

A summary of the online meeting (the second time) held on Apr 25, 2023

Our second meeting was successfully done again: four researchers delivered inspiring presentations, and participants actively exchanged their ideas. More than 25 people joined the meeting. The following are some highlights of this meeting.

Presentation #1: Pollution and risks of contaminants of emerging concern in the Lake Victoria Basin.

Dr. Kandie from Moi University presented (i) occurrences of contaminants of emerging concern in water, sediments and biota in the Lake Victoria Basin, (ii) removal efficiencies of pharmaceutical residues in wastewater stabilization ponds, and (iii) risk assessment for crustaceans exposed to sediment concentrations. Dr. Kandie also provided an outlook that the risk assessment results can in turn serve as base information to prioritize compounds for national level monitoring and regulation in Kenya. In the Q and A session, Prof. Sakakibara asked about the most important micropollutants that should be controlled in Kenya, and also requested a comment on antibiotics. Dr. Kandie answered that based on obtained results, the most important pollutants are pesticides; specifically diazinon and pirimiphos-methyl were found to drive the risk considerably for crustaceans, but for algae and fish, a different category of compound (e.g., herbicide) poses a risk. Dr. Kandie noted the uncertainty associated with underlying data used for risk assessment, which in some cases are based on developed countries' situation. Dr. Kandie noted that steroids, although not studied in detail yet, might be important pollutants and the inclusion of steroids could provide a different picture of risk assessment. Dr. Kandie let us know that antibiotic microbial resistance is now under investigation, as this is related to human health risks. Prof. Kipkemboi asked Dr. Kandie whether micropollutant concentrations in macro-invertebrate have been investigated. Additionally, Prof. Kipkemboi provided an insight that it is possible to use the presence of micropollutants in macro-invertebrate as an indicator for pollution significance. Dr. Kandie responded to Prof. Kipkemboi, saying that a link between micropollutants and macro-invertebrate can be revealed through a multivariate analysis, where levels of micropollutants accumulated in bodies, abundance and divergence of species could be correlated to identify areas severely affected by the pollution. Dr. Inagaki inquired about the location of analytical equipment (high resolution liquid chromatography mass spectrometer), the way of sample transportation to Germany, and difficulties arisen with respect to the shipment (e.g., customs clearance procedure). Dr. Kandie shared her experiences ranging from sample preservation in a lab to the shipment procedures, and noted that the entire operation was smoothly executed.

A list of Dr. Kandie's works related to her presentation can be found in:

<https://scholar.google.com/citations?user=7p8IKd0AAAAJ&hl=en&oi=sra>

Presentation #2: Microcystin in Lake Victoria—A liver cancer causing agent

Prof. Onyango from Masano University, who is an expert on molecular epidemiology, introduced an ongoing research project about molecular application of protein phosphatase 2A in cyanobacteria microcystins quantification and degradation in water purification systems. Prof. Onyango leads a research group studying the direct association between the presence of serum microcystin and development of primary liver cancer in patients who take water without any treatments for drinking and daily use purposes from Lake Victoria, where algal blooms are often observed. Prof. Sakakibara inquired about the validity of the claim that microcystin contained in drinking water causes liver cancer in the Lake Victoria region, referring to the fact that cyanotoxin levels are not that high enough to cause diseases such as cancer in lakes all over the world. Prof. Onyango affirmed that it is the case in the studied area. According to Prof. Onyango, in the research design, other factors potentially contributing to the cause of cancer were controlled; hence, it is most likely that high levels of microcystin in blood played a major role in the development of cancer in patients. Prof. Kipkemboi asked about identification

of a main species producing cyanotoxin, and then further showed his concern over the safety of cage culture fish farming in Lake Victoria. Prof. Onyango noted that a particular species has been already identified by the research group, and also that the identified species is currently fed to fish. Prof. Onyango provided an additional research finding that fish kidney and muscle actually contain a high level of cyanotoxin as a result of feeding. With this regard, Prof. Onyango stressed that bio-accumulation in fact accelerates in Lake Victoria. Prof. Kipkemboi commented that studying the cause of algal blooms in Lake Victoria and understanding what happens in the catchment would be necessary to eventually protect consumers of fish cultivated in Lake Victoria. Dr. Obubu asked three questions: (i) have other liver diseases been looked at other than cancer?; (ii) which are the most vulnerable groups for the microcystin effect?; (iii) how about the regulation and guideline to control microcystin. On behalf of Prof. Onyango, Dr. Ramkat assisted in responding to Dr. Obubu's questions: (i) other diseases have not been investigated yet. Skin allergy and itches are typical symptoms that studied patients exhibited; (ii) a categorization of patients has not been done yet, but may be explored in the future; (iii) the research group has already sought collaboration with policy makers and stakeholders for the establishment of regulations and guidelines.

