SUPPLEMENTARY MATERIAL A

Horizon scanning method

Horizon scanning seeks expert opinions and explores promising trends (Amanatidou et al., 2012; Cuhls et al., 2015; Hines et al., 2019). When conducted as a participatory study that involves stakeholders or experts, it allows for a cross-fertilisation of ideas, facilitates mutual learning and informs decision-making and the development of viable solutions (Wintle et al., 2020). Furthermore, horizon scanning based on experts' opinions harnesses collective expert knowledge (Duboff, 2007) and thus lends credibility to its results (Könnölä et al., 2012). Horizon scanning can be done with a short-term or long-term focus, depending on its goals (Hines et al., 2019).

Several research areas have adopted horizon scanning as a research priority setting method. These include conservation issues, which have been conducted annually since 2010 (Sutherland et al., 2019), global agriculture (Pretty et al., 2010), digital agriculture (Fleming et al., 2021; Ingram et al., 2022), food production systems (Glaros et al., 2022) and sub-domains of plant science (Brown et al., 2016; Neve et al., 2018). However, despite the growing frequency of applying horizon scanning for research priority setting in agriculture, most horizon scanning activities rely on bibliometric analyses. This does not lead to globally applicable and integrated research priorities addressing key food security and sustainability crops.

Our study followed a Delphi technique to engage with rice experts. This technique typically has two or three rounds of engagement with participants. Participants identify pressing issues in a specific knowledge domain, prioritise and rate them by importance and re-evaluate their ratings based on structured feedback or weighted group discussions. Additional rounds can be included. The Delphi technique has many variants, but all share common characteristics: 1) partial or complete anonymity of experts; 2) iterative participation through surveys, interviews, or workshops; and 3) structured feedback in a statistical summary to the experts between rounds (Rowe & Wright, 2001).

The two rounds of surveys were hosted on Qualtrics (an online survey tool). Each survey was pretested to eliminate errors before publishing on Qualtrics. The published survey was publicised through the professional networks of the study co-authors, corresponding authors of relevant publications in rice research and snowballing sampling techniques.

Demographic information of participating experts

One hundred and one experts participated from across thirty-one countries and five continents (Figure SA1). Experts' experience varied from a decade or less (46%) to more than three decades (11%) (Figure SA2). Experts identified themselves as researchers (69%), academic/university staff (21%) and directors/consultants (10%) from diverse fields. Experts could choose multiple options and the highest choice was for agronomy/crop/soil science (Figure SA2). The 101 experts from Round 1 were re-invited to participate in Round 2; 60% participated again.

