fragile areas, instead prioritizing regulated hatcheries and the introduction of *L. vannamei* and Specific Pathogen Free (SPF) *Penaeus monodon* for sustainable production. Shrimp farming in India has experienced cycles of rapid growth followed by setbacks, notably the disease epidemics of the late 1990s. Transitioning from the native black tiger shrimp to the exotic Pacific white shrimp (*L. vannamei*) has since revitalized the sector, contributing significantly to seafood exports and coastal livelihoods. Manoj and Vasudevan (2009) emphasize that robust regulatory mechanisms are essential to address environmental challenges such as nutrient enrichment, salinization, and mangrove destruction. To provide a formal legal framework, the Coastal Aquaculture Authority (CAA) was established in 2005 to ensure that activities are conducted in an eco-friendly manner.

Mandatory CAA guidelines now require Effluent Treatment Systems (ETS) for farms exceeding 5 hectares within the CRZ and 10 hectares outside the CRZ to mitigate adverse ecological impacts on open waters. Historically, the influx of private and multinational companies in the 1990s transformed traditional practices into intensive systems, often at the expense of mangrove ecosystems. Mangroves are vital for coastal food security, providing breeding grounds for crabs, prawns, and finfish, while also protecting groundwater aquifers from saline intrusion and buffering against tsunamis and floods. Globally, the rapid expansion of aquaculture has raised sustainability concerns, as unlimited profit motives and poor pond management have led to litigation and social conflict. In countries like the Philippines, Indonesia, and Thailand, high rates of mangrove depletion are directly attributed to shrimp farming expansion.

India accounts for approximately 3.3% of global mangrove cover, with significant areas located in West Bengal, Gujarat, and the Andaman and Nicobar Islands. Historically, some of these wetlands were drained for aquaculture tanks, leading to salt-water intrusion and the release of contaminants into local aquifers. Globally, such environmental degradation negatively impacts genetic diversity, water quality, and the overall feasibility of culture systems (Nesar Ahmed and Marion Glaser, 2016). To ensure long-term sustainability, integrated models combining agriculture, aquaculture, and salt panning are being promoted to meet the diverse dietary and livelihood requirements of coastal communities (Salin and Ataguba, 2018). These integrated approaches aim to harmonize economic development with the preservation of critical coastal habitats.

7 Promotion of inland aquaculture

In freshwater systems, the sustainability of a species depends on its ability to breed in captivity, optimize nutrient output, and adapt to resource-efficient culture environments. Polyculture is generally preferred over monoculture to meet the rising demand for animal protein by maximizing productivity per unit area. As the world's fastest-growing food-producing sector with an annual growth rate of 8.0%, aquaculture in India relies heavily on bulk production of Indian Major Carps (IMC), namely *C. catla*, *L. rohita*, and *C. mrigala*. Additionally, exotic carps such as *H. molitrix*, *C. idella*, and *C. carpio* constitute the second most significant group of cultured fishes. This six-species combination is a cornerstone of modern polyculture in South Asia, achieving high yields by utilizing all ecological niches: the surface (*C. catla* and *H. molitrix*), column (*L. rohita* and *C. idella*), and bottom (*C. mrigala* and *C. carpio*).

Major carps (IMCs) account for approximately 80% of total production in these systems, while exotic species like silver, grass, and common carp contribute significantly to maximizing spatial and nutritional efficiency (Laxmi Prasad et al., 2020). The adoption of such advanced polyculture systems-including sewage-fed aquaculture-enhances food security, builds resilience against extreme weather, and supports the livelihoods of rural farmers (Ghosh, 2020; Bhattacharya, 2021). Despite this potential, challenges such as low technology adoption, disease prevalence, and the high cost of quality feed must be addressed through scaled-up dissemination and capacity building (Lakra and Gopalakrishnan, 2021). Furthermore, biotechnological advancements, including the use of synthetic hormones for breeding, monosex culture, polyploidy, and transgenesis, are revolutionizing the industry. These modern approaches improve nutrition, health management, and gene banking, ultimately bolstering the global aquaculture sector (Lakra and Ayyappan, 2003).