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Opinion

Promote Low-Carbon Rice Technology to Reduce Methane Emissions from Paddy Fields

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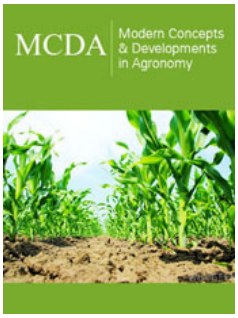

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Abstract

Methane produce by paddy fields is the most important sources of agricultural activities. Reducing methane emission from rice fields is of great significance for reducing and controlling methane in China. This paper summarizes some achievements in China's methane emission reduction work in recent years, analyzes the main reasons why the progress of methane emission reduction in paddy fields is slow, and puts forward the countermeasures for reducing methane emissions from paddy fields.

Opinion

In 2022, China's methane emissions were 55.6761 million tons, of which 18.5019 million tons were emitted by agricultural activities, accounting for 33.23%. The sources of methane emission from agricultural activities mainly include rice planting, animal intestinal fermentation and livestock and poultry manure. China is the first country to plant rice. The rice planting area accounts for about 20% of the world and the yield accounts for about 29% of the global rice yield [1]. Flooding in paddy fields is beneficial to the growth of methanogenic bacteria. Methane produced by large-scale paddy fields accounts for about 40.1% of agricultural activity emissions, which has become one of the most important sources of agricultural methane emissions [2]. The annual methane emission from rice cultivation in China is as high as 8.911 million tons, accounting for 16% of the total methane emissions [3]. So, reducing methane emission from rice fields is of great significance for reducing and controlling methane in China.

The '13th Five-Year Plan for Controlling Greenhouse Gas Emissions' clearly stated that farmland methane emissions should be controlled in 2016. The Ministry of Agriculture and Rural Affairs issued the 'Guidance on Promoting the Construction of Ecological Farms' in January 2022, exploring the low-carbon compensation policy for methane emission reduction in paddy fields with ecological farms as the object. In June, 'Implementation Plant for Carbon Reduction and Carbon Sequestration in Agriculture and Rural Areas' was issued and methane emission reduction in paddy fields was listed as the first of the 'ten major actions. Although some achievements have been made in China's methane emission reduction work in recent years, the progress of methane emission reduction in paddy fields is slow. The main reasons are as follows. Firstly, the proportion of traditional flooding farming mode is too large. Submerged planting separates the air from the soil. Although the anaerobic environment created can remove most of the weeds, it is very conducive to the survival of methanogenic bacteria, resulting in a large amount of methane emissions from paddy fields [4]. At present, most of the rice is planted in the traditional submerged farming mode. Secondly, farmers's participation is not high. Especially in the southern region, because the per capita arable land area is too small, the annual income per mu of rice planting is 600-1200 yuan and its economic benefits

are far lower than the remuneration of migrant workers [5]. If there is no corresponding policy support, new varieties of rice carbon reduction technology are difficult to promote, and farmers have no application power. Thirdly, there is a lack of demonstrations led by large-scale farmers. Although the center of gravity of rice planting in China is shifting to the northeast, the southern region is still the most important rice producing area, accounting for about 65 % of the total rice production in China [6]. Rice planting is mostly small-scale farming and has not yet formed a large farm, so the large-scale demonstration effect is not obvious.

In order to promote low-carbon rice technology and reduce methane emissions from paddy fields, the following countermeasures can be recommended. First, the promotion of new farming methods should be accelerated. The system of rice intensification tillage method is popularized [7]. The furrow flooding and intermittent irrigation are used to make the paddy soil dry and exposed to the air regularly, so as to reduce the methane emission from the paddy field. The ridge planting method is promoted, and the crops are planted on the ridge and irrigated in the furrow, which not only reduces methane emissions but also facilitates water level management [8]. The promotion of dry land direct seeding method can avoid seedling raising and transplanting [9]. Planting the drought-tolerant rice seeds into the field directly through the direct seeding machine not only saves water and increases efficiency, but also rapidly reduces methane emissions.

Second, the enthusiasm of farmers to participate should be improved. To increase the R&D investment and promotion of low-carbon super rice and high-quality rice varieties improve rice yield, quality and planting efficiency. The popularization and application of rice low-carbon farming technology should be included in the content of high-standard farmland construction. The corresponding subsidies should be issued to farmers. Exploring more economical subsequent crops such as beans can not only fix nitrogen but also increase soil organic matter [10]. To promote the technology of formula fertilization and improve the level of fertilization can reduce the input of agricultural materials in the second year.

Third, large-scale planting demonstration of low-carbon rice should be promoted. To establish and improve China 's land transfer and trusteeship system smooth the transfer of land management rights, providing land factor protection for large-scale cultivation of low-carbon rice. By using emerging digital technologies such as the Internet of Things and cloud computing, linkage precision irrigation, unmanned agricultural machinery and other agricultural machinery facilities, we achieve accurate field management and do a good job in the construction of low-carbon rice large-scale planting demonstration sites. The science and technology management department established a demonstration project for large-scale cultivation of low-carbon rice and promoted the experience of large-scale cultivation of low-carbon rice in time by organizing on-site observation meetings and technology summary meetings.

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