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Climate change coupled with elevated soil arsenic will decrease rice productivity and grain quality

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With more than half of the world's population consuming rice daily, it is crucial to ensure rice production in the future. Our current assessment of climate change impacts on rice productivity is based on increased annual temperatures and atmospheric CO_2 conditions. It does not, however, consider the presence and continuous input of the toxic metalloid arsenic into paddy soils. Once in the paddy, the fate of arsenic in a soil-rice continuum is heavily influenced by the prevailing environmental conditions, which include temperature and atmospheric CO_2. Here, we examine whether and to what extent climate change affects the bioavailability of arsenic in the soil and its uptake by rice, and consequently the future productivity of rice.

We performed plant growth studies with different climatic conditions and soil arsenic concentrations. We show that the biogeochemical processes altered by higher temperature and atmospheric CO_2 increase arsenic mobility, and that higher arsenic concentrations persist within the rhizosphere, leading to an increased uptake of arsenic by the plant. We show that such increased levels of arsenic in rice (i) reduce the number of filled grains and (ii) increase the amount of accumulated arsenic in filled grain. Overall, climate change coupled with elevated soil arsenic levels will lead to a substantial loss of rice grain productivity and quality.

Our findings provide important advancements in predictions of future rice grain production and quality, that will need to be addressed to sustain food quality and quantity.