frontiers | Frontiers in Sustainable Food Systems

TYPE Editorial
PUBLISHED 17 October 2023
DOI 10.3389/fsufs.2023.1287451

OPEN ACCESS

EDITED AND REVIEWED BY
Ole Mertz,
University of Copenhagen, Denmark

*CORRESPONDENCE
Julia Compton
✉ jaf.compton@gmail.com

†PRESENT ADDRESSES
Julia Compton,
Independent Consultant, Cardiff, Wales, United Kingdom

Ruben Echeverría,
International Center for Tropical Agriculture (CIAT), Cali, Colombia

P. V. Vara Prasad,
Sustainable Intensification Innovation Lab, Kansas State University, Manhattan, KS, United States

Pablo Tittonell,
University of Groningen, Groningen, Netherlands;
IFAB, INTA-CONICET, San Carlos de Bariloche, Argentina

RECEIVED 01 September 2023
ACCEPTED 02 October 2023
PUBLISHED 17 October 2023

CITATION
Compton J, Echeverría R, Prasad PVV and Tittonell P (2023) Editorial: Improving investment in research and innovation to transform agrifood systems in the global south. *Front. Sustain. Food Syst.* 7:1287451. doi: 10.3389/fsufs.2023.1287451

Editorial: Improving investment in research and innovation to transform agrifood systems in the global south

Julia Compton*†, Ruben Echeverría†, P. V. Vara Prasad† and Pablo Tittonell†

Commission on Sustainable Agriculture Intensification (CoSAI), Colombo, Sri Lanka

KEYWORDS

research and innovation, investment, global south, innovation instruments and pathways, agriculture and food systems, environmental sustainability, gender and social inclusion

Editorial on the Research Topic
Improving investment in research and innovation to transform agrifood systems in the global south

1. Introduction

The agri-food sector is globally critical for tackling climate change and environmental decline, poverty and inequity, and hunger and nutrition. Achieving the Sustainable Development Goals (SDGs) will require huge increases in investment in agrifood research and innovation (ARI) (Herrero et al., 2020). Innovation is needed in policy, social institutions, finance, technology, and management practices.

This Research Topic (RT) was initiated by an international Commission on Sustainable Agriculture Intensification, CoSAI (CoSAI Secretariat, 2022), created to promote more and better innovation to support rapid sustainable and equitable transformation of agrifood systems in the Global South. This Research Topic covers three main areas that are key to decision making by research/innovation organizations and their funders (Figure 1): ARI gaps, needs and priorities; pathways, approaches and instruments; and assessment of ARI with a sustainability lens. It brings together eight articles generated from CoSAI working papers with four from an open call. The articles are rich and the findings are often surprising. Space only allows a few points: we urge readers to consult the full articles.

2. ARI investment gaps, needs and priorities

2.1. Current investment in ARI must be reoriented to transform agrifood systems

Rosegrant et al. estimate the *ARI investment gap for the Global South* at around US$10.5 billion per year, and provide a useful comparison with related estimates from other models.

Prasad et al. summarize an ambitious first attempt to estimate *current investment in ARI for the Global South*, including broader investments in innovation as well as R&D.

Despite the importance of the agrifood sector for global goals, current levels of ARI investment as a proportion of output are estimated at only two thirds of those in the energy sector. When analyzed across five domains of sustainable agricultural intensification (productivity, economics, environment, social and human; Stewart et al., 2018), <7% of ARI investment had discernible environmental aims, and only 4.5% had both environmental and social or "human" (e.g., nutrition) aims, which is extremely low.

The serious neglect of social and human aspects of ARI investment is also highlighted by Porciello et al., who used machine learning to extract information on 1.2 million ARI publications, and Brown et al., who reviewed a smaller sample of highly-cited agricultural modeling publications. Brown et al. propose a framework integrating social and demographic modeling with agricultural modeling to assess ARI investments.

These findings support international calls to massively increase and reorient ARI for sustainable and equitable agrifood systems, increasing funding for social equity, human and environmental aspects of ARI.

2.2. Conspicuous areas of underinvestment for the global south include post-harvest management, local seed systems, and (peri-)urban agriculture

Prasad et al. highlight several areas of underinvestment. Two stand out:

- ARI in *post-production issues* receives <10% of the funding for production-related ARI, although post-production accounts for the majority of food costs (Reardon et al., 2019) and is critical for food waste and the environment (Chen et al., 2020).
- Innovation *in self-saved and local seed systems* receives <0.5% of all seed innovation funding, although these are the main sources for most small-scale farmers in the Global South (Coomes et al., 2015), and a key mechanism of *in-situ* agrobiodiversity conservation (FAO, 2019).

