

low-value fish, shrimp head waste, and oyster meat in cage fattening, and it gave the best weight gain and molting response among fresh feeds in a single-room system. Formulated diets show promise, but current evidence indicates that formulation quality matters more than formulation alone. Some artificial diet studies found no significant differences in growth, molting, or feed efficiency across tested formulations, suggesting that diets with inadequate protein levels or unstable water conditions can mask treatment effects. Similarly, varying carbohydrate-to-lipid ratios within a 35% isoprotein diet did not significantly affect growth or feed efficiency, although the 31% carbohydrate and 10% lipid treatment showed a favorable trend. More targeted nutrient manipulation appears more effective when aligned with crab physiology: a diet containing 20% starch improved growth and nutrient utilization in juvenile *Scylla paramamosain*, while krill oil supported higher weight gain, specific growth rate, and feed efficiency than linseed oil, with performance similar to fish oil. Feeding frequency appears less influential than feed quality under stable conditions, because RAS culture showed no significant growth differences among once-, twice-, and thrice-daily feeding, although once-daily feeding produced the best overall values. At early life stages, feed choice remains critical, with Lansy pellet feed and frozen *Artemia* producing better growth than pureed shrimp meat and NRD pellets from megalopa to crablet-1.

Precision feeding technologies for mud crab aquaculture are developing toward automated, sensor-linked, and data-driven control of feed delivery. The underlying rationale is strong because feed is a major production cost, and manual feeding often causes waste, labor inefficiency, and inconsistent feeding intensity across ponds. Broader aquaculture research defines precision nutrition as matching dietary composition and feeding strategy to the animal's requirements while minimizing waste. This framework extends beyond simple ration control by integrating genetic background, metabolism, environmental conditions, and production goals. In practical terms, mud crab farming is moving from labor-dependent feeding toward automated and computer-assisted systems, a transition already recognized across aquaculture sectors but still uneven in developing regions. Recent engineering studies show how this transition may occur in crab farming. An IoT-based indoor mud crab system combined automatic feeding with continuous monitoring of pH, salinity, temperature, and water level, and it reported improved growth, reduced mortality, and lower labor demand. Machine-vision monitoring platforms now allow real-time detection of crabs and bait on feeding platforms, with bait detection rates above 90%, offering a basis for adaptive ration adjustment. At the pond scale, RTK-GPS-guided bait casting systems have been designed to achieve variable and spatially uniform feed distribution, with positioning accuracy below 30 cm and continuous feeding speeds up to 240 m² per minute. More advanced feeding boats now incorporate multi-voyage path planning to improve complete bait coverage while reducing repeated paths, turning frequency, and energy consumption. Together, these technologies indicate that precision mud crab feeding will likely combine automated delivery, environmental sensing, machine vision, and algorithmic navigation rather than relying on fixed schedules alone.

Future research should focus on stage-specific feeding strategies, nutritionally optimized formulated diets, and stronger integration between feed management and rearing environment. Current evidence shows that mud crabs do not respond uniformly across life stages or systems. Juvenile and nursery stages appear especially sensitive to feed suitability, salinity, and rearing conditions, with *Artemia*, Lansy pellets, and favorable salinity ranges improving growth or shortening the molting cycle in early-stage *Scylla paramamosain*. By contrast, several grow-out and fattening studies found limited differences among feed treatments when water quality fluctuated or when diets were broadly adequate, indicating that environmental control is often necessary to reveal true nutritional effects. This means future experiments should use better-controlled systems, longer feeding periods, and standardized performance metrics so that dietary effects can be separated from salinity and water-quality noise. Industrial prospects are strongest for feeding systems that reduce dependence on seasonal trash fish while improving feed conversion, labor efficiency, and production consistency. Reviews of mud crab culture already emphasize that sustainable expansion depends on combining suitable feed, rearing system, stocking density, and environmental management rather than optimizing feed in isolation. At the industry level, aquaculture nutrition research points toward more precise requirement estimates, wider ingredient diversification, and greater use of sustainable protein and lipid sources. That direction is directly relevant to mud crab farming, where trash fish remains common but is constrained by seasonality, storage limits, variable quality, and sustainability concerns. Novel ingredient