Assessment of Greenhouse Gas Emission from Water Reservoir in Taiwan

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This study is aimed to establish a measure and a reference database for greenhouse gas (GHG) emission assessment of reservoirs in Taiwan. The nationwide estimation of GHG emissions was conducted by on-site field investigation of three selected reservoirs, Baoshan Second Reservoir (Hsinchu), Liyutan Reservoir (Miaoli), and Tsengwen Reservoir (Chiayi). The results help the water resource management authorities to initialize the life cycle assessment of GHG emissions for water resources in Taiwan and establish GHG reduction strategies for reservoir management. It will also be useful decision supporting information that promotes mitigation and adaptation on climate change in the water resources management as well.

This study followed the methodology in "GHG Measurement Guidelines for Freshwater Reservoirs" published by UNESCO in 2010 to measure the GHG emissions flux, so that our local investigation data can be compared with international data. For the GHG emission estimation of reservoirs, this spatial boundary included the reservoirs' water body (GHG emission flux crossing the water-gas interface based on practical measurement using chamber method), the management centres (indirect emissions from energy consumption estimated by data collection) and the catchment area (the carbon sinks varied in the forest area, except the GHG emission of human activities in the non-expropriated region). Summarizing the GHG emission from the three sections of the selected reservoirs, we may estimate the general GHG emission coefficients of the reservoirs in Taiwan. The total GHG emission amount of 24 main reservoirs in Taiwan was estimated around 30,000 ton CO2e/yr.

Based on the aforementioned information, the carbon reduction strategies for reservoir systems may be proposed, including the strategies for reservoirs' plan and design, operation, water body management, and the tailor-made solutions for the individual reservoirs. The main consensus were to optimize water storage and distribution process, maintain storage space of reservoirs, reduce water wastage, and reduce the use of real desalination or recycled water derived from high-energy facilities. Furthermore, it is also recommended to take carbon emission inventory into the engineering contract in the future to more accurately assess GHG emission from reservoirs' construction and operation. Efficient and effective GHG emission control of the reservoir system might be well practiced while the emission status and amount are comprehensively informed.

Keywords: greenhouse gas emission inventory, carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), reservoir, nutrient salts