Prain et al. review ARI investment priorities for Urban and Peri-Urban Agriculture (UPA) in the Global South, e.g., city-region planning, water and waste recycling and controlled-environment agriculture. With 70–80% of global food production consumed in cities (FAO, 2019) and 40% of global cropland located within 20 km of urban areas (Thebo et al., 2014), investment is much needed to develop circular economies with strong rural-urban interactions.

Fuglie et al. model the multidimensional impacts of agricultural productivity growth across 110 low- and middle-income countries (LMICs). Their thought-provoking findings include:

- *South Asia* is the region where agricultural productivity growth gives by far the highest returns in income growth, hunger reduction, and reductions in greenhouse gas (GHG) emissions.
- *Increasing cereal productivity* results in greater increases in diet micronutrient availability (zinc, iron and protein) than investments in other crops.
- Productivity growth *in livestock* reduces GHG emissions per unit product, but conversely *increases* the risk of hunger and overall land use.

Finally, Nin Pratt and Stads model factors affecting investment in ARI in different types of countries, especially highlighting the challenges faced by small LMICs. In a wide-ranging and thoughtful

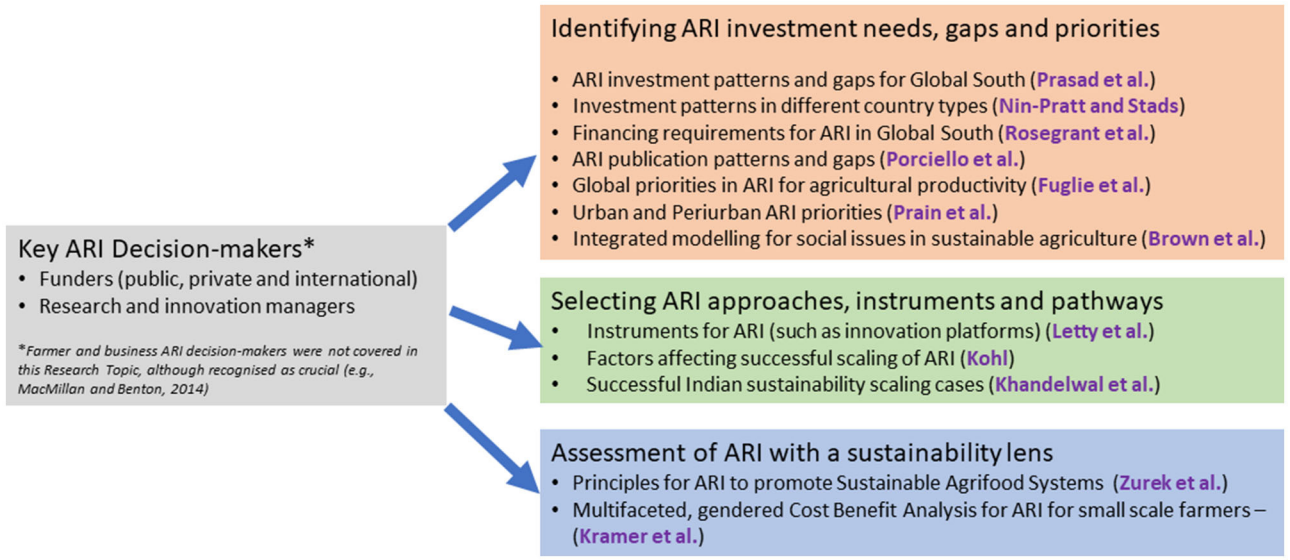

FIGURE 1
Agrifood research and innovation (ARI) for sustainable agrifood systems: mapping the contributions of the CoSAI (Commision on Sustainable Agricultural Intensification) Research Topic.

discussion, they suggest that *small LMICs may benefit from* investing in ARI capacity development and ruthless prioritization of Research Topics, along with stronger international linkages.

3. ARI pathways, approaches and instruments

Letty et al. review the main *instruments* that have been used to incentivize and support ARI in the Global South, such as innovation platforms and networks, grants, prizes, incubators and accelerators. They find that despite their potential, most of these instruments are still used in projects, and not at scale. More rigorous evaluations are needed, which should document important aspects such as social equity, financial and transaction costs.

