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Turning the Tide: Sustainable Utilization of Billfish Waste in Tamil Nadu

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Abstract

Billfishes such as sailfish, swordfish, and marlins are highly valued in Tamil Nadu's marine fisheries for their commercial and ecological significance. However, the post-harvest waste generated from these species remains underutilized, leading to environmental degradation and missed economic opportunities. This paper explores the current status and potential for sustainable utilization of billfish waste in Tamil Nadu, with a focus on Thengapattinam, the state's leading landing center for billfishes. It highlights the composition and disposal practices of billfish waste, the associated environmental and economic impacts of mismanagement, and the wide range of value-added products that can be derived from these by-products, including fish meal, oil, collagen, and silage. The study underscores the importance of institutional and policy interventions, including the establishment of waste processing infrastructure, promotion of community-level enterprises, and the development of a comprehensive fisheries waste management policy. By advocating a circular economy approach, the paper envisions a model where fish waste is transformed into a resource, contributing to environmental sustainability and enhanced livelihoods for coastal communities in Tamil Nadu.

Introduction

Billfishes such as sailfish, swordfish, and marlins are large pelagic fishes known for their elongated bills and fast swimming capabilities. These species are highly prized in recreational and commercial fisheries due to their size and meat quality. In Tamil Nadu, billfishes contribute modestly to total marine fish landings but are significant in value due to demand in local and export markets [1]. These species are caught predominantly using longlines and drift gillnets by mechanized and motorized crafts. Their presence in Tamil Nadu waters, especially along the west coast, highlights the ecological richness of the region. Apart from their role as apex predators, they help maintain the balance in marine food webs [2]. Despite their importance, post-harvest handling and waste management of billfishes receive limited attention. The waste generated from these fishes can be substantial, especially when large landings occur. This waste often includes fins, bones, skin, and viscera, which are rich in nutrients. If properly utilized, billfish waste can be

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transformed into economically valuable products, contributing to sustainability in the fisheries sector [3].

Highest Landings in Tamil Nadu

Thengapattinam, located along the west coast of Tamil Nadu, records the highest billfish landings in the state [4]. This is largely due to the region's active longline fishing fleet and favorable fishing grounds that attract large pelagic species. Fishing activities in this area are well-coordinated, and fishers possess deep traditional knowledge of the behavior and migratory patterns of billfishes. The harbor facilitates regular landing of swordfish, sailfish, and marlins, making it a vital hub for these species. However, the high volume of landings also leads to significant generation of waste. During peak seasons, waste from billfish processing can account for 40–50% of the total biomass [5]. Unfortunately, most of this waste is discarded untreated, leading to environmental concerns. The lack of dedicated waste processing units further aggravates the problem. With the implementation of targeted interventions, Thengapattinam can become a model for sustainable waste management and utilization. This requires collaboration among fishers, processors, researchers, and government agencies to implement best practices in waste handling [6].

Improper Disposal of Billfish Wastes at Landing Centre

Billfish wastes were discarded directly into the sea

Waste Composition and Disposal Practices

Billfish waste primarily includes parts such as the head, fins, internal organs, bones, and skin. These components are typically removed during the primary processing stage at landing centers or during secondary processing at facilities. In many fishing harbors of Tamil Nadu, including Kasimedu, Tharuvaikulam, and Thengapattinam, this waste is discarded into nearby waters or onto land adjacent to harbor premises [7]. Such practices lead to water pollution, foul odor, and unhygienic conditions for both workers and visitors. The waste is rich in protein and oils, making it suitable for conversion into

valuable by-products like fish meal and fish oil [8]. However, due to lack of infrastructure and awareness, these opportunities are often missed. Improper waste disposal also attracts scavengers and contributes to the spread of disease. Community-based waste management systems and the introduction of mobile waste processing units could address this issue effectively [9]. Establishing linkages between fishing cooperatives and fish meal plants would help channel the waste into productive use. With structured systems in place, the problem of disposal can be turned into an opportunity for economic gain [10].

