farm occupies a 15 m² footprint within a larger residential compound in Little Legon, a peri-urban neighbourhood in the University of Ghana. The site is characterised by a compound layout — a rich residential plot with a central open area — typical of middle-income housing development in peri-urban Accra. Critically, the compound contained a stand of established Leucaena leucocephala trees (locally known as white lead or river tamarind), fast-growing nitrogen-fixing legumes that self-seed prolifically in the red laterite soils of the Greater Accra Region and are commonly regarded as nuisance vegetation requiring clearance. The founding design decision of the LLM Farm was to invert this conventional attitude toward the Leucaena trees: rather than clearing them to create a construction site, the growing house was designed and built around the living trees, which were incorporated into the structural system of the building as natural vertical posts. This decision, which appears simple, has consequences that cascade through every dimension of the project: construction cost, structural performance, microclimate management, aesthetic quality, and ecological function.

The LLM Farm also integrates mushroom production within a wider small-scale animal husbandry system. The compound maintains a variety of birds and poultry — including guinea fowl, doves, and laying hens — as well as rabbits, all maintained as both a food source and an income supplement. This integration creates a closed-loop resource system in which spent mushroom substrate (the colonised sawdust bags after production is complete) is repurposed as a high-protein supplementary feed for the compound's animals, whose manure in turn enriches the soil in which the Leucaena trees grow. The LLM Farm thus functions as a miniature agro-ecological system rather than a single-commodity production unit.

3. Construction Process and the Tree-Integration Strategy

3.1 The Living-Tree Frame: Engineering and Environmental Logic

Conventional mushroom growing house construction uses hardwood timber posts of 100 mm × 100 mm cross-section set at approximately 1.0 m centres to form the structural frame of the building. Each post costs approximately GH₵45 (~$4.14) on current Accra market, and a standard 5.0 m × 3.0 m growing house requires 18 posts — a material cost of GH₵810 (~$74.5) for the frame alone, before any other structural members are added. The LLM Farm eliminated this cost almost entirely by using the standing Leucaena tree trunks as the primary vertical structural members of the growing house frame (Alagidede, 2025a, 2025b). *Leucaena leucocephala* is a fast-growing pioneer legume that reaches heights of 5–15 metres and trunk diameters of 80–200 mm at maturity, providing cross-sectional dimensions comparable to commercial timber posts. Its wood has a density of approximately 560–670 kg/m³ and a modulus of rupture of 90–120 MPa — properties within the range of locally available commercial hardwoods — and its deep root system in laterite soil provides natural foundation stability without the need for post-setting in cement mortar. The trees were selectively pruned to remove lower branches within the growing house volume, creating a canopy that begins above the eaves level and provides continuous natural shading to the roof structure. Beyond cost saving, the living-tree frame provides three environmental functions unavailable in a conventional timber frame. First, the tree canopy reduces direct solar radiation reaching the roof and wall surfaces, lowering the thermal load on the growing house and assisting in the maintenance of the 24–28°C internal temperature target. Second, transpirational water loss from the trees' leaves — estimated at 5–15 litres per tree per day in the tropical dry season — contributes to elevated humidity in the immediate microclimate, reducing the frequency and volume of manual spraying required to maintain 80–90% relative humidity within the growing space. Third, the root networks of the nitrogen-fixing Leucaena trees improve soil fertility beneath the growing house, supporting the compound's vegetable garden and the Leucaena's own continued vigorous growth.

3.2 Construction Sequence

Construction proceeded in six sequential phases over approximately 10 working days, following site clearing and selective pruning of the *Leucaena* stand (figure 1).

Phase 1 — Setting Out and Foundation: The perimeter of the growing house was established using string lines anchored to existing tree trunks where available, and to temporary stakes where tree positions did not coincide with the required perimeter line. A 300 mm course of 150 mm hollow cement blocks was laid in stretcher bond to form a continuous plinth around the perimeter, bonded with a 1:4 cement-sand mortar mix. The plinth raises the floor level above the surrounding grade, preventing moisture ingress and creating a definite threshold between the outdoor environment and the controlled interior.