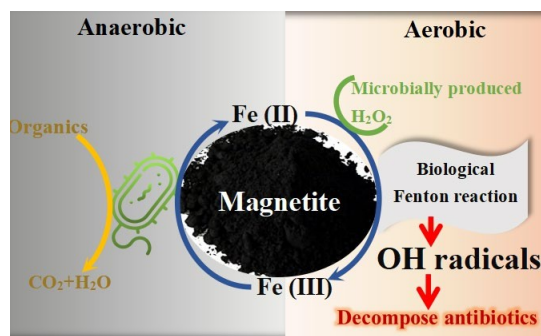
Presentation #3: Satellite image-assisted water quality parameter estimations for the effective management of Two Rivers Dam Reservoir

Ms. Omondi from Prof. Emmanuel's group at Moi University talked about a research project, where she successfully retrieved four reservoir water quality parameters (i.e., chlorophyll-a, suspended solids, dissolved oxygen and turbidity) using satellite images for waters in Two Rivers Dam Reservoir. Ms. Omondi employed the empirical multivariate regression model to correlate remote sensing-derived data with field data that were obtained three times at 13 locations during the period from December 2020 to January 2021 (corresponding to the dry season in Kenya). Dr. Sagawa first asked about the reason for the selection of Landsat and suggested a use of Sentinel imagery. As a response, Ms. Omondi pointed out the revisit time of Landsat 8, shortening of this revisit time that can be achieved with combinations of Landsat 8 and 9, and her preference of Landsat over Sentinel, citing previous studies for the comparisons of the two satellites. The second question from Dr. Sagawa was what components of satellite-derived data contributed mainly to the estimation of water quality parameters. As a response to Dr. Sagawa, Ms. Omondi explained how to extract data (i.e., digital numbers and spectral reflectance values) from images. Prof. Onyango posed a question about the mechanisms of how water quality parameters can be estimated and the entire workflow about satellite data acquisition, and possibilities of estimation of nitrate, phosphate and sulfate concentration levels in water with satellite images. Ms. Omondi explained the details of her work for field surveys, laboratory analysis and satellite image analysis. Ms. Omondi also mentioned that nutrient concentrations can be estimated using proxy indices such as chlorophyll, according to the literature.

Presentation #4: A bio-AOP process to treat antibiotics

Ms. Shen from Prof. Sakakibara's group at Waseda University introduced a novel approach to treat antibiotics that are difficult to be removed with a conventional biological process. She first laid out antibiotic microbial resistance issues, advanced oxidation process, in particular a Fenton process, and in-situ production of hydrogen peroxide. Ms. Shen then introduced the advanced activated sludge process, which incorporates heterogeneous Fenton reactions coupled with microbial production of hydrogen peroxide (the conceptual diagram for a bio-Fenton sequencing batch reactor system is shown below). Afterwards, Ms. Shen presented representative experimental results demonstrating the performance of the proposed system, such as detection of OH radicals, redox cycle of magnetite, continuous microbial production of hydrogen peroxide, superior removal performance of sulfamethoxazole, a model antibiotics compound used in her study. Dr. Obubu acknowledged the importance of Ms. Shen's study and asked

about the removal performance under different operating conditions. As a response to Dr. Obubu, Ms. Shen commented on the optimal condition for magnetite dose levels in her experiments.



Graphical abstract from Shen et al (2022)

Updates of our initiatives

Dr. Inagaki briefly explained the current status for three ongoing tasks: (i) development of learning materials for satellite image analysis; (ii) creation of a website for our group; (iii) preparation for a research fund application. The first item is currently dedicated to supporting institutional capacity building for Malawi and Uganda government institutes. However, developed resources will be bundled as a package and will be then expected to be used for personal skill development of our group members and/or tools of an instructor for a short course given by a member of our groups. The purpose of the second item is to make visible to the world our initiatives, research findings obtained through our research projects, and analytical techniques including code. This platform also functions to ensure reproduction of research. The positive side effect is that this website will contribute to displaying our research capacities, thereby attracting proposal evaluators in funding agencies as well as potential collaborators outside our group. For the third item, Dr. Makwinja preliminarily provided some insights. Considering that our group consists of people in different sectors (not only in academia but also in the government sector), It is possible to make smooth collaborations between a research institute (e.g., a university) and a government entity. The university side mainly proposes an idea for an effective intervention for environmental problems, while the government side actually implements the intervention. Furthermore, at the meeting, Dr. Makwinja proposed an idea of the establishment of a data bank to advance research capabilities in Africa, as data availability is one of the challenging parts in Africa. Once we acquire research funds and host research projects, data can be stored and shared with stakeholders across the continent. At the end of the meeting, Dr. Obubu commented that the inclusion of water and wastewater treatment aspects into the scope of our project adds further value, and that a bio-AOP process presented by Ms. Shen could contribute to treatment of emerging contaminants in Africa.

Next online meeting in June

We have already internalized having a bimonthly meeting to share knowledge and experiences that members of our group have. At the next meeting in the middle of June (let's set the meeting date at June 20 temporarily), Dr. Sagawa will first give a talk about fundamentals of remote sensing, since the desire to have solid understanding for remote sensing techniques is high among our group members. Then, we will have a short segment to discuss the trend, or future prediction regarding how to deal with wastewater treatment in Africa. Currently, our group consists of members from 8 African nations. As an extension of this discussion, we can synthesize a report about wastewater discharge and treatment in Africa (and eventually submit it as a research article to a peer-reviewed journal, if the quality reaches the standard). We can have more presenters at the next meeting. If you have a topic to be presented, your contribution is highly appreciated.