ARI success is often judged by the success of "scaling," or wide adoption by potential users. A variety of theories and tools for scaling success have been advanced (Dror and Wu, 2020), and there is a global community of practice[1] and at least one sourcebook (Cooley and Howard, 2019). Kohl contributes to this literature by assessing six common hypotheses on "scaling success" factors against 15 case studies from seven countries. Among many interesting points are:

- The importance of individual leadership. This has gained new importance with the need for leadership to attain sustainability/equity goals alongside scaling (Lukwago et al., 2022; Boeske, 2023).
- The importance of a long-term portfolio approach, where a few big ARI successes more than compensate for many failures. Short-term project targets set by ARI funders can unintentionally undermine long-term portfolio success.

Khandelwal et al. critically discusses two fascinating sustainability scaling cases: Safe Harvest (pesticide-free produce) and Trustea (tea certification), both developed by and for the domestic market in India.

4. Assessment of ARI, with a sustainability lens

"Innovation solves problems and creates new ones" (van Noordwijk et al., 2021, p. 1). "Assessing potential trade-offs . . . and unintended effects" is one of the eight *Principles for guiding research and innovation toward sustainable and equitable agrifood systems* developed and piloted by an international taskforce supported by CoSAI, together with practical guidance[2] and a simple scoring system for their application by ARI managers and funders (Zurek et al.).

Estimating costs and benefits in ARI is often based on income estimates, calculated at household level. Kramer et al. introduce a *novel method for Cost-Benefit Analysis that quantifies other welfare benefits*, such as consumption smoothing, empowerment, and time use, for individual women and men within households. The framework was tested in a case study of climate information services in Ghana.

5. Discussion

The findings of this Research Topic support global calls for critical re-orientation of ARI investments for transforming our agrifood systems to address SDGs and climate goals. It contributes evidence to three main areas of decision making for funders and ARI managers: how much and where to invest; what instruments and pathways may increase ARI uptake; and how to assess ARI with a sustainability lens.

A common theme is that *intentional* prioritization and management of ARI is vital to meet multiple sustainability and equity objectives. The wide adoption of Principles for ARI (Zurek et al.) would be an important step. The Principles could be combined with other tools, such as agroecological assessments (Mottet et al., 2020); the sustainable intensification assessment framework (Stewart et al., 2018) or sustainability indicators (e.g., the UN SDGs). Transparent global tracking of ARI is also important, in part to increase incentives and pressure on funders (Prasad et al.; Compton et al., 2022; FAO, 2022). Modeling, which underpins many decisions, must be "transparent and humble" (Saltelli et al., 2020; Wiebe and Prager, 2021). Finally, the Research Topic highlights major evidence gaps that persist around social equity and human aspects of ARI, and around instruments for ARI, as above (CoSAI, 2021; Letty et al.).

Author contributions

JC: Writing—original draft, Writing—review and editing. RE: Writing—review and editing. PVVP: Writing—review and editing. PT: Writing—review and editing.

Funding

Publication of this editorial was supported by Feed the Future Sustainable Intensification Innovation Lab (SIIL) and United States Agency for International Development (USAID) (Cooperative Agreement # AID-OAA-L-14-00006). The work of CoSAI (see Acknowledgments) was principally funded by the CGIAR Trust Fund (https://cgiar.org/funders), with contributions from USAID and SIIL, as acknowledged in individual papers in this Research Topic.

Acknowledgments

The guest editors wish to thank the authors and reviewers for all their contributions. This Research Topic was initiated by the

1 https://www.scalingcommunityofpractice.com/groups/scaling-up-in-agriculture-and-rural-development/

2 https://www.youtube.com/watch?v=KwKM-Mo7hZI

Commission on Sustainable Agriculture Intensification (CoSAI), supported by the CGIAR Research Program on Water, Land, and Ecosystems, based in the International Water Management Institute, Colombo. Detailed acknowledgments are in the final CoSAI management report (CoSAI Secretariat, 2022), along with a summary of key CoSAI achievements and links to further work.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

Boeske, J. (2023). Leadership towards sustainability: a review of sustainable, sustainability, and environmental leadership. *Sustainability* 15:12626. doi: 10.3390/su151612626

Chen, C., Chaudhary, A., and Mathys, A. (2020). Nutritional and environmental losses embedded in global food waste. *Res. Conserv. Recycl.* 160, 104912. doi: 10.1016/j.resconrec.2020.104912

Compton, J., Stads, G. J., Barrett, C. B., Herrero, M., Arndt, C., Prasad, P. V. V., et al. (2022). *Global Tracking of Agrifood Research and Innovation for Meeting Food Security and Sustainable Development Goals*. Available online at: https://www.global-solutions-initiative.org/policy_brief/global-tracking-of-agrifood-research-and-innovation-for-meeting-food-security-and-sustainable-development-goals/ (accessed August 21, 2023).