Figure 1. The Little Legon Mushroom Farm growing house

Source: Author

Phase 2 — Floor Slab: A 100 mm compacted laterite sub-base was placed within the block plinth, followed by a 75 mm cement screed (1:3 cement-sand mix) finished to a smooth, level surface, cured for seven days before subsequent construction trades were permitted to work within the floor area.

Phase 3 — Wall Frame Integration: Horizontal timber rails of 50 mm × 100 mm section were fixed at mid-height (1.2 m) and at eaves level (2.4 m) between the standing tree trunks, using galvanised coach bolts drilled through pilot holes. This connection method is less invasive than notching, which would damage the cambium layer and potentially kill or weaken the trees.

Phase 4 — Roof Structure: Roof rafters of 50 mm × 75 mm section were fixed at the eaves rail, rising to a central ridge beam at a ridge height of approximately 3.2 m. The resulting pitched roof geometry (slope approximately 1 in 3.75, 15°) defines the stack-effect ventilation chimney that drives natural air circulation. A continuous 100 mm ridge gap served as the primary air exhaust outlet.

Phase 5 — Cladding: Woven straw mats (premprem) were tied to the timber rail frame, covering wall panels between tree trunks. The mats' approximately 20–30% open area provides essential passive ventilation while attenuating solar radiation and wind velocity. The roof was covered with palm frond thatch bundles, providing a thermal resistance of approximately R 1.5–2.0 m^2K/W.

Phase 6 — Interior Fitting: A straw-mat partition divides the interior into an incubation room (spawn run area, approximately 7.5 m^2) and a cropping room (fruiting area, approximately 7.5 m^2). Four-tier timber shelf racks were installed in both rooms, and a lockable timber door was fitted to provide secure access.

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Figure 2. Interior of the Little Legon Mushroom Farm cropping room showing fully colonised oyster mushroom (*Pleurotus ostreatus*) substrate bags arranged on four-tier timber shelf racks

Source: Authors

4. Construction Cost Analysis: Tree-Integrated vs Conventional Frame

4.1 Itemised Cost Breakdown for the LLM Farm

Table 1 presents the complete itemised cost breakdown for the LLM Farm as constructed, reflecting the tree-integrated design. Material prices reflect Accra and peri-urban Greater Accra market rates at the time of construction (early 2026), obtained from three independent local suppliers.

Table 1. LLM Farm itemised construction and first-cycle cost (GH₵ and USD equivalent at GH₵1 = $0.092, early 2026)

Item	Specification	Qty	Unit Price (GH₵ / USD)	Total (GH₵ / USD)
Cement blocks (150 mm hollow)	Stretcher bond plinth	120 pcs	5.50 / $0.51	$60.7
Cement (42.5 N)	Plinth, screed, mortar	8 bags	90 / $8.3	$66.2
Sand (sharp)	Screed and mortar	2 loads	350 / $32.2	$64.4
Laterite fill	Sub-base compaction	1 load	200 / $18.4	$18.4
Timber rails (50×100 mm)	Wall frame horizontals	12 @ 3.6 m	45 / $4.1	$49.7
Roof rafters (50×75 mm)	Pitched roof structure	10 @ 4.0 m	35 / $3.2	$32.2
Ridge beam (50×100 mm)	Carried by tree trunks	1 @ 5.0 m	45 / $4.1	$4.1
Premprem straw mats	Wall cladding (permeable)	25 pcs	35 / $3.2	$80.5
Palm thatch bundles	Roof covering	40 bundles	20 / $1.8	$73.6
Coach bolts (M10 × 150 mm)	Tree-to-rail connections	24 sets	8 / $0.74	$17.7
Timber door (lockable)	Secure access	1	350 / $32.2	$32.2
Shelf racks (4-tier, timber)	Substrate bag racking	8 units	75 / $6.9	$55.2
Room partition (straw mat)	Incubation/cropping division	1	250 / $23.0	$23.0

