Sustainable agriculture for health and prosperity: stakeholders' roles, legitimacy and modus operandi

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Abstract

Food systems need to focus more on health, prosperity, and environmental sustainability. This requires changes in what, where, how and by whom food is produced, marketed, and consumed. Interdisciplinary research and trans-disciplinary collaboration are needed. Stakeholders need to agree on their respective roles, values, responsibilities and *modus operandi* so that research better responds to real-world challenges and opportunities. In this Viewpoint we argue that this is especially the case in the Global South post Covid-19. Without these changes, there will continue to be unrealistic expectations of impact from agricultural research, and disappointment when these are not realized.

Truly moving beyond agricultural productivity

As researchers engaged in agricultural research-for-development (AR4D), we have long grappled with identifying, articulating and influencing how research can contribute more meaningfully to valued and positive impacts within and beyond the agriculture sector. In the past, agricultural researchers understood that their main mission was to increase productivity to feed the world's growing population, with the development of new technology and its transfer to farmers being the key mechanisms for doing this. This mission is exemplified by the Green Revolution, which through the introduction of high yielding varieties of rice and wheat, was a success when assessed in terms of its ability to increase food production and feed growing human populations.

While populations continue to rise and food and nutrition insecurity remain significant, along with inter- and intra-generational equity issues, agriculture is now expected to contribute to an array of development objectives. These include health and nutrition (Byerlee and Fanzo 2019), gender equality (Anderson and Sriram 2019), poverty reduction (Christiaensen and Martin 2018) and environmental sustainability (Hansen et al. 2019). Objectives encapsulated in several of the Sustainable Development Goals (SDGs) of the United Nations' 2030 Agenda for Sustainable Development, and captured in the planetary boundary debate (Steffen et al. 2015). In effect, there has been increasing recognition that a paradigm shift is needed to transform further the focus of global food systems to one that includes delivering better health and economic outcomes for all segments of the population, and building well-being and equity while also ensuring environmental sustainability (Benton and Bailey 2019).

Fulfilling this vision will require radical re-thinking in what, where, how and by whom food is produced, marketed, and consumed. It will also require addressing trade-offs and building synergies between improved nutrition, environmental sustainability, social and gender equity, and economic prosperity. For agricultural researchers, the challenges we need to grapple with are daunting: global food and agriculture systems are characterized by growing inequalities, and increasingly unsustainable use of natural resources (FAO 2018). Furthermore, the world is becoming increasingly prone to climatic vagaries of heat, drought and flooding. Such changes not only undermine agricultural production but challenge national food security, increase the divide between high and low income countries, enhance disparities within countries, and contribute to political tensions (Lassa, Lai, and Goh 2016).

Addressing these challenges implies that AR4D itself needs to change more. Researchers and research organizations need to be equipped to foster greater interdisciplinary science and to embed themselves more in trans-disciplinary networks to transform the research process from inception to evaluation. As agricultural researchers, with direct knowledge of the workings of organizations responsible for delivering the Green Revolution, we can provide insights into the roles, legitimacy and *modus operandi* of different stakeholders in these networks. This is crucial to allow for more holistic inter-disciplinary research (Paasche and Osterblom 2019) and to have greater transparency about what agricultural research can and cannot realistically achieve with respect to leveraging development changes (Faure et al. 2018; Blundo-Canto et al. 2018).

Food diversification and the improved nutritional quality of cereal crops

In the Green Revolution, plant breeders had largely focused on increasing crop yields. This was often at the expense of nutritional traits, for example, lower micronutrient content in high-yielding (cereal) crop varieties (Qaim 2017). Poor quality diets with low nutritional values have also emerged as a growing issue, particularly in urban contexts where people are dependent on industrially-produced foodstuffs, high in saturated fats and sodium. Hence, in recent years there has been a change in emphasis from feeding to 'nourishing' greater numbers of people (DeFries et al. 2015). This has been largely in response to the fact that increasing numbers of people eat too little, too much, or the wrong type of food. It follows that food systems can be both a primary cause of, and potential solution, to these problems (Willett et al. 2019).

