氏　　　　名	AL-BAGHDADI Mohammed Baqer Naji
授与した学位	博　士
専攻分野の名称	工　学
学位授与番号	博甲第　　　６７２２　　　号
学位授与の日付	２０２２年　９月　２２日
学位授与の要件	環境生命科学研究科　　　環境科学専攻 （学位規則第４条第１項該当）
学位論文の題目	Investigation of the physical environmental characteristics for tidal flat creation in brackish water areas of the Yoshii river and the Asahi river （吉井川及び旭川の汽水域における干潟造成に向けた物理環境特性の検討）
論文審査委員	教授　西山　哲　　准教授　赤穂　良輔　　准教授　吉田　圭介　　教授　前野　詩朗

学位論文内容の要旨

　Environmental conservation in estuarine tidal flats is an important environmental engineering issue because they embrace a variety of lifeforms creating unique ecosystems. The tidal flat area in the estuary of the Yoshii river, southwest of Japan, is natural habitat to many organisms, including some threatened species of animals and plants. This area has decreased over the past decades and the only remaining part of it is the so-called Otogo tidal flat which is located at left bank side between 2.0~2.6 km from the river mouth. This study aims to propose a new tidal flat creation sites based on the physical environmental characteristics obtained by flow analysis of the Yoshii River estuary. Since the Yoshii river is hydraulically connected to Kojima bay which is connected to the Asahi river, we cannot study it separately without understanding the whole system of the Asahi river, Kojima Bay and the Yoshii river.

　In this study, fixed-point observation setup, in which salinity loggers are installed in a vertical configuration at a fixed point to take measurements at a long period of time, was conducted at four locations of the system: (1) upstream of the Yoshii River, (2) near the Yoshii river mouth, (3) Kojima Bay center, and (4) the Asahi river mouth. Furthermore, local observations using underwater drone were performed at specific locations to understand the salinity movement.

　Next, a quasi-three-dimensional model that considers the effects of tidal run-up in salt water was used to simulate the flow and salinity behavior. The salt flow model is constructed to consider the effect of baroclinity by using the additional dispersion flux term, and can predict saltwater intrusion into brackish rivers under moderate to well mixed conditions.

　The results showed that the tidal (shallow) part of the Yoshii river has a well to moderate mixing condition, and the salinity increases at the deeper parts. At the Yoshii river mouth, well-mixing and high salinity (up to 33 PSU) was observed, which was used to set the boundary value of the numerical model. In Kojima Bay, the salinity trend showed well-mixing conditions, and at the Asahi river mouth more moderate-mixing behavior was observed because it is located at the closed end of the bay.

　Finally, numerical analysis results showed that a promising location for tidal flat regeneration in terms of hydraulic and salinity characteristics was suggested at the sections ranging 3.9−4.6 km from the river mouth. However, since it has a limited vegetation area in the transverse direction, with a width of only 30 m, the performance under hypothetical flood conditions showed poor shear stress resistance. Therefore, improvements of extending the length of the vegetation area by adding sediment and constructing new groynes were introduced. Numerical results showed a that these improvements can successfully secure a tidal flat land that has similar behavior as the Otogo tidal flat. It is conceivable that the method of this study can be applicable to other rivers by combining with the field observation to examine the candidate area for creating tidal flat.

<div align="center">

論文審査結果の要旨

</div>

　本研究では，吉井川感潮域に位置する乙子干潟の保全・再生に向けた研究として，吉井川の塩水遡上を中心とした干潟周辺の物理環境特性について，現地観測および数値解析より検討が行われている。本研究で得られた主な成果は以下の通りである。

　1)吉井川河道内の塩分流動特性の把握を目的として，河床に固定したブイを用いた定点観測と水中ドローンを用いた集中観測が実施された。観測結果より，吉井川河口付近，乙子干潟周辺，潮止堰下流地点における塩分の混合状態の季節的な特徴と，満潮時及び干潮時の乙子干潟周辺における塩分鉛直分布の特徴を明らかにしている。

　2)実用的な準三次元モデルを用いて吉井川下流域における塩水遡上計算を実施し，現地観測結果との比較から再現性を検証するとともに，数値実験より干潟の新たな造成候補地の提案を試みた。数値実験結果より，平水時の塩水遡上特性および出水時の河床せん断力に着目した検討を行ったところ，吉井川左岸側の河口から3.9-4.6kmの地点において，水制の設置と土砂の投入，ヨシの植栽を併用することで，同様の物理環境特性を有する干潟を造成できる可能性が示唆された。

　近年，干潟の重要性は再認識されており，干潟の保全・再生の取り組みが各地で進められている。本研究内容は，人工的な干潟造成に向けて，実用性の高い数値解析モデルを用いて検討がなされており，学術的だけでなく，社会的に有用な知見が示されていると考えられる。また，論文発表会において，研究背景，研究方法，結果の意義について分かりやすく説明がなされており，質疑においても適切な回答がなされていた。

　以上より，合格に値すると判定した。