Item	Specification	Qty	Unit Price (GH₵ / USD)	Total (GH₵ / USD)
Assorted fixings and hardware	Nails, binding twine, hinges	—	—	$17.6
STRUCTURAL FRAME SAVING	Leucaena trees replace 18 timber posts	—	—	(–$72.2)
Subtotal: Construction				GH₵5,688 / $523.3
Labour (10 days × 2 workers)	Semi-skilled carpenter + labourer	20 man-days	85 / $7.8	GH₵1,700 / $156.4
First-cycle spawn and consumables	500 bags, spawn, substrate inputs	—	—	GH₵4,485 / $412.6
Contingency (5%)				GH₵800 / $73.6
TOTAL PROJECT COST				GH₵12,673 / $1,166

Source: Authors' own construction records and Accra market survey (2026).

4.2 Comparative Analysis: Tree-Integrated vs Conventional Frame

Table 2 provides a systematic comparison of the tree-integrated construction approach against the conventional hardwood timber post frame on twelve evaluative parameters.

Table 2. Comparative analysis: tree-integrated vs conventional timber frame construction

Parameter	Conventional Timber Frame	Tree-Integrated (LLM)	Advantage
Structural posts	18 hardwood posts @ GH₵45 ($4.1) = GH₵810 ($74.5)	Leucaena tree trunks: GH₵0	Tree (GH₵810 / $74.5 saving)
Post foundation	Setting in cement mortar: ~GH₵85 (~$7.8)	None required: deep root stability	Tree
Structural service life	5–8 years (rot in humid environment)	Indefinite (living, self-renewing)	Tree
Solar shading	None	Continuous canopy shading	Tree
Humidity contribution	None	Transpiration 5–15 L/day per tree	Tree
Roof covering	Palm thatch R~1.5–2.0 m^2K/W; GH₵800 ($73.6)	Palm thatch + canopy shade layer	Marginal tree
Wall cladding	Premprem 25 pcs @ GH₵35 ($3.2) = GH₵875 ($80.5)	Identical specification: GH₵875 ($80.5)	Equal
Room partition	Straw mat on timber stud; GH₵250 ($23.0)	Identical; GH₵250 ($23.0)	Equal
Floor screed	75 mm screed on 100 mm laterite; GH₵1,475 ($135.7)	Identical specification; GH₵1,475 ($135.7)	Equal
Aesthetic character	Standard industrial/agricultural	Distinctive; living trees visible	Tree
Ecological function	None; net vegetation loss	N-fixation; soil improvement; biodiversity	Tree (strong)
Construction skill	Standard carpentry	Standard carpentry + basic pruning	Conventional (marginal)
Total structural frame cost	GH₵2,410 ($221.7) (posts + rails + rafters)	GH₵1,625 ($149.5) (rails + rafters + stub posts)	Tree (GH₵785 / $72.2 saving)

Source: Authors' construction records and cost analysis (2026).

The comparative analysis demonstrates unambiguous advantages for the tree-integrated approach across six of the twelve parameters evaluated. The GH₵785 (~$72) structural frame cost saving represents approximately 6% of the total project cost — a meaningful reduction at the constrained budget level at which this enterprise operates. More significantly, the living-tree frame provides a structural service life that conventional timber posts cannot match in the humid interior environment of a mushroom growing house, preservative-treated timber posts typically exhibit significant decay within five to eight years, requiring costly replacement. Living tree trunks are self-renewing and will increase in diameter and strength over time.

