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GHG Emission from Rice Field: Myth vs Scientific Reality

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Rice is our staple food and the lifeline of our farmers. In Bangladesh, food security essentially means rice security, as nearly 75 percent of the country's cultivated land is devoted to rice farming. Given this deep dependence, it is concerning that several negative narratives about rice continue to circulate. Claims that rice fields emit excessive greenhouse gases, that Bangladeshi rice contains arsenic, that rice cultivation wastes groundwater, or that eating rice leads to diabetes and obesity are frequently repeated. Yet many of these assertions either lack solid scientific evidence or are presented without proper context.

Among these concerns, the most widely discussed issue globally is the claim that rice fields are major sources of greenhouse gas emissions. This claim is only partially true. Rice cultivation does release greenhouse gases such as methane (CH_4), carbon dioxide (CO_2), and nitrous oxide (N_2O). However, what is often overlooked is that rice plants also absorb a significant amount of carbon dioxide through photosynthesis. In reality, the relationship between emission and absorption is far more balanced than commonly portrayed.

Scientific research provides a clearer understanding of this balance. The Soil Science Division of the Bangladesh Rice Research Institute (BRRI) has been studying the issue since 2013. According to their findings, producing 1 kilogram of rice leads to the emission of about 666 grams of carbon dioxide, 53 grams of methane, and 0.5 grams of nitrous oxide. At the same time, the rice plant absorbs approximately 2,200 grams of carbon dioxide during its growth. This indicates that the absorption capacity of rice plants is substantial and must be considered alongside emissions when assessing environmental impact.

In addition to plant absorption, natural atmospheric and soil processes also help mitigate greenhouse gases. Methane released from rice fields can react with water vapor in the atmosphere, converting into carbon dioxide and hydrogen gas, which are then reused by plants through photosynthesis. Similarly, nitrous oxide undergoes chemical transformations that eventually produce ammonium, a form that can enter the soil and contribute to plant nutrition. Within the soil, oxygen transported through the rice plant's aerenchyma tissues supports microbial activity that converts methane into carbon dioxide, further reducing methane emissions.

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Research further shows that rice plants themselves are responsible for only a small share, around 5 to 10 percent, of total methane emissions from rice fields. The majority, about 90 to 95 percent, originates from soil processes, particularly in waterlogged conditions where organic matter and methanogenic bacteria produce methane. This means that emissions are largely influenced by soil and water management rather than the rice plant alone. In some cases, fallow lands and unmanaged waste sites can contribute more significantly to methane emissions than cultivated rice fields.

Bangladesh produces more than 50 million tons of paddy annually across the Aus, Aman, and Boro seasons. Based on this level of production, total emissions are estimated at about 33.3 million tons of carbon dioxide, 2.65 million tons of methane, and 0.025 million tons of nitrous oxide. Using the Global Warming Potential (GWP) framework, these emissions amount to approximately 112.2 million tons of carbon dioxide equivalents. On the other hand, rice cultivation absorbs roughly 110 million tons of carbon dioxide through photosynthesis. This near balance between emission and absorption demonstrates that rice farming is not simply a net contributor to greenhouse gases but also plays a role in regulating atmospheric carbon.

A broader regional perspective also helps put the issue into context. Across South Asia, rice cultivation, wetland modification, and coal extraction are common activities. Countries such as China and India produce significantly more rice than Bangladesh and operate hundreds, even thousands, of coal mines, major sources of methane emissions. In comparison, Bangladesh has only one large-scale coal mine in operation. This suggests that responsibility for greenhouse gas emissions is unevenly distributed, even though developing countries are often criticized disproportionately in global climate discussions.

At the national level, it is equally important to consider other emission sources. Bangladeshi scientists have pointed out that Dhaka, the country's only major megacity, has relatively low per-capita waste generation, about 0.61 kilograms per person per day. This indicates that Bangladesh's overall contribution to global emissions remains relatively modest.

The real challenge, therefore, lies in reducing greenhouse gas emissions while maintaining agricultural productivity. In this regard, the Bangladesh Rice Research Institute is actively working on forward-looking strategies. One key initiative is the development of rice varieties with enhanced capacity to absorb carbon dioxide. As a C3 plant, rice responds positively to increased atmospheric CO_2 levels, leading to higher photosynthetic activity and potentially greater yields. Scientists have already identified promising germplasm from the BRRI gene bank that show stronger responses to CO_2 and improved productivity. These will be used in breeding programs to develop high-yielding, climate-resilient varieties.

At the same time, farmers are being encouraged to adopt improved cultivation practices to reduce emissions. Techniques such as alternate wetting and drying (AWD) irrigation, balanced fertilizer application, deep placement of urea, and adherence to Good Agricultural Practices (GAP) can significantly lower greenhouse gas emissions while sustaining yields. These methods also improve resource efficiency, particularly in water and nutrient use.

Looking ahead, technological advancements are expected to play a transformative role. As Bangladesh integrates into the Fourth Industrial Revolution, precision agriculture, genome editing, and data-driven farming practices will become more widespread. These innovations can enhance efficiency, reduce waste, and further limit emissions. Emerging technologies such as nanotechnology and artificial intelligence may also contribute to improved agricultural management, while the increasing use of renewable energy, particularly solar power, can reduce dependence on fossil fuels.

Against this backdrop, it is important not to be misled by oversimplified or misleading narratives about rice cultivation. A balanced, science-based understanding shows that while rice farming does contribute to greenhouse gas emissions, it also plays a meaningful role in carbon absorption and environmental stability. The focus should therefore remain on improving practices, investing in research, and adopting innovative solutions that ensure both food security and environmental sustainability.

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