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Opinion Article

Remote Sensing Estimates for Dissolved Oxygen at Aquaculture Operations

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DESCRIPTION

Since it is necessary for aerobic metabolism, oxygen is one of the environmental factors that has the greatest impact on the physiology and performance of marine creatures, along with temperature. As a result, the level of dissolved oxygen (DO) in the water is an important monitoring parameter for finfish aquaculture since it has a direct impact on the survival, growth, intake of food, and health of the farmed fish. The thorough and ongoing monitoring of DO is essential for an aquaculture cage in particular since the ambient conditions at rearing sites are subject to variations that could endanger output and are consequently out of human control. Over the years, semi-automatic and automated techniques as well as manual measurements employing sensors have been used to monitor DO. While these straightforward methods of DO monitoring have worked well for historically empirical practises, the rapid expansion of aquaculture toward precise, data-driven management (precision farming) calls for the creation and application of sophisticated systems that make use of automation and contemporary technologies for forecasting and real-time monitoring. The ability to predict the oxygen content in the farm based on the site-specific characteristics of the farming area and its surrounds is particularly significant. Sensors are not very effective for this information since they cannot cover the necessary region. Additionally, structured aquaculture zones with multiple farms placed have comparable requirements, and forecasting requires extensive monitoring. Remote sensing is a promising area that might offer practical tools in the situation.

For the detection of optically active parameters including temperature, total suspended matter, and chlorophyl-a (chl-a), remote sensing is frequently utilised. Parameters that have an impact on water's optical characteristics at particular wavelengths can be found via satellite sensors. Therefore, it is doubtful that the satellite sensors' reflection measurements will directly represent the DO concentration. However, studies have shown that because of its association with other parameters, including temperature and chl-a, it can be indirectly measured. In general, DO and sea temperature show a negative association. The solubility of oxygen declines as water temperature rises. So, throughout the winter and early spring, when the concentration peaks, and during the summer, when it reaches its lowest point, surface waters can show seasonal fluctuations in DO concentration. Studies have revealed that solubility caused by temperature is the primary factor driving DO concentrations in surface waters, particularly in the Mediterranean.

The primary production is a significant oceanographic factor that also has a significant impact on the levels of DO. Primary production is typically measured in remote sensing by chl-a concentration, which serves as an indicator of phytoplankton abundance in surface waters. Because phytoplankton releases oxygen during the daytime as a result of photosynthesis, there is a positive link between chlorophyll concentration and DO. This is most noticeable in the productive water layer, where the depth changes depending on the season and kind of phytoplankton as well as between the surface and the thermocline. Since the ocean-atmosphere gas exchange takes place in surface waters, oxygen levels are higher there. Conversely, at depths below 200 metres, where the euphotic zone often ends and oxygen absorption due to organic matter breakdown begins, oxygen levels are lower. However, studies have shown that high phytoplankton levels might have the opposite impact. Phytoplankton absorbs oxygen during night when there is no light, and in cases of extreme abundance, it can even result in anoxic conditions in the ocean. In these situations, the environment degrades, which negatively affects larger organisms like fish. The effect might be worse in the case of aquaculture farms when fish are present in large quantities.

Several researchers have attempted to create models based on the correlation of DO with various environmental parameters, such as sea surface temperature (SST) and chl-a, in order to estimate its concentration and distribution. These models were developed with the knowledge of the aforementioned theoretical mechanisms. To estimate water parameters using Landsat data. They used field measurements from 16 stations on around the

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same dates and 18 Landsat 7 pictures. However, because the created methodology is based on local measurements, it cannot be applied to other study regions, despite the fact that their results were quite encouraging. This is seen to be a limitation of this study because we have observed that the disparities between the predicted and measured values are greater when the values are outside the usual range. We intend to expand our investigation to new locations with a variety of local variables in order to provide our model with more data in order to solve this difficulty. For the model to be properly trained and subsequently improved, the dataset must be expanded to include more cases.