5. Household Nutrition, Protein Provision, and Animal Integration

5.1 Oyster Mushrooms as Household Protein Source

Dried oyster mushrooms contain 19–35% crude protein on a dry weight basis, with a protein digestibility-corrected amino acid score (PDCAAS) of 0.6–0.8 — higher than most plant protein sources and comparable to some animal proteins (Manzi et al., 1999; Chang & Miles, 2004). At fresh weight, oyster mushrooms contain approximately 3.3% protein, providing approximately 33 g of protein per kilogram of fresh mushrooms consumed — sufficient to meet approximately 40–50% of the daily protein requirement of one adult per kilogram consumed. The LLM Farm's production of 60–85 kg of fresh oyster mushrooms per production cycle, with four to five cycles per year, places approximately 240–425 kg of fresh mushrooms into the production system annually. Even if only 15–20 kg per cycle (roughly 20–25% of production) is retained for household consumption rather than sold, this represents a consistent weekly protein supplement of approximately 800 g–1.0 kg of fresh mushrooms per week — providing 26–33 g of protein per week, equivalent in protein terms to approximately 3–4 medium eggs. For low-income urban households spending 40–60% of income on food, this protein contribution — produced at essentially zero additional cost beyond the production infrastructure already in place for commercial purposes — is nutritionally and economically significant. Mushrooms also provide iron, phosphorus, potassium, B-vitamins (B2, B3, B5), and ergosterol (which converts to Vitamin D under sunlight exposure), addressing micronutrient deficiencies that are prevalent in Ghana's urban population, particularly among women of reproductive age and young children.

5.2 Integration with Animal Husbandry: Birds, Poultry, and Rabbits

The LLM Farm's integration with the compound's animal husbandry system creates a resource efficiency that transforms what is conventionally treated as a waste product — spent mushroom substrate — into a productive input. After completing its three to four production flushes, a substrate bag retains approximately 50–60% of its original organic material in the form of partially degraded lignocellulosic matter heavily colonised with Pleurotus mycelium. This spent substrate has a crude protein content of approximately 8–12% on a dry weight basis — significantly higher than raw sawdust (2–3% protein) because of the protein synthesised by the fungal mycelium during colonisation — and contains elevated levels of digestible fibre relative to unfermented agricultural waste (Adamovic et al., 1998).

At the LLM Farm, spent substrate from completed production cycles is broken out of the bags and mixed with conventional poultry feed at a ratio of approximately 20–30% by weight as a protein-supplementing extender for the compound's guinea fowl, laying hens, and doves. Preliminary observations suggest normal feed intake and no adverse health effects at this inclusion level —

consistent with the findings of Adamovic et al. (1998) and Okano et al. (2009), who documented safe inclusion rates of 10–25% Pleurotus-fermented substrate in poultry diets. The compound's rabbits consume spent substrate directly, finding the partially degraded lignocellulosic material highly palatable. Given that poultry and rabbit feed represents one of the major recurring costs in small-scale animal husbandry in Ghana — laying hen concentrate retails at GH₵150–180 (~$13.8–16.6) per 50 kg bag — even a 20–25% reduction in feed purchase requirements through substrate supplementation represents a meaningful annual saving of GH₵600–900 (~$55–83) per year at typical flock sizes. The integration also works in reverse: the manure generated by the compound's poultry and rabbits enriches the soil around the Leucaena trees that form the structural frame of the growing house, supporting vigorous tree growth and therefore maintaining and improving the structural and environmental functions the trees provide. This nutrient cycling — mushroom substrate enriching animal feed, animal manure enriching tree growth, trees supporting mushroom production — exemplifies the agroecological integration that distinguishes the LLM Farm concept from a conventional monoculture production system.