Reflecting the greater stress found now on the quality of food crops, as shown by the new emphasis on nourishment, agricultural research has shifted focus from a handful of cereal crops to a wider range of crops with inherently higher nutritional values, such as pulses, fruits, and vegetables (Horton et al. 2017). Food diversification into healthier and more nutritious foods, including leveraging neglected and under-utilized agricultural biodiversity, is now considered highly desirable (Gillespie et al. 2019). Nutrient-rich crops and wild edible

plant species have the potential to transform food systems while supporting environmental sustainability (Hunter et al. 2019).

While food diversification is a desirable outcome of food system transformation, cereal-, root- and tuber-dominated diets, with a limited range of additional nutritional elements, will continue to dominate agricultural-based consumption patterns in the Global South for the foreseeable future. This is because production and consumption of staple crops is deeply entrenched in the socio-economic, political and cultural fabric of people's daily lives, particularly in rural contexts. Added to this, of course, is the limited capacity to make new dietary choices that is inherent in poverty and food insecurity for significant numbers of people in regions of the Global South, both urban and rural.

A complementary approach to efforts to improve the range of crops produced and consumed is to improve the nutritional quality of staple cereal crops. Indeed, food fortification programs are one of the fastest ways to improve health for targeted population groups who continue to consume large quantities of cereals, roots and tubers (Qaim, Stein, and Meenakshi 2007). Fortification has been used in public health strategies in many countries, including Bangladesh, India and Cambodia (WHO 2016). These efforts have improved micronutrient-related health indicators in individual consumers. Despite this, fortification programs seldom take into account sensory dimensions. Consumer acceptance could be enhanced if breeding efforts led to fortified crops that incorporate consumer-preferred organoleptic properties (Custodio et al. 2016).

Crop breeding efforts can also mitigate the trade-off between yield and quality. Rice provides a good example: recent advances in breeding low glycemic index rice and higher grain quality rice do not negatively impact yield (Butardo and Sreenivasulu 2016). New transgenic rice varieties have been in the offing for some time but societal concerns and subsequent regulations have led to limited demand by producers and consumers. Conventional breeding combined with modern genomics e.g. CRISPR-mediated gene editing, however, can generate non-transgenic rice with desirable agronomic and nutritional traits and, thus, fast-track breeding for improved varieties with benefits for producers and consumers (Zaidi et al. 2019). Societal debates around preferences, property rights, seed and food sovereignty, biodiversity consequences, governance and regulation issues, however, are needed for their introduction (Bartkowski et al. 2018).

Policy options for health and prosperity

Population growth, increases in income, and urbanization drive new food consumption choices and changing diets. Consumers' acceptance of new diets is shaped by attitudes and beliefs, as well as by issues such as the gender dynamics of domestic labour time, capacity to pay and by marketing. Consumer policy can harness similar demand shifts to transform

food production. Nutritional health is highly correlated with income (Webb and Block 2012) and in many countries a key policy target is affordable prices of healthy foods for urban consumers. However, pro-productivity and pro-trade policies have implicitly or explicitly encouraged the externalization of the costs of agriculture on the environment and health (Benton and Bailey 2019). Internalizing these externalities will likely lead to higher production costs, resulting in higher food prices, unless there are further changes away from the productivity paradigm to one that focuses on food system efficiency and equity, while also rethinking consumption choices through societal debate and their multifaceted consequences for different actors and for the environment.

Policy makers need to respond to the environmental, climate and health emergency with appropriate levels of policy ambition and effectiveness. Lessons can be learned from the experience gained on the international Climate, Ozone, Chemical, or Trade agreements to select the array of policy measures that will induce appropriate behavioral change. Governments already recognize the need to go beyond informing, nudging, encouraging, and piloting. The most effective channels to induce rapid and lasting change in household and corporate behavior involve financial incentives (subsidize healthy foods) or disincentives (tax unhealthy foods). It may also mean banning unsustainable and collectively harmful practices (e.g. deforestation for agriculture expansion), technology (e.g. high-carbon economy), or substances (e.g. specific fertilizers). More positively, the enforcement of clear, traceable and transparent “clean” labelling on food products is a promising avenue for change. Taxing highly processed food through tariff escalation has been effective in combatting obesity in Sub-Saharan Africa (Boysen et al. 2019).

