Response to reviewer's comments

We'd like to thank the editor for giving us a chance to revise the manuscript. We also would like to thank the reviewers for spending their expensive time and expertise to comment on our manuscript. We have carefully read the comments and revised the manuscript accordingly, point by point. Based on these comments, we think that the quality of the manuscript has been very much improved and now meets the journal standard. All the changed texts in the revised manuscript are marked with **red color** in a separate file for reviewing.

Reviewer 2

Soil salinity, which significantly impacts agricultural activities worldwide, is considered one of the major environmental hazards caused by both natural and human-induced processes. This phenomenon has become increasingly severe due to the impacts of climate change, particularly rising sea levels. Therefore, evaluating soil salinity is regarded as a critical task for supporting sustainable agricultural planning. Assessing adaptive capacity is also regarded as a crucial instrument for reducing the impact of soil salinity on local livelihoods. One of the strengths of this article is the integration of physical data, machine learning models, and socio-economic data (through interviews with local populations). As such, this article is relevant and well-aligned with the journal's scope. I accept publishing this article with the condition of major revisions.

Response: We would like to thank the reviewer for the constructive and valuable comments. We have revised the manuscript's content based on your feedback and addressed them all. The manuscript's quality has been significantly improved after the revision. Going forward, our responses in blue are to try our best to ensure clarity and efficiency, but please know that we genuinely appreciate all the reviewer's inputs.

Abstract: Although the authors present the objectives, data, and results of the article, I would like to see the inclusion of quantitative results and the significance of the findings.

Response : Thank you for your observation. We have added the quantitative resultat in the abstract.

Introduction: It is necessary to point out the importance of this article. Additionally, it is important to emphasize the role of adaptive capacity in reducing the effects of soil salinity.

Response : Thank you for your observation. We have added the information due to the role of adaptive capacity in line 116-127.

"The adaptive capacity is defined as the capability of the community to cope, adjust, and adapt to the impacts of growing soil salinity. It measures the ability to predict, respond, and recover from the phenomenon. It is assessed on different scales, using different approaches, according to the region in question (Mazumder and Kabir, 2022; Thiam et al., 2024). Furthermore, understanding the adaptive capacity of communities plays an important role in reducing the negative effects of salinity intrusion in coastal regions in general and the Red River Delta in particular. By assessing adaptation at multiple scales with site-specific methods, researchers and local governments can identify interventions (such as crop variety changes, crop calendars, irrigation systems) that are effective. The IPCC in 2014 indicated that farm adaptive capacity depends on five main factors: natural capital, human capital, material resources, financial resources, and social capital. Therefore, integrating the adaptive capacity of populations with the soil salinity map improves the accuracy of predictions and proposes adaptation strategies that strengthen the overall resilience of communities.”

Study Area: The reasons for selecting this study area should be explained in more detail, especially the effects of soil salinity on agricultural activities.

Response : Thank you for your observation. We have added the information due to the effects of soil salinity on agricultural activities as suggested in line 180-186

Map 1: Please revise Map 1 for better clarity.

Response: Thank, corrected.

Map 2: Similarly, Map 2 should be revised for better quality.

Response: Thank, corrected.

Methodology: This study uses machine learning and optimization algorithms to construct the soil salinity map. However, I do not fully understand how the authors constructed these models. A more detailed explanation is needed.

Response: Thank you for your observation. We have added the information due to explaine how they are integrated with the XGBoost model with the algorithm optimisation in line 270-291.

« The machine learning model-building process was divided into two main steps: the first was the XGB model building, and the second was the hybrid model building (the integration of XGB with optimization algorithms). The accuracy of the machine learning model depends on the parameter adjustments of the XGB model. In this study, the XGB model parameters were selected using the trial-and-error method. Finally, the XGB parameters were n_estimators=100, max_depth=4, subsample=0.5, and colsample_bytree=0.5. While the hybrid model was built by integrating the XGB model and optimization algorithms, namely GOA, POA, SOA, STO, and PSO. To integrate the XGB model with optimization algorithms, we first need to construct an objective function F(θ) that returns the error value of XGB on the validation set when using the parameter sets θ. That is, each parameter set has a different error value. Next, determine the search space of the hyperparameters (n_estimators, max_depth, subsample, colsample_bytree) as discrete value intervals. Then, the optimization algorithms will initialize the population of individuals with the size and parameters characteristic of each optimization algorithm. This study was tested with 500 iterations: at each iteration, each individual will generate a combination of θi, and the optimization algorithms will update the position or velocity of the individuals according to their own rules. This process is repeated until a stopping threshold is set. Finally, the results are the optimal parameters. The parameters of the model are as follows: problem_size = 3, batch_size = 25, epoch = 500, pop_size = 50, "fit_func": fun_avr2, "lb": [0] problem_size, "ub":