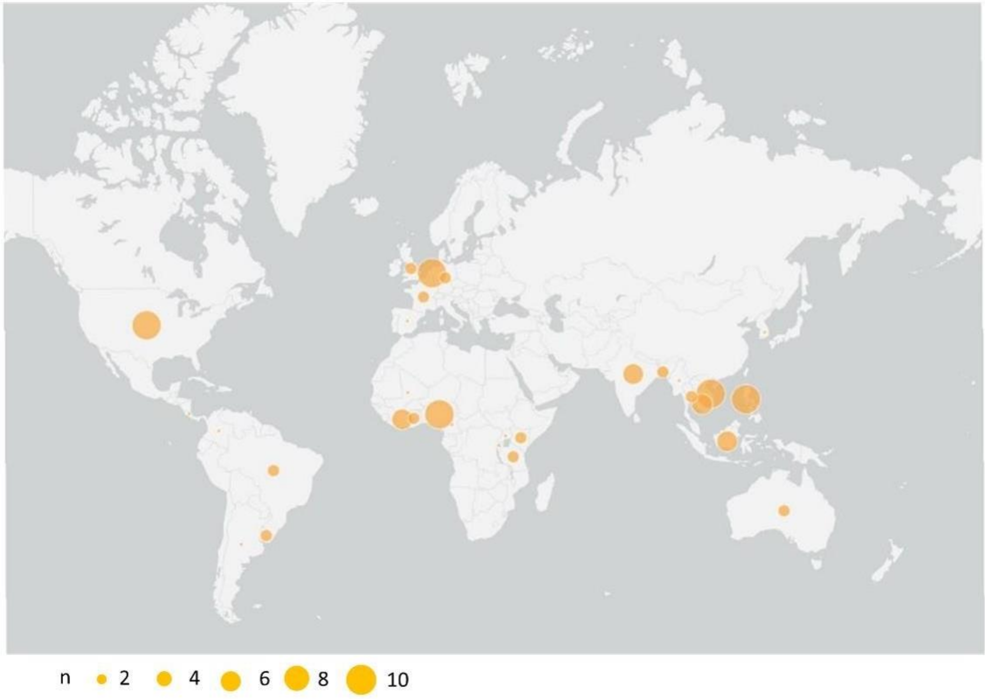

Figure SA1: Global distribution of rice experts who participated in the horizon scan to identify research gaps for sustainable rice systems by 2050. The size of the bubbles reflects the number of participants from each country, with the bubbles centred over the country rather than the precise location of experts.

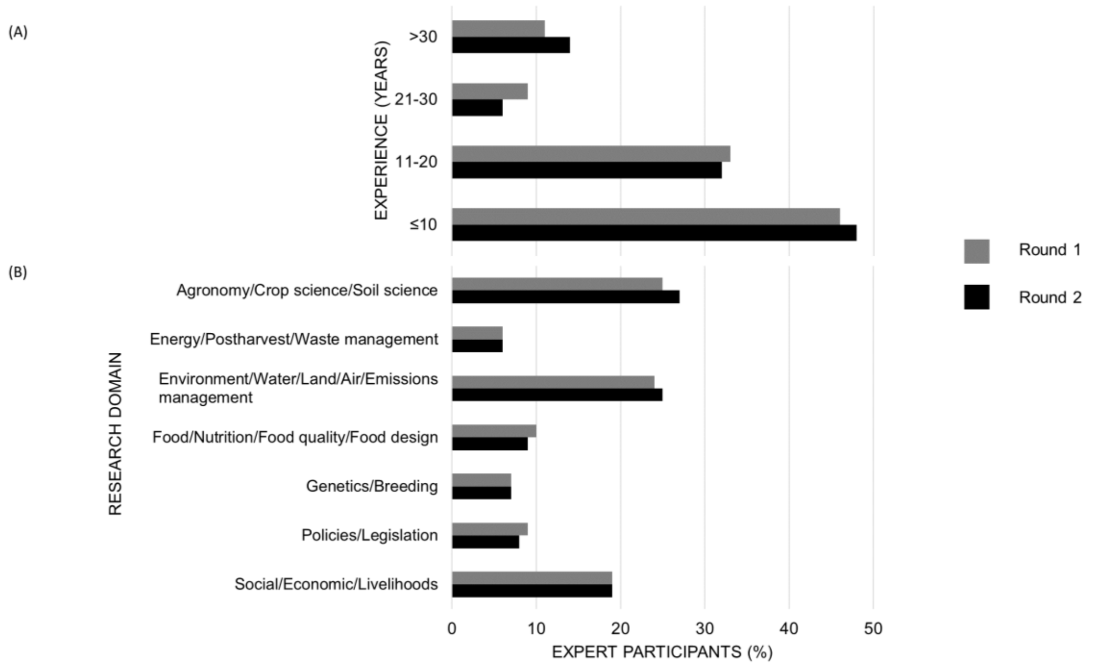

Figure SA2. Representation of participants in the horizon scanning activities indicating ranges of rice research experience (A) and varied research domains (B) as a percentage of the total. Expert participants self-identified their research domains and were allowed to choose multiple research domains. Genetics/Breeding is considered a subset of Agronomy/Crop Science/Soil Science. Data from all experts and domains were used in the analysis.