Developing Methodology for Social Implementation of Water Management in Rice Paddies as a Global Warming Mitigation Option

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Rice paddies are one of the major anthropogenic sources of the atmospheric methane. Japanese researchers have played a fundamental role in developing promising mitigation options, such as water management and organic matter management, since 1980s. However, there is a limitation in voluntarily disseminating such options to rice producers. I therefore proposed that creating incentives other than global warming mitigation are a key in the social implementation (i.e., dissemination to rice producers and reflection into governmental policy) of such options. To accelerate the social implementation, it is necessary to (1) categorize the approaches, (2) show the detailed ways to implement, and (3) establish the scientific basis.

The approach of implementing mitigation options in agricultural sector was categorized into three [1]. First is "voluntary approach" that can get help from co-benefit of improved rice productivity and climate change adaptation, such as soil carbon sequestration. That is, a voluntary approach can be implemented without additional cost and labor. Second is "semi-institutional approach," by which rice producers can get economic incentive from a subsidy and an eco-labeling. Last is "institutional approach" that is accountable to the national inventory of greenhouse gas emissions. An emission trading system and a market mechanism are examples of this approach.

To establish the scientific basis for the institutional approach of paddy water management, we confirmed the robustness of methane emission reduction by paddy water management through model simulation and meta-analysis. The institutional approach requires rigid quantification of emission reduction through Measurement, Reporting, and Verification (MRV) that is a system to assure the accuracy and reliability of emission and its reduction. We integrated existing scientific knowledge, and developed guidelines for measuring methane and nitrous oxide emissions from rice paddies by a manual closed chamber method [2]. We then developed an introductory book for implementing MRV for paddy water management [1].

To develop an innovative option for the voluntary approach, we tested an irrigation with oxygen-nanobubble (ultrafine bubble) water to reduce methane emission without the conventional drainage practices. In a pot experiment, we confirmed that the nanobubble water irrigation can significantly reduce the methane emission compared to that with normal water irrigation because of the improvement of soil reductive conditions that was observed as the decrease in iron dissolution into the pot drainage [3].

References

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[3] Minamikawa, K. et al.: Environmental Research Letters, 10, 084012 (2015).