[1] problem_size, c_min = 0.00004, c_max = 2.0 for XGB-GOA; problem_size = 3, batch_size = 25, epoch = 500, pop_size = 50, “fit_func": fun_avr2, "lb": [0] problem_size, "ub": [1] problem_size, c1=2.05, c2=2.05, w_min=0.4 for XGB-PSO ; problem_size = 3, batch_size = 25, epoch = 500, pop_size = 50, "fit_func": fun_avr2, "lb": [0] problem_size, "ub": [1] problem_size for XGB-POA; problem_size = 3, batch_size = 25, epoch = 500, pop_size = 50, "fit_func": fun_avr2, "lb": [0] problem_size, "ub": [1] problem_size for XGB-SOA; problem_size = 3, batch_size = 25, epoch = 500, pop_size = 50, "fit_func": fun_avr2, "lb": [0] problem_size, "ub": [1] problem_size for XGB-STO.»

Interviews with Local Populations: The inclusion of the interview methodology is necessary because adaptive capacity is a key outcome.

Response: Thank you for your observation. We have corrected the interview methodology.

Discussion: Although this article clearly discusses the strengths and weaknesses of the machine learning models and also touches on the adaptive capacity of the populations, I believe it would be useful to add the methodology for addressing the effects of soil salinity at the community level.

Response: Thank you for your observation. We have added the information due to the strategie to reduce the effects of soil salinity in line 704-717.

“From field surveys, it can be seen that in the Red River Delta, adaptation options to soil salinity mainly rely on upgrading the sea dike system, river dikes, and saline prevention sluice systems. In addition, other adaptation options mainly include increasing the resilience of the current agricultural system, such as changing the crop calendar, changing crop varieties, using fertilizers, and planting mangroves. Many households have transitioned from rice cultivation to aquaculture in coastal areas, where soil salinity has a significant impact. In addition, some fish farming households have also switched to shrimp farming or fish farming due to increased saline intrusion. Some households do not have the capital to convert their agricultural systems, and while agricultural productivity decreases due to saline intrusion, they consider finding non-agricultural jobs or migrating to the city to find jobs with more stable incomes. Households located further inland, less affected by saline intrusion, still maintain traditional agriculture. Some households practice intercropping by growing rice alongside vegetables to increase their income. Thus, it can be seen that the adaptability of households in the Red River Delta is not only based on strengthening the system of sea dikes, river dikes, and salinity prevention sluices, but also on transforming the traditional agricultural system to minimize the impact of salinity intrusion. However, capital barriers force many households to abandon agriculture, seriously affecting the food security situation in the region.”

Extrapolation Issues: In this section, the authors present issues of extrapolation. I would suggest expanding on this point, as it is a challenge not only in soil salinity but also in other types of natural hazards.

Response: Thank you for your observation. We have added the discussion due to the extrapolation issues in line 718-727.

"A significant problem when using machine learning is that of extrapolation. Each model built is adapted only to one set of data. Therefore, evaluating the soil salinity in other regions is challenging. General, there is only one model that fits each training dataset. In theory, this would not be a problem if enough training data were collected and all extreme events were included. However, in practice, it is very difficult to collect data for all these events, especially in the context of climate change and sea level rise.. To solve this problem, several studies have pointed out that integrating machine learning with conventional models for example, remote sensing or hydrodynamic models can be effective, as such traditional models can provide the training data to use as the input file of the machine learning model. Another solution is to combine machine learning with optimization algorithms, as in this study, to enhance the prediction capability of the machine learning model (Tran and Kim, 2022)."