CRP FELLOWSHIP SUMMARY REPORT

Name:	Morihiro Maeda
Subject title:	Modelling microbially-driven nitrogen and carbon dynamics in soil amended with nano-biochar
Theme:	Managing Natural Capital (Theme 1)
Host institute:	Institute of Geosciences & Environment (IGE), Grenoble Alpes University, France
Host researcher:	Jean M.F. MARTINS
Duration:	27th August to 26th November 2022

I consent to this report being posted on the Co-operative Research Programme's website.

1. What were the objectives of the research project? Why is the research project important?

This research proposal aims to mitigate water quality degradation and greenhouse gas (GHG) emissions in agricultural areas using innovative methodologies relying on agricultural waste-derived nano-biochar. The specific objectives of the research are (i) to determine the roles of microorganisms in nano-biochar amended soil by measuring microbial activities and fictional genes and (ii) to develop a numerical model of microbially-driven nitrogen and carbon dynamics.

Biochar could be used in water treatments as a low-cost technology and was recently reported to reduce the emissions of GHGs from agricultural soils by controlling redox potential. Okayama University has developed a new type of nano-biochar, chained nano-biochar, which may substantially improve the functions of biochar.

Many researchers have used N and C dynamics models extensively worldwide. There are, however, few models that explicitly include microbial activities in soil. Our first attempt will help understand the roles of microorganisms in soil receiving nano-biochar and be able to predict the long-term impacts of soil management on nutrient removal and GHG emissions.

2. Were the objectives of the fellowship achieved?

The objectives mentioned above were partially achieved. We had many in-depth discussions during the fellowship and reviewed many related publications. We conducted 18 sets of column experiments and finished major water quality parameter measurements and DNA extractions from soil and water samples. At present, extracted DNA is being analysed due to more than 500 samples, which were unexpectedly huge numbers. We are on the way to obtaining qPCR results in France and Japan.

3. What were the major achievements of the fellowship? (up to three)

1) Establishment of a research group between Grenoble Alpes University and Okayama University regarding microorganism roles on N and C dynamics in soil
2) Acquisition of techniques to handle toxic microorganisms and their genes
3) Finding a new idea on the transport and decomposition of antibiotic resistance bacteria and their genes in soil

4. Will there be any follow-up work?

We continue to work together to complete the rest of the analyses of DNA extracted from soil and water. We will prepare the subsequent column experiments for different soil, which a new master's student at IGE will conduct.

We are preparing a research presentation at an academic meeting of the Japanese Soil Science Society and will make a manuscript being submitted to an international journal of environmental science.

Through the relationship constructed during the fellowship, we will apply a research collaboration project to JSPS/MEAE-MESRI in 2023.

5. How might the results of your research project be important for helping develop regional, national or international agro-food, fisheries or forestry policies and, or practices, or be beneficial for society?

Our collaboration research was a cross-disciplinary collaboration with the expectation of many innovative

research outcomes, significantly contributing to SDGs (UNESCO-2015) and IPCC (International Panel on Climate Change) goals, and building a solid partnership between France and Japan. Based on the discussion during the fellowship, we understood the differences between EU and Asian countries in agriculture and therefore, political measures against climate change and water quality degradation in rural areas. Because we both have many research partners in Vietnam, we will continue to collaborate on research studies in Vietnam in the future.

6. How was this research relevant to:

This research matches all objectives of the CRP. Modelling microbially-driven C and N dynamics based on data of microbial activities and functional genes of DNA extracted from the soil is a very challenging and timely theme because molecular biology has been radically developed, but those data have not been quantitatively analysed yet with the N and C cycles in soil. Therefore, our results would contribute mainly to scientific advances in soil science and environmental studies.

We are preparing a new research project on water cleaning technology using nano-fiber materials in agricultural zones, to be applied for MSCA (Marie Skłodowska-Curie Actions) Staff Exchanges Program 2024, which will be useful for policy decision-makers in fields of the sustainable use of natural resources in the agricultural sector. This research and our planning research align with **THEME 1** "Managing Natural Capital," aiming at soil and water conservation in agricultural areas. Furthermore, our proposal matches "Climate change, including carbon sequestration in agriculture, forestry and land use" and "Antimicrobial resistance; One Health approach to agriculture and food systems" that are listed as suitable examples.

7. Satisfaction

The OECD CRP fellowship was entirely in accordance with my purpose by gaining knowledge and experience, and developing solid networks between EU countries and Japan. The fellowship has directly increased my career opportunities. I was selected vice-chair of Commission 3.1 (Soil Evaluation and Land Use Planning) of the International Union of Soil Science to contribute more to worldwide researcher networks.

I did not encounter any practical problems, but three months was too short for me, although I decided the period by myself due to my busy schedule at my home university. I do not suggest any improvements in the Fellowship Programme because I am satisfied with it.

8. Advertising the Co-operative Research Programme

I learnt about the Co-operative Research Programme from the website, although I knew it a long time ago from my colleague. I contacted the Japanese contact persons listed on the application guideline. They kindly instructed me on the application method.

If I propose a way to make the program more visible, it is leaflet distribution or poster hanging at international and domestic scientific meetings. Persons who have received the fellowship are willing to help with these small works.