Economic and Environmental Impact of Waste Mismanagement

The improper disposal of billfish waste has both environmental and socio-economic implications. Environmentally, the dumping of organic fish waste into coastal waters can lead to eutrophication and oxygen depletion, impacting local marine biodiversity [11]. Fish waste on land can produce strong odors and become breeding grounds for flies and other pests. This affects the overall sanitation of fishing harbors and reduces the appeal of fish markets to consumers and tourists. Economically, waste mismanagement results in the loss of potential income that could be generated from value-added products. The waste, if converted into fish meal, could supply the growing demand in poultry and aquaculture feed industries [12]. In addition, fish oil and collagen extracted from waste are in high demand in the pharmaceutical and cosmetic industries. Without proper systems, these economic benefits are foregone. Implementing structured waste management not only helps in conserving the environment but also provides employment opportunities in fish waste processing [13]. The government and private sector can play crucial roles in establishing cold chains, processing units, and training centers to support these initiatives.

Potential Uses and Products from Billfish Waste

Billfish waste is rich in nutrients and biochemical compounds that make it ideal for producing various products. The head, bones, and fins are excellent sources of gelatin and collagen, which are used in the food, cosmetic, and pharmaceutical sectors [14]. Fish oil extracted from internal organs is rich in omega-3 fatty acids and has health benefits for humans. The solid waste components can be ground and dried to produce fish meal, a crucial ingredient in animal and aquaculture feed. Fish silage can also be produced by fermenting waste with organic acids or enzymes [15]. In addition, waste can be composted and used as organic fertilizer in agriculture. These products can fetch attractive prices in both domestic and international markets. Small-scale women's groups and self-help groups can be trained in producing dried fish silage or compost, providing them with alternative livelihoods. Supporting entrepreneurship in fish waste valorization would also reduce dependency on traditional fishing incomes [16]. With proper planning and support, the

transformation of billfish waste into marketable products is not only feasible but also profitable.

Status of Fish Meal Industry in Tamil Nadu

Tamil Nadu houses several fish meal plants along its coastal belt, primarily focused on low-value species and trimmings from commercial fish. However, there is limited utilization of high-value waste such as billfish by-products [17]. Most fish meal plants are located in regions like Thoothukudi and Nagapattinam. The inclusion of billfish waste into these plants' input streams could improve the quality of the final product due to the higher protein content of these species. However, lack of coordination and structured waste collection systems prevents this [18]. Mobile processing units and decentralized collection centers near landing sites can help bridge the gap. Fish meal made from billfish offcuts could meet the growing demand in the poultry and shrimp farming industries. Research into optimizing processing conditions for such high-value waste is essential [19]. If supported through policy and subsidies, Tamil Nadu's fish meal sector could become a benchmark for sustainable fishery byproduct utilization.

Institutional and Policy Interventions Required

For the sustainable management of billfish waste, institutional support and regulatory frameworks are vital. Currently, marine waste management in Tamil Nadu operates in a fragmented manner with overlapping roles between the fisheries, environment, and municipal departments [20]. A comprehensive fisheries waste management policy that includes guidelines for handling, transporting, and processing of fish waste is necessary. Such a policy should also promote the establishment of fish waste collection centers at major landing sites. Government agencies can incentivize fishers and processors to adopt sustainable practices through subsidies, training, and capacity building programs [21]. Partnerships with academic institutions can facilitate research and pilot projects on fish waste utilization. International case studies and success stories can guide policy formulation. Waste audit systems should be implemented to monitor disposal methods and ensure compliance. A dedicated task force on fish waste management under the Department of Fisheries could help coordinate all stakeholders and implement a holistic action plan.

Conclusion

The potential for sustainable utilization of billfish waste in Tamil Nadu is immense but largely untapped. With increasing emphasis on environmental sustainability and blue economy principles, the fisheries sector must adopt circular economy models [22]. Instead of viewing fish waste as a disposal problem, it should be considered a resource for

generating value. Thengapattinam, with its high landings, can act as a model hub for piloting waste utilization projects. Collaboration among fishers, researchers, policymakers, and entrepreneurs is essential to realize this goal. Technological innovations, supported by policy and funding, can ensure the transformation of billfish waste into economically viable products. This shift will not only reduce the environmental footprint of marine fisheries but also enhance the livelihoods of coastal communities. Moving forward, Tamil Nadu can lead the way in setting up sustainable fisheries waste management systems aligned with global sustainability goals.

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