

SUPPLEMENTARY MATERIAL B

Horizon Scanning Round 1 Survey questionnaire

- Personal data
- What countries/regions does your research focus on?
- How long have you worked in your rice related research domain?
 - 10 years
 - 11-20 years
 - 21-30 years
 - >30 years
- Which research domain(s) best fits your expertise? (Multiple answers possible)
 - Agronomy/Crop science/Soil science
 - Genetics/Breeding
 - Social-economic/Livelihoods
 - Policies/Legislation
 - Environment/Water/Land/Air/Emissions management
 - Energy/Postharvest/Waste management
 - Food/Nutrition/Food quality/Food design
- What is your specific expertise and designation? e.g., Lecturer in water management.
- What are the three most important CURRENT drivers of change and trends with respect to rice systems? Think broadly across all social, technological, economic, environmental, or political categories. For each driver, choose the most related driver-category from the drop-down list. Also specify at what spatial scale each driver applies (could be global, a certain region, a certain country, a certain ecology, etc.).
- What are the 3 most important FUTURE drivers of change by 2050 with respect to rice systems? Think broadly across all social, technological, economic, environmental, or political categories. For each driver, choose the most related driver-category from the drop-down list. Please specify at what spatial scale each driver applies (could be global, a certain region, a certain country, a certain ecology, etc.).
- You have mentioned above future drivers of change.....How will these drivers affect rice systems? Answers can be framed as projections, for example; By 2050, food consumption patterns (future driver) could change to more meats, fruits and vegetables (future change) which will lead to less rice demand (future impact/outcome). You can list multiple projections per driver.
- The projections which you have made could present challenges to sustainable rice systems. What could these CHALLENGES be? You can include the how, when, where, whom (affected group of persons). For example; Less rice demand could affect rice farmers (whom affected) in rural Asia (where) through loss of livelihoods (how affected).

- The projections which you have made could present opportunities to achieve sustainable rice systems. What could these OPPORTUNITIES be? You can include the how, when, where, whom (affected group of persons). For example; Less rice demand could lead to less rice production (how), reducing greenhouse gas emissions from rice land (where).
- What research gaps might result from the projected future changes?
- What techniques, knowledge and/or methods from your own expertise can you apply to fill these research gaps?
- What new research and strategies will be needed to fill the research gaps for a sustainable rice future?
- Any additional comments.

Horizon Scanning Round 2 Survey questionnaire

The aim of this second round is to prioritize the research gaps from Round 1 on novelty and on relevance to sustainable rice systems.

- Personal data

Please rate the research gaps on relevance to sustainable rice systems and on novelty. How relevant to sustainable rice systems is this research question/gap? On relevance, you can choose from high, moderate, or little relevance. You can choose "No idea" if the statement falls outside your scope of knowledge of rice systems.

How novel is this research gap? Choose from;

- Novel (means that previous knowledge is limited on this particular subject)
- Not novel (means that sufficient knowledge already exists on this particular subject)
- New to me (if unsure about novelty due to limited knowledge of the particular subject, choose 'new to me') .

With the comments box, you can make suggestions to improve the clarity and readability of the research gap.

- RG1.1 Research on the socioeconomic drivers of rice yield gaps across the world
- RG1.2 Research on understanding farmers' actual conditions to bridge the profit-loss margin
- RG1.3 Research on the development of indicators to assess the actual drivers of change in different rice systems, ex. whether due to climate change and/or human population changes.
- RG1.4 Research on understanding the processes of farmers' transformation to sustainable management practices
- RG1.5 Research to understand the selection and conservation of traditional varieties by farmers.
- RG1.6 Research on emerging land grabs and large scale land acquisitions by wealthy farmers/investors due to rising profitability in rice production