6. Financial Analysis and Investment Returns

6.1 Revenue Projections at Current Market Prices

Oyster mushrooms are a premium fresh produce item in Accra's markets. At the time of writing (early 2026), retail prices for fresh oyster mushrooms range from GH₵55 to GH₵75 (~$5.1–6.9) per kilogram in Greater Accra, reflecting strong and growing demand from health-conscious urban consumers, restaurants, and caterers. The LLM Farm adopts GH₵55 (~$5.1) per kilogram as its conservative base-case price for financial analysis, representing the lower bound of current market pricing (Quartey, 2025). The LLM facility accommodates 500 substrate bags per production cycle, each bag producing an average of 150–200 g of fresh mushrooms per flush over 3–4 flushes. This gives a per-cycle yield of 60–85 kg of fresh oyster mushrooms. Four to five production cycles per year are achievable under the LLM Farm's passive environmental management system, with a slight reduction in cycle frequency during the harmattan dry season (December–February). Table 3 presents the complete financial projections.

Table 3. LLM Farm financial projections — production revenue and return on investment analysis

Parameter	Conservative Case (low end)	Base Case (realistic mid)
Yield per cycle (kg fresh mushrooms)	60 kg	75 kg
Price per kg (GH₵ / USD)	GH₵55 (~$5.1)	GH₵55 (~$5.1)
Gross revenue per cycle (GH₵ / USD)	GH₵3,300 (~$304)	GH₵4,125 (~$380)
Production cycles per year	4	4.5
Annual gross revenue (GH₵ / USD)	GH₵13,200 (~$1,214)	GH₵18,563 (~$1,708)
Recurring costs per cycle (spawn, substrate, fuel, hygiene, water)	GH₵2,300 (~$212)	GH₵2,300 (~$212)
Annual recurring production costs	GH₵9,200 (~$847)	GH₵10,350 (~$952)
Annual labour cost (2 part-time workers, 3 hrs/day × 300 days)	GH₵5,400 (~$497)	GH₵5,400 (~$497)
Annual maintenance (mat replacement, minor repairs)	GH₵500 (~$46)	GH₵500 (~$46)

Parameter	Conservative Case (low end)	Base Case (realistic mid)
Total annual operating cost	GH₵15,100 (~$1,389)	GH₵16,250 (~$1,495)
Annual operating profit / (loss)	(GH₵1,900) (~–$175)	GH₵2,313 (~$213)
Adjusted net surplus (family-labour model)	GH₵3,500 (~$322)	GH₵7,713 (~$710)
Total capital investment (construction + first cycle)	GH₵12,673 (~$1,166)	GH₵12,673 (~$1,166)
Payback period (family-labour model)	~3.6 years	~1.6 years
Payback period (hired labour model)	N/A (loss)	~5.5 years
Daily mushroom income equivalent (family labour)	GH₵9.6 (~$0.88) / day	GH₵21.1 (~$1.94) / day

Source: Authors' own cost and revenue analysis (2026).

The financial analysis reveals that the LLM Farm is most viable in the family-labour model, where the two workers managing the facility are household members who receive the operating surplus as effective household income rather than as a wage deduction against revenue. In the family-labour model, the base case generates GH₵7,713 (~$710) per year in household income surplus — equivalent to approximately GH₵642 (~$59) per month, or roughly one additional minimum wage income — from a capital investment of GH₵12,673 (~$1,166). This represents an annual return on investment of approximately 61% in the base case, which is exceptional by the standards of any comparable investment available to a low- or middle-income urban household in Ghana.

6.2 Comparison with Alternative Investments

Table 4 places the LLM Farm investment in comparative context against other common small-capital investments available to Ghanaian households and micro-entrepreneurs, using conservative estimates and publicly available return data.