Shifting diets towards healthier, more nutritional food consumption, while improving environmental sustainability and enhancing prosperity for all, is a biophysical necessity and moral imperative. Achieving this goal requires bringing together diverse stakeholders, whose role may be multiple and evolve all along the innovation process: scientists and their partners as innovators; development agencies, government and the private sector as scalers; and policy makers and implementors as regulators of the emerging food system, amongst others. To drive long-lasting systemic change, and minimize trade-offs, stakeholders need to identify context-specific obstacles and leverage points to ensure that future food systems increasingly operate at the intersections between prosperity, nutritional health, and environmental sustainability (Kremen and Merenlender 2018). It is at these intersections that the most promising policy research breakthroughs lie to address the food system challenges of our times by delivering further compelling evidence about what can work, how and where (Jez, Lee, and Sherp 2016), and for whom.

Stakeholders' roles and legitimacy

The paradigm shift from feeding to nourishing growing populations raises many challenges and opportunities for all stakeholders engaged in food systems, not least researchers. Much progress has been made in realizing the paradigm shift but there is still a large gap between theory and practice.

Agricultural technology development remains critical but it is only a partial answer to the human development challenges associated with food systems research. There is a need for a scaling out of these technologies to greater numbers of farmers and scaling up in terms of fostering the organizational, governance and policy environments that encourage scaling. It requires agricultural researchers to foster and integrate themselves in trans-disciplinary networks. Ironically much can be learned from the Green Revolution.

The Green Revolution of the 1960s may have been under-pinned by high-yielding rice and wheat varieties but wide-scale uptake by farmers in Mexico, India and the Philippines was premised on concerted efforts by researchers and others on capacity development of farmers, breeders, irrigation engineers and extension agents etc. It also involved engaging with government officials to foster enabling policy and institutional environments that included input subsidies and guaranteed market prices. While these same policy tools may not be so readily available in today's economic and financial climate, organizational and institutional processes are still critical to scaling and to the fostering of sustainable agriculture technologies, practices and knowledge that can contribute to better health and nutrition, and increased prosperity.

Although the pressure on AR4D "to deliver" has grown in recent years, competition for research funding has also increased. In our experience, this has contributed to a situation where, to secure funding, researchers often over-promise on what they can deliver during the life-time of a research project and/or on the extent to which their research products (generated during the lifetime of a funded project) are going to contribute to outcomes and impacts (that may realistically be beyond a project's lifetime) (Hainzelin et al. 2017). This has several consequences, not least that researchers generally feel the pressure to focus on 'quick wins' rather than "*working towards the kinds of long-term transformations that are needed to combat poverty and enhance global food security*" (Leeuwis, Klerkx, and Schut 2017).

Despite much progress in articulating more comprehensive (and complex) theories of change in the development of research projects and programs, there is still a tendency to evaluate a project in terms of the number of farmers trained and/or the number of farmers who have adopted certain technologies by the end of the project. These numbers are important, but they reveal little about human development changes in terms of increased

nutrition and health, empowerment of marginalized groups, or how farmers have invested the often-reported higher income accruing from adoption of the technologies. They also do not consider whether this adoption is partial, lasting, or whether farmers transformed the "technological package" to fit their context, needs and preferences, therefore changing the nature of the innovation (Glover, Sumberg, and Andersson 2016). The evaluation of outcomes supposedly cascading from adoption is often limited to yields or income from market access even though neither automatically translates into human development outcomes.