Cooley, L., and Howard, J. (2019). *Scale Up Sourcebook*. West Lafayette, IN: Purdue University and African Development.

Coomes, O. T., McGuire, S. J., Garine, E., Caillon, S., McKey, D., Demeulenaere, E., et al. (2015). Farmer seed networks make a limited contribution to agriculture? Four common misconceptions. *Food Policy* 56, 41–50. doi: 10.1016/j.foodpol.2015.07.008

CoSAI (2021). *Better Instruments and Approaches are Needed to Transform Agri-Food Systems Research and Innovation. Commission on Sustainable Agriculture Intensification*. Available online at: https://www.iwmi.cgiar.org/archive/cosai/sites/default/files/CoSAI_Policy_Brief_4_AIS_v2/index.pdf (accessed October 8, 2023).

CoSAI Secretariat (2022). *Final Management Report. Colombo: Commission on Sustainable Agriculture Intensification, CGIAR Research Program on Water, Land and Ecosystems, International Water Management Institute*. Available online at: https://www.iwmi.cgiar.org/archive/cosai/sites/default/files/CoSAI-Final-Management-Report/index.pdf (accessed October 8, 2023).

Dror, I., and Wu, N. (2020). *Scaling Better Together: The International Livestock Research Institute's Framework for Scaling*. Nairobi: ILRI.

FAO (2019). *FAO Framework for the Urban Food Agenda*. Rome: Food and Agriculture Organization of the United Nations (FAO).

FAO (2022). *Introducing the Agrifood Systems Technologies and Innovations Outlook*. Rome: Food and Agriculture Organisation of the United Nations.

Herrero, M., Thornton, P. K., Mason-D'Croz, D., Palmer, J., Benton, T. G., Bodirsky, B. L., et al. (2020). Innovation can accelerate the transition towards a sustainable food system. *Nat. Food* 1, 266–272. doi: 10.1038/s43016-020-0074-1

Lukwago, J., Martins, A. M. D. A., and Tefera, O. (2022). Drivers and barriers in developing sustainability leadership – a case of natural scientists at Ugandan universities. *Int. J. Sust. Higher Educ.* 24, 895–910. doi: 10.1108/IJSHE-08-2021-0327

MacMillan, T., and Benton, T. G. (2014). Agriculture: engage farmers in research. *Nat. News* 509, 25. doi: 10.1038/509025a

Mottet, A., Bicksler, A., Lucantoni, D., De Rosa, E., Scherf, F., Scopel, B., et al. (2020). Assessing transitions to sustainable agricultural and food systems: a tool for agroecology performance evaluation (TAPE). *Front. Sust. Food Sys.* 4, 579154. doi: 10.3389/fsufs.2020.579154

Reardon, T., Echeverria, R., Berdegué, J., Minten, B., Liverpool-Tasie, S., Tschirley, D., et al. (2019). Rapid transformation of food systems in developing regions: highlighting the role of agricultural research and innovations. *Agric. Syst.* 172, 47–59. doi: 10.1016/j.agsy.2018.01.022

Saltelli, A., Bammer, G., Bruno, I., Charters, E., Di Fiore, E., Didier, M., et al. (2020). Five ways to ensure that models serve society: a manifesto. *Nature* 582, 482–484. doi: 10.1038/d41586-020-01812-9

Stewart, Z. P., Middendorf, B. J., Musumba, M., Grabowski, P., Palm, C., Snapp, S., et al. (2018). *SIToolKit. com. Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification*. Manhattan, KS: Kansas State University.

Thebo, A. L., Drechsel, P., and Lambin, E. F. (2014). Global assessment of urban and peri-urban agriculture: irrigated and rainfed croplands. *Environ. Res. Lett.* 9, 114002. doi: 10.1088/1748-9326/9/11/114002

van Noordwijk, M., Wainaina, P., Foundjem, D., Mandiefe, S. P., and Tanui, J. (2021). "Innovation in a systems perspective," in *Tree Commodities and Resilient Green Economies in Africa*, eds. P. A. Minang, L. A. Duguma, and M. van Noordwijk (Nairobi: World Agroforestry).

Wiebe, K., and Prager, S. (2021). Commentary on foresight and trade-off analysis for agriculture and food systems. *Q. Open* 1, qoaa004. doi: 10.1093/qopen/qoaa004