Table 4. Comparative investment returns — LLM Farm vs alternative GH₵12,000–15,000 (~$1,104–1,380) capital investments in Ghana (2025–2026)

Investment Option	Capital Required (GH₵ / USD)	Annual Return (GH₵ / USD)	Annual ROI (%)	Key Risk / Constraint
LLM Mushroom Farm (family labour, base case)	GH₵12,673 (~$1,166)	GH₵7,713 (~$710)	~61%	Spawn quality; harmattan humidity management
Government Treasury Bills (91-day, 2025)	GH₵12,000 (~$1,104)	GH₵~2,700 (~$249) (est. 22.5%)	~23%	No active employment created; pure passive
Fixed Deposit Account (top Ghanaian bank, 2025)	GH₵12,000 (~$1,104)	GH₵~1,800 (~$166) (est. 15%)	~15%	No household food benefit; currency risk
Mobile money susu / informal savings group	GH₵12,000 (~$1,104)	GH₵~600–1,200 (~$55–110) (5–10%)	5–10%	Counterparty risk; low formal return
Petty trading (provisions, foodstuffs)	GH₵12,000 (~$1,104) working capital	GH₵3,600–7,200 (~$331–662) (30–60%)	30–60%	High competition; theft risk; full-time required
Small-scale poultry (100 broilers, 3 cycles/year)	GH₵12,000–15,000 (~$1,104–1,380)	GH₵3,000–6,000 (~$276–552) (est.)	25–50%	High feed cost volatility; disease risk

Investment Option	Capital Required (GH₵ / USD)	Annual Return (GH₵ / USD)	Annual ROI (%)	Key Risk / Constraint
Cassava farming (1 acre, Greater Accra peri-urban)	GH₵12,000–15,000 (~$1,104–1,380)	GH₵1,800–4,500 (~$166–414) net (est.)	15–37%	Land access; seasonal; physically intensive
Urban land rental (compound room, Adentan area)	GH₵12,000 (~$1,104) (first year deposit + fit-out)	GH₵6,000–8,400 (~$552–773) / year	50–70%	Requires land asset; tenant default risk

Source: Authors' own analysis; Bank of Ghana (2025); Quartey (2025).

The comparison demonstrates that the LLM Farm, in the family-labour model, offers investment returns competitive with the best available small-capital investment options in Ghana, with the additional and unique advantages of generating household food security, creating two employment positions, and producing a by-product with independent value as animal feed. It is also important to note the income trajectory: each production cycle improves the operator's spawn management, humidity control, and contamination prevention skills, typically increasing yield per bag by 10–20% over the first year of operation, generating proportionally higher returns on the same infrastructure base.

7. Employment Creation and the Two-Person Operating Model

The LLM Farm is designed for a two-person operation — a management structure that reflects the tasks required for consistently successful mushroom production and the labour intensity distribution across the production cycle. The primary operator (Person 1) carries responsibility for the technical and quality-sensitive operations: inoculation of substrate bags in sterile conditions, monitoring of environmental parameters (temperature, humidity, CO_2), management of the spawn run during colonisation, and quality assessment at harvest. This role requires approximately 2–3 hours of daily attention during the active fruiting phase and 1–2 hours during the colonisation phase, making it compatible with other household or part-time employment commitments. The secondary operator (Person 2) manages the physical maintenance operations: daily humidity spraying (2–3 times per day during fruiting), substrate bag preparation and sterilisation at the start of each cycle, spent bag removal and animal feed preparation, and general hygiene maintenance. This role also requires approximately 2–3 hours daily during fruiting, reducing to 1 hour during colonisation. The combined labour requirement of 3–5 person-hours per day — approximately 15–20 hours per week for a two-person team — is compatible with part-time working arrangements and does not preclude either operator from holding additional employment. At the current Accra minimum wage of GH₵18 (~$1.66) per day, two part-time workers dedicated to the LLM Farm generate employment income equivalent to GH₵2,700 (~$249) per month in notional wage value — or GH₵5,400 (~$497) per year in formal employment terms — from a facility that cost GH₵12,673 (~$1,166) to establish. The LLM Farm demonstrates that meaningful, dignified employment can be created from very modest capital at a cost-per-job that is far below the formal investment required to create equivalent employment in manufacturing or services.

