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Identification of Suitable Areas for *Pinctada* sp. (Pearl Oyster) Culture in the Northwestern and Northern Regions of Sri Lanka, Based on GIS Approaches

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Abstract

Pearls are usually referred to as the "queen of jewels" and are highly lucrative products in the global market. Therefore, pearl oyster culture receives greater attention in aquaculture. Site selection is a crucial but time-consuming and expensive process in any aquaculture facility. Even though over 2,000 years, the Gulf of Mannar has sustained pearl fisheries in Sri Lanka, site selection for pearl culture has not yet been studied. Therefore, this study focuses on identifying suitable sites for pearl oyster culture in the Northwestern and North coasts of Sri Lanka using satellite data. For this study, a GIS-based multi-criteria evaluation process was used to identify the most suitable sites for pearl culture, and the suitability analysis was based on physicochemical parameters including bathymetry, chlorophyll concentration, temperature, pH, salinity, Secchi disk depth, current speed, and dissolved oxygen in this study area. Satellite data from 2022 to 2023 were downloaded from the Copernicus Marine Service and Gridded Bathymetry Data. Ultimately reclassifying the data and weighted overlay for multi-criteria analyses were performed by using ArcGIS 10.6 software. In this research, the study area was classified into three classes: 'Highly suitable', 'Moderately suitable', and 'Less suitable' depending on their suitability levels. Suitability analysis revealed that the variations observed in pH and dissolved oxygen concentration fell in the year-round 'Highly suitable' range. However, bathymetry, chlorophyll concentrations, Secchi disk depth, current speed, and salinity observed the monsoonal fluctuations of the study area become 'Moderately suitable' or 'less suitable'. The results suggest that except for the 1st inter-monsoon period, the other monsoons show almost similar levels of high suitability throughout the study period. In contrast, the 1st inter-monsoon period exhibits smaller areas with high suitability for pearl culture during the study period. Year-round high suitability was observed in the Gulf of Mannar, above and below the Mannar Island, Achchankulam, and Chilaw regions, highlighting these areas as potentially suitable for pearl culture across the 2022 and 2023 years. Among these highly suitable sites, the Gulf of Mannar showed the largest highly suitable patch, ranging from 88 km² in the 1st inter-monsoon period to 568 km² in the northeast monsoon period.

Keywords: *Pinctada sp., Pearl culture, Area suitability, Site selection, Multi-criteria analysis, Physicochemical parameter*