8 Human Resource Development

Currently, India requires technically skilled fisheries professionals to navigate future industry challenges. Enhanced education is vital for improving fish productivity and generating employment across academic institutions, industrial research facilities, and state government departments (Kamleshbhai et al., 2024). Despite ongoing efforts to strengthen manpower, a significant shortage remains in this rapidly growing sector, which ultimately constrains overall growth. Fisheries education fosters innovation and creates employment by transferring specialized knowledge to farmers and stakeholders. Because the sector is highly skill-based, professional training is essential for equipping the workforce for roles in resource management and industrial operations. While comprehensive data are limited, an increasing number of universities now offer advanced M.Sc. and Ph.D. programs in aquaculture and marine sciences to address these needs.

In many higher education programs, modern communication technologies are being effectively utilized to disseminate technological expertise. Graduates with hands-on field experience are better prepared to manage commercial farms and address the technical challenges facing the aquaculture industry. Extension programs further support sector growth by transferring best practices to practitioners, while specialized training-such as scuba diving for resource assessment-addresses critical human resource gaps in deep-sea fishing and governmental departments. Furthermore, the Central Institute of Fisheries Education (CIFE), through its HRD initiatives, has trained a significant number of extension workers who promote sustainable practices nationwide. These trained professionals find diverse employment in research, academia, and administration, where their expertise helps build robust cold chains and marketing networks to reduce spoilage and waste.

9 Sustainable Ecofriendly Aqua Farming Technologies

The integrated fish farming (IFF) is an optional solution refers to the production and integrated management of comprehensive use of aquaculture, agriculture and livestock giving emphasis on a sustainable farming system. It is efficiency better in resources utilization in enhanced income and higher food fish production. IFF is simple, cost-effective technology to ensure employment, food and nutritional security for marginal and small hill farmers suitable to use resources sustainably to achieve the productivity as economic viable systems. It enhances the net return, generates employment, conserves natural resources, reduces the cost of production and increases the income by minimizing risk enable farmers producing diverse food by conserving resources well. IFF practices are highly eco-friendly and ensures higher returns as well as suitable for sustained production of fish and other components (Deepa Bisht, and Harshit Pant Jungran, 2023). The practice of carp polyculture introduced in China and India, as a traditional aquaculture production technique and in many Asian nations with integration of conventional management practices of animal husbandry. The farming supports aquaculture as ecologically healthy ecosystem with culture of native carp species, freshwater prawns with appropriate stocking of different fishes having different feeding habits. The wastage generated from agriculture also utilizes as fertilizer or feed in fish culture. Thus fishery sector plays a vital role in the socio- economic development of the state and is recognized to stimulate the growth of several subsidiary industries and is a cheap nutritious food besides being a foreign exchange earner.

10 Integrated Multi Trophic Aquaculture (IMTA)

Integrated Multi-Trophic Aquaculture (IMTA) is a sustainable and innovative approach that cultivates multiple species from different trophic levels within the same aquatic system. By utilizing the waste products of one species as nutritional inputs for another, IMTA creates a closed-loop system that reduces environmental impact and maximizes resource efficiency. In a typical IMTA configuration, three distinct groups are cultured: primary high-value finfish (e.g., salmon or trout), secondary filter-feeders or detritivores (e.g., shellfish or sea cucumbers), and tertiary extractive species (e.g., seaweeds or algae). The primary species produces waste in the form of uneaten feed and fecal matter, which microorganisms convert into dissolved nutrients. These are then sequestered by the secondary and tertiary species, transforming potential pollutants into valuable biomass while significantly improving water quality.