8. The LLM Farm as a Replication Model

8.1 The Research and Extension Gap

The LLM Farm experiment was designed from the outset as a replication model. The central premise is that a facility of this type — achievable within GH₵13,000–15,000 (~$1,196–1,380), buildable in 10 working days with semi-skilled local labour, operable by two people with basic training — should not be a rare or exceptional intervention. It should be a common feature of compound living in Ghana's urban and peri-urban environment. Four specific research gaps have been identified through the LLM Farm experience. First, there is no nationally validated construction specification for small-scale mushroom growing houses in Ghana. This article and the companion construction paper (Alagidede, 2025a) begin to address this gap, but the specifications require validation across Ghana's agro-ecological zones. Second, there is no formal, affordable spawn supply chain that reaches beyond the Greater Accra Region. Third, there is no established market infrastructure for fresh mushrooms in Ghana's secondary cities. Fourth, the nutritional and public health case for household mushroom production has not been translated into accessible extension materials.

8.2 A Scalable Replication Framework

Table 5 presents a three-tier replication framework that articulates the progression from the single household LLM-type facility to a village-cluster enterprise network.

Table 5. Scalable replication framework: from household unit to commercial enterprise network

Parameter	Tier 1: Household Unit (LLM Model)	Tier 2: Community Hub (5–10 units)	Tier 3: Commercial Enterprise
Target operator	Single household; family or compound workers	Village/neighbourhood cooperative; youth group; women's group	Registered SME; agribusiness; university spin-out
Facility size	15 m² (1 growing house)	75–150 m² (5–10 growing houses, shared spawn lab)	200–500 m² (greenhouse tunnel or controlled-environment lab)
Capital required	GH₵12,000–15,000 (~$1,104–1,380)	GH₵80,000–150,000 (~$7,360–13,800)	GH₵500,000–2,000,000 (~$46,000–184,000)
Yield per year	240–425 kg	1,200–4,250 kg	5,000–24,000 kg
Annual gross revenue (@ GH₵55/kg)	GH₵13,200–23,375 (~$1,214–2,150)	GH₵66,000–233,750 (~$6,072–21,505)	GH₵275,000–1,320,000 (~$25,300–121,440)
Employment created	2 (part-time)	8–15 (combination part/full time)	15–40 (full-time)
Technical requirements	3-day training; basic hygiene protocols	Shared spawn production; basic laboratory; 1-week training	HACCP; food safety certification; professional management
Market channel	Household consumption + direct neighbourhood sales	Local market stalls + restaurant supply + informal aggregation	Supermarkets; restaurants; food processing; export
Animal integration	Compound poultry, rabbits fed spent substrate	Shared poultry/rabbit unit fed aggregated spent substrate	Formal livestock integration; by-product processing

Source: Authors' own framework development (2026).

Figure 3. Greenhouse tunnel system for Tier 2 medium-scale mushroom production, arrangement on multi-tier racks.

Source: Authors

Figure 4. Tier 3 controlled-environment mushroom laboratory

Source: Authors

9. Discussion

The LLM Farm experiment produces findings that challenge several assumptions embedded in Ghana's agricultural development discourse. First, it challenges the assumption that meaningful food production requires significant land area. The LLM Farm's 15 m² footprint — smaller than a typical bedroom — produces 240–425 kg of premium fresh produce per year, generating more protein per square metre than virtually any field crop cultivated in Ghana. The constraint on mushroom production is not land: it is knowledge, spawn access, and the GH₵12,000–15,000 (~$1,104–1,380) construction investment. Addressing these three constraints — through training, spawn supply chain development, and targeted agricultural credit — is entirely feasible within existing institutional frameworks.

Second, the LLM experiment challenges the assumption that environmental sustainability and economic productivity are in tension. The decision to build around the Leucaena trees rather than clear them produced a building that is simultaneously cheaper, more durable, better performing environmentally, and more aesthetically distinctive than the conventional alternative. This is a design principle — that working with existing ecological assets rather than against them produces better outcomes — with implications far beyond mushroom cultivation.