Ultimately, though, the aim of agricultural research is to empower users and enablers of agricultural technologies through practices, capacity and knowledge in ways that enable them to choose and embark on improved livelihood trajectories, including off-farm ones. The trajectories open to them, however, are determined by the actions of numerous stakeholders along diverse impact pathways. There remains an urgent need for these diverse stakeholders to recognize explicitly their respective roles and responsibilities by building shared visions and systemic theories of change (Douthwaite et al. 2017; Blundo-Canto et al. 2018). This includes researchers recognizing they have a key role to play and should be held accountable for the delivery of 'outputs' (the sphere of control, Figure 1). But they should also, during the lifetime of a project (and often beyond), identify suitable mechanisms between innovators, scalers, and regulators that are needed to foster appropriation of these outputs to bring about change at global, national and local levels (the sphere of influence, Figure 1).

Figure 1 here

Realizing impact largely falls within the sphere of interest (Figure 1); the operating spaces of governments, the civil society and private sector best placed to foster and nurture the organizational and institutional processes that underpin the sustainability of agriculture for health and prosperity.

It is in the spheres of influence and interest where one finds stakeholders, including donors and investors, who have perhaps encouraged agricultural researchers to over-promise on their project's deliverables and the impact of these research outputs. In our experience, this stems from situations whereby researchers are requested and/or perceive that there is an expectation to deliver on outcomes and impacts that are (by their very nature) outside researchers' sphere of control. Of course, this does not absolve researchers of responsibility beyond their sphere of control; on the contrary, part of their remit is to analyze, identify the mechanisms and policy changes needed and engage in targeted knowledge creation and transmission, capacity building, enabling methods and tools etc. that support stakeholders' appropriation of research outputs leading to outcome and impact. This is one reason why

effective transdisciplinary engagement between researchers and other stakeholders is so important.

Interdisciplinary scientific advance and trans-disciplinary collaborations are needed in response to complex challenges such as food system transformation and climate change (Cundill, Currie-Alder, and Leone 2019). Articulating plausible and systemic theories of change does not lessen agricultural researchers' responsibility. On the contrary, it enables them to define better their roles, legitimacy and *modus operandi* within trans-disciplinary networks of researchers, development practitioners, policy-makers, civil society and the private sector. Crucially, it enables other key stakeholders in the sphere of control, influence and interest to do likewise. Ultimately, it is a reflexive issue on each stakeholder's practice and role in the transformation of food systems towards valued changes.

Despite much progress, there still remain the challenge of designing and implementing appropriate monitoring, evaluation and learning systems that enable reflexivity and change; identifying suitable metrics to assess progress (Ton, Vellema, and Ge 2014); and factoring in trade-offs between development outcomes (Hellin and Fisher 2019). However, clarity and agreement on different stakeholders' roles, responsibilities and *modus operandi* is a first step in facilitating their working together to meet these challenges and ultimately to realize positive outcomes and impacts. The disruption to agricultural and food systems caused by Covid-19 (Stephens et al. 2020) makes this need even more imperative.

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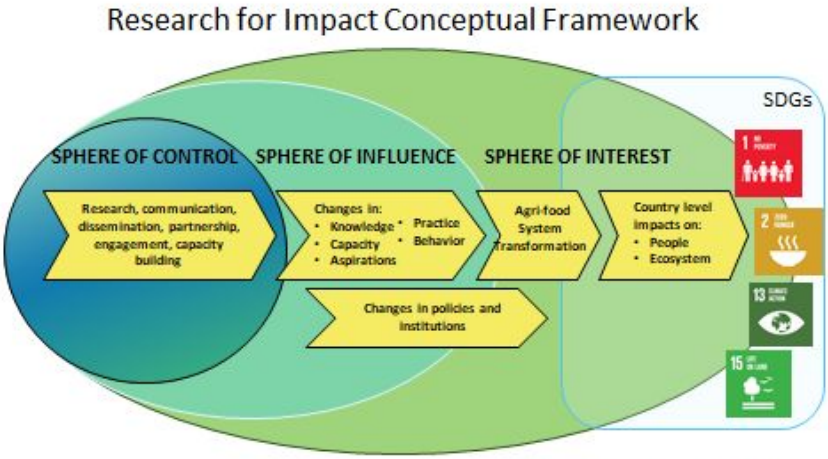
Sustainable agriculture for health and prosperity: beyond smoke and mirrors for agricultural research organizations



Authors adapted from CGIAR (2016)