

Despite that strong economic and environmental profile, Manila clam culture faces mounting production constraints that make husbandry optimization increasingly important. Production has declined in some major farming regions over the past decade, partly because of reduced availability of wild seed, habitat degradation, and climate-related stressors. Climate projections further suggest that habitat suitability for *R. philippinarum* will shift substantially, with decreases in important current producing areas such as parts of the Mediterranean and sections of the Chinese coastline, even as opportunities may open in higher-latitude regions. At the same time, greater reliance on hatchery seed introduces new cost structures and management concerns, because hatchery-based supply can stabilize production continuity but also increase environmental burdens and, if poorly managed, contribute to reduced genetic variability or inbreeding-related performance losses (Wei et al., 2023). Within this context, stocking density emerges as a key aquaculture management factor because it governs how effectively animals convert space, food, oxygen, and husbandry inputs into marketable biomass. Field evidence in juvenile Manila clams cultured in suspended lanterns shows a clear density-dependent decline in shell growth, with larger final shell lengths consistently recorded at lower or intermediate densities than at extra-high densities across batches and sites (Bordignon et al., 2021). Under less favorable water conditions, excessively high density can also sharply reduce survival, showing that density effects are not limited to slower growth but can directly depress final yield through mortality. Comparable patterns appear across other hard-clam and bivalve systems: in *Meretrix lyrata*, high density reduced growth, although intermediate to high density increased tonnage and intermediate density maximized profit; in otter clam, growth was highest at the lowest density, yield rose with density, but economic return peaked at an intermediate level; and in mangrove clam, the highest tested density depressed growth even where survival changed little (Ngô et al., 2025). Hatchery studies reinforce the same principle at earlier life stages: increased larval density commonly reduces shell growth, delays settlement or metamorphosis, and can lower survival or spat yield, even though the exact optimum differs by species and culture stage. Mechanistically, these responses are consistent with stronger competition for food and space, oxygen limitation, and the accumulation of metabolic wastes at high density, whereas very low density can raise production costs and reduce space-use efficiency. Stocking density therefore functions as a classic optimization problem rather than a simple maximization variable: lower densities often improve individual growth and condition, higher densities can raise gross output per area, and intermediate densities frequently produce the best compromise among survival, yield, and economic return.

Against this background, a review focused on the effects of stocking density on the yield and quality of hard clams is timely and necessary. The practical problem for farmers is not merely whether density affects performance, but how density interacts with culture system, seed source, water conditions, predator pressure, and production stage to determine harvest quantity and market quality. Yield is highly sensitive to mortality and seed-related costs in commercial Manila clam operations, and broader hard-clam production analyses show nonlinear relationships between stocking density and farm output rather than a single universal optimum. Density recommendations also vary by context, as seen in soft-shell clam enhancement strategies that favor moderate planting densities under predator protection and in hatchery systems where moderate larval densities improve subsequent spat production. Accordingly, the objective of this review is to synthesize current evidence on how stocking density influences the principal performance traits of hard clams, with emphasis on growth, survival, biomass yield, and quality-related outcomes that determine commercial value. Its scope includes both Manila clam aquaculture, because of its dominant economic role and broad evidence base, and supporting evidence from other hard-clam and clam species where density-dependent mechanisms illuminate general culture principles. Particular attention is given to identifying trade-offs between individual performance and areal productivity, to clarifying why optimal density differs among nursery, grow-out, pond, lantern, and hatchery systems, and to highlighting the implications of density management for sustainability under seed limitation, climate stress, and intensifying aquaculture development. In that sense, the present review frames stocking density not as an isolated husbandry parameter, but as a core lever through which producers can balance biological performance, product quality, environmental conditions, and economic resilience in hard-clam farming.