Third, the integration of mushroom production with animal husbandry at the LLM Farm illustrates a principle of resource efficiency that is largely absent from urban and peri-urban agricultural extension in Ghana: the by-product of one production system (spent mushroom substrate) is the input of another (poultry and rabbit feed), and the by-product of the second (animal manure) is the input of a third (tree fertilisation and compound soil improvement). This cascade of resource use, organised within a single compound, produces more food, more income, and less waste than any of the individual production systems would produce in isolation.

The financial analysis presents a nuanced picture that merits careful interpretation. The conservative case — 60 kg per cycle at GH₵55 (~$5.1) per kilogram, with hired labour — shows a slight operating loss, underscoring that the mushroom enterprise is not viable at minimum-scale yield with full hired-labour costs. The critical variables are yield consistency (driven by spawn quality and environmental management skills) and the labour model (family versus hired). Extension workers and practitioners must communicate this distinction clearly to prospective operators to set realistic expectations.

10. Conclusions and Recommendations

The Little Legon Mushroom Farm documents what is possible when a small-scale agricultural enterprise is designed with equal attention to ecological intelligence, construction economy, nutritional purpose, and financial viability. Its key contributions are fivefold.

First, the tree-integrated construction strategy — building around existing Leucaena trees rather than clearing them — reduces structural timber costs by approximately GH₵785 (~$72), improves microclimate performance through transpirational humidity and canopy shading, enhances aesthetic character, and provides a permanent structural frame with indefinite service life. This strategy is directly replicable wherever Leucaena or other structurally suitable trees are present in compound settings.

Second, the financial analysis demonstrates that the LLM Farm generates annual household income of GH₵7,713 (~$710) in the base-case family-labour model — a 61% annual return on the GH₵12,673 (~$1,166) investment — while creating two employment positions and supplying the household with 15–20 kg of premium fresh mushrooms per cycle as a direct nutritional benefit. No comparable capital deployment available to a low-to-middle income urban household in Ghana generates this combination of financial return, employment creation, and food security benefit.

Third, the integration of mushroom production with animal husbandry — specifically the repurposing of spent substrate as high-protein supplementary feed for the compound's poultry and rabbits — creates a resource-efficient closed loop that reduces animal feed purchase costs by an estimated GH₵600–900 (~$55–83) per year.

Fourth, the three-tier replication framework provides a clear progression from the household LLM unit through the community cooperative hub to the formal commercial enterprise, specifying at each tier the capital, technical, labour, and market requirements for successful operation. This framework provides the actionable planning tool that has been absent from Ghana's mushroom sector development literature.

Three priority recommendations emerge for practitioners and policymakers. First, the Ministry of Food and Agriculture and the Directorate of Agricultural Extension Services should develop a standardised

LLM-type construction package — a construction brief, materials checklist, and three-day operator training curriculum — deliverable through existing district agricultural offices at minimal additional cost. Second, the Ghana Microfinance and Small Loans Centre (MASLOC) and similar institutions should recognise mushroom growing house construction as an eligible category for their agricultural micro-enterprise loan products, given the demonstrated investment returns and the short payback period. Third, academic and applied research institutions should conduct monitored trials of the LLM construction model across Ghana's agro-ecological zones — and specifically in the Northern, Upper East, and Upper West Regions, where protein deficiency is most severe — to validate and adapt the specifications for conditions of lower ambient humidity and higher temperature range.

The Little Legon Mushroom Farm is a small building. It occupies 15 square metres of a residential compound, costs less than a second-hand car, and employs two people for a few hours each day. But it produces food that feeds a family, income that supplements a household, employment that dignifies two workers, and a model that — if replicated across the tens of thousands of urban and peri-urban compounds in Ghana — could transform the country's relationship with protein security. That is the ambition of this experiment, and this article is the beginning of its documentation.

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