- RG1.7 Research to understand different rice market segments to target rice products to specific markets
- RG1.8 Research on geospatial analyses of cropland expansion and development of crop-type maps.
- RG1.9 Research on the replacement of manual, in-person Monitoring-Reporting and Verification (MRV) with remote sensing/satellite technology
- RG1.10 Research on shared information systems between key players in the rice value chain for increased transparency in MRV
- RG1.11 Research on the monitoring and assessment of the environmental impact of new rice technology
- RG2.1 Research on the development and utilization of genetically modified rice (GMO) and its consequences.
- RG2.2 Research on quantifying the effect and responses of rice cultivation at local scale to abiotic stresses/climate change
- RG2.3 Research on the potential trade-offs that attempting to limit greenhouse gas emissions from rice production would have on local food security
- RG2.4 Research on the shifting dynamics of rice consumption due to increasing incomes and urbanization in different parts of the world
- RG2.5 Research on the impact of urbanization and industrialization on availability of arable land for rice production
- RG2.6 Research on the effect of increased food insecurity and food prices on farmers practices of sustainable methods
- RG2.7 Research on the potential socio-economic impact of technological change to small-scale farmers
- RG2.8 Research on the sectoral migration away from farming by youths and by existing farmers
- RG2.9 Research on the impacts of increasing rice production on food crop production diversity in Africa
- RG2.10 Research on the impact of changing dynamics in global rice markets such as the attainment of self-sufficiency by current rice importers
- RG2.11 Research on the interplay and price dynamics between different staple crops develop (ex. wheat/rice prices) at the global scale
- RG2.12 Research to develop accurate climate and water information at local scales
- RG3.1 Research to develop climate-resilient cultivars/varieties which can thrive under harsh conditions ex. varieties with better avoidance traits and a highly developed root system
- RG3.2 Research to develop rice varieties with improved physical qualities (high milling recovery, head rice, length to width ration
- RG3.3 Research to develop rice varieties that are efficient in the use of environmental resources (such as solar energy)
- RG3.4 Research to develop rice types that are perennial; that is, can be harvested season in and season out.
- RG3.5 Research on growing rice on soil-less media
- RG3.6 Research on developing floating rice varieties

- RG3.7 Research on the development of rice varieties richer in nutritional qualities such as Omega rice, vitamin E rice, high Fe, Zn, and low glycaemic content
- RG3.8 Research to alter the photosynthesis of rice from C3 to C4 pathway
- RG3.9 Research on the development of methanogenic inhibitors for reducing methane emission in rice cultivation
- RG3.10 Research to optimise increasing CO2 levels for improved rice crop ecology and productivity
- RG4.1 Research on the development of innovative fertilizers for soil fertility management
- RG4.2 Research on developing sustainable local seed systems
- RG4.3 Research on the integration of rice systems into more diversified, regenerative and nature-based agro-ecosystems to optimize productivity and resource use efficiency
- RG4.4 Research on industrial dryland rice production
- RG4.5 Research on converting unproductive areas to rice croplands; due to rising scarcity of arable land
- RG4.6 Research to develop proactive measures to curtail emerging diseases and pests brought by climate change
- RG4.7 Research on fair sustainable business models and supply chains that results in economic benefits to producers and environmental sustainability
- RG4.8 Research on carbon farming solutions towards sustainable systems
- RG4.9 Research on planetary health diets: healthy diets with minimal environmental footprint
- RG4.10 Research to utilise by-products from rice production for other purposes ex. rice straw for the production of biofuels, fertilizers etc.
- RG5.1 Research on the use of surface water as a collective regional resource and its potential for balanced supply of rice in the region
- RG5.2 Research on upscaling findings from farm-level (micro-level) to regional/global scale (macro-level)
- RG5.3 Research on translating science to practice eg. application of genetic advancements
- RG5.4 Research on redirecting rice production from export-oriented production to production for local consumption
- RG5.5 Research on improving the agricultural literacy of rice producers
- RG5.6 Research on the integration of rice systems with tourism
- RG5.7 Research to develop diverse food products from rice grains
- RG5.8 Research to develop indigenous technology to support the rice value chain
- RG5.9 Research on the development of new or and adaptation of old technology to be suitable and affordable for small-holder farmers
- RG5.10 Research on the policy options needed to boost rice productivity, sustainability and inclusive transformation
- RG5.11 Research on the policy options to mitigate the envisaged rice production loss by 2050 in some parts of the world such as Asia
- Any additional comments.