An application of DNDC to assess greenhouse gas emissions from different rice cultivation systems in Taiwan

Yi-Chien Wu[1] and Huu-Sheng Lur[1]

1. Department of Agronomy, National Taiwan University, Chinese Taiwan.

Abstract: Climate change and global warming are crucial environmental and ecological issues nowadays. Greenhouse gases (GHGs) produced by human activities including agriculture are the main causes to global warming. Processes of agricultural productions bring emissions of GHGs including CH_4 and N_2O, and aggravate the trend of global warming. In the other hand, climate stresses induced from global warming also damage agriculture production. For these reasons, a new cultivation scheme which considers both "adaptation" and "mitigation" is needed. Rice is the most important food crop in Taiwan, and rice cropping system is recognized as the major GHG source of regional agricultural activities in Taiwan. For developing an adequate rice cropping system with a balanced adaptation/mitigation, the objective of this study is to utilize DNDC tool to assess the GWP for different rice cropping systems. Our research included 2 parts: 1. comparisons among different cultivation periods and 2. comparisons among cultivation districts and practices. In experiment 1, rice was transplanted in 17 different dates from 2/28 to 8/21 in 2007 and 2008. In Experiment 2, we collected samples produced with 3 different cropping practices (conventional, organic, integrated or natural practice) and from 3 rice production districts in Taiwan. Afterwards, we applied DNDC model to analyze the emissions of GHGs from each cropping system and cultivation region, and transferred the results into "global warming potential (GWP)" as unit of CO_2 equivalent. In the present results, GWP was lowest in samples transplanted in February and March. Because of the increased high temperature, the GWP would increase if transplanting date was postponed along the year. For the similar reason, GWP of sample collected in cooler district was less than in warmer district. However, there were cross effects between cultivation districts and periods. GWP of organic farming was lower in warmer district than in cooler district. For considering grain yield, nutrients and pest management, and GWP together, we should take integrated cultivation practice in the future with proper transplanting date and adequate water and nutrient management for different cultivation districts. In our study DNDC model is shown to be an useful tool for designing these objective cropping systems.

Keywords: DNDC model, rice, global warming potential, transplanting date, organic farming, integrated farming, natural farming.