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Nutrition and Health Outcomes: Targets for Agricultural Research



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Despite remarkable advances in agricultural productivity over the past 50 years, hunger and malnutrition remain widespread in developing countries, where food insecurity affects more than 800 million people. A staggering 2 billion people suffer from vitamin and micronutrient deficiencies, while rates of obesity and associated chronic diseases are soaring in both the industrialized and developing world.¹ Food availability alone does not ensure good nutrition.

The Lancet 2013 series on maternal and child nutrition² identified 10 nutrition-specific interventions that, if implemented at 90% coverage, could cut stunting by 20%. However, this still leaves 80% of stunting that must be addressed elsewhere. Nutrition-sensitive actions, including agriculture, can contribute to better nutrition and health outcomes, but the potential benefits of such approaches are yet to be realized.

Where are the knowledge gaps, and what are the priority research areas for CGIAR? How can we show evidence of the impact agricultural development has on nutrition and health? Over 200 agricultural, nutrition and health specialists sought to answer these questions at the 2013 CGIAR Science Forum, held in Bonn, Germany from 23 to 25 September. The Forum was structured to be a mix of plenary and breakout sessions, with five simultaneous breakout sessions enabling greater opportunities for active participation of all delegates.

The plenary and breakout sessions are documented in a summary report.³ This brief outlines the context and the existing evidence base, together with priority research areas and key issues identified by participants at the Forum as those which CGIAR needs to consider in designing agricultural research that can deliver better nutrition and health outcomes.

The context: Nutrition-sensitive agriculture

Historically, the agricultural community's approach to improving nutrition has been to focus mainly on increasing yields of staple cereal, legume, and root crops that can meet caloric requirements at relatively low prices. The nutrition community's approach has been a focus on micronutrient interventions such as supplementation, fortification, and improving diet quality. Addressing the gaps between the two approaches is the emerging field of nutrition-sensitive agriculture. It explicitly incorporates nutrition objectives into agricultural research to ensure their inclusion in the health, education, economic, environmental, and social aspects of approaches to hunger and undernutrition. Nutrition-sensitive agriculture strategies include not only increased food production but also diet diversification and fortification, food safety, gender empowerment, value chain analysis, and policy support. The CGIAR Research Program on Agriculture for Nutrition and Health (A4NH) is currently undertaking new research in these areas, while other CGIAR Research Programs (CRPs) are also conducting research that will contribute to the CGIAR System Level Outcome (SLO) 'Improved Nutrition and Health'.

The objective of this Science Forum was to help the CGIAR System as a whole contribute to that SLO by using *'recent evidence across a range of disciplines to identify priority research needs and new scientific approaches and facilitate new and stronger partnerships through which the agricultural community can add most value to the delivery of nutrition and health outcomes'*.

The evidence base that links agricultural interventions with nutrition

Published evidence for direct links between agriculture and improved nutrition is weak. A review by Marie Ruel and Harold Alderman

in *The Lancet* series attributes this mainly to a lack of rigor in impact evaluations, but also to weak program goals and study design.⁴ There is evidence, however, of indirect links between agricultural interventions and improvements in nutrition. For example, investments in agriculture can lead to positive nutrition outcomes through productivity increases and women's empowerment, although it is important to note that nutrition and health improvement do not necessarily go hand in hand with income and productivity growth.

A key point for discussion of the links between agriculture and nutrition is the indicators used to assess the impact. Many attendees agreed that anthropometric measures of stunting and underweight are not the most sensitive indicators of the success of an agricultural intervention project. Stunting is a general indicator of malnutrition, but specific interventions seeking to address the complex causes of this syndrome often need more proximal and intervention-specific assays of efficacy. The complexity is reflected in the so-called triple burden of malnutrition, micronutrient deficiency and, in some populations, obesity.

Research design is another key factor in determining whether impact can be measured. A focus on a whole-diet approach and improving diet diversity is important, and may be more effective than a micronutrient-by-micronutrient approach. In fact, improving individual dietary components may have adverse effects on the overall diet, as in one case in which a biofortified staple food displaced traditional crops that provided a wider range of micronutrients. But quantity still counts, and a basic level of nutrition is needed for the body to absorb certain nutrients. Efficacy trials have shown that animal source foods can improve child growth and development at low overall levels of nutrition.

Additionally, good sanitation is necessary for successful nutrition outcomes. No nutrition-sensitive intervention can be

truly effective in people who are suffering from gastrointestinal diseases.

The status of women also plays a key role in the nutritional success of agricultural programs, since they are generally directly responsible for the nutritional status of young children. Where they control resources and are focused on home gardens or dairy production for example, interventions in these areas tend to benefit the nutritional status of children in the household. But where women fend for themselves, have limited access to improved inputs, markets, or knowledge, and there is an increased burden on their time to tend livestock or fetch water for irrigation, there is less time for them to care for their own health and for breastfeeding and child care, and hence the nutritional status of children may suffer. In some cases, a link between increased household income and a *decrease* in women's agency has been found.

Finally, the overemphasis of agricultural research on staple crops and lack of support for non-staple grains and legumes, and the lack of attention to the relatively higher relative prices of micronutrient-dense food such as fruits, vegetables, and livestock products, has led to food supply policies that perpetuate a cycle of undernutrition in developing countries.

What do we need to know?

What are the best strategies to improve the dietary quality of the poor? This and, many related questions were raised during the course of the meeting.

First, data are needed on the levels of nutrients in the diets of target populations and the amounts ingested across seasons by individuals, households, and communities. These data need to be collected against internationally agreed indices and with increased awareness of local components of the diet, particularly for the complementary feeding of children. Appropriate strategies to provide the nutrients missing in local diets need to be designed, to take account of the context (agricultural, seasonal, cultural, and

economic). More generally, there is a need to understand how and why diets are changing at both the country and household level. What determines the choices that influence diet quality, in both long and short value chains? How do labor dynamics and changing occupational structures in agriculture shape the ways in which agricultural policy affects nutrition/health? How is nutrient quality influenced by production and postharvest handling and processing? Political science research is required to understand changes in food system regulation. Researchers also need to determine the long-term effect of agricultural interventions for improving nutrient status and growth while preventing obesity and cardiovascular risk.

Given that aspects of malnutrition can be addressed through dietary augmentation, supplementation, the fortification of foods, and the potential biofortification of staples (often on quite different research time frames), we need to know how and when micronutrient interventions should be integrated into overall strategies, or when to introduce fortified foods for maximum effect.

What kinds of women's empowerment are critical for specific nutritional outcomes? Looking at the direct and indirect influences of gender on nutrition, it is not clear where interventions have the most impact. Potential opportunity costs in terms of child care and leisure need to be identified at the outset.

Impact assessment was a much-discussed issue. The vast majority of impact studies on agricultural interventions have focused on productivity, with only a few considering effects on income or nutrition and health. For those that did explicitly look at nutrition, the data often could not be translated into significant findings. Many of these failures were attributed to study designs, including population sizes and choice of indicators (often with few health metrics other than production and income and some measure of consumption). This has limited the value of prior agricultural

experiments and the amount of data and knowledge that can be used to inform the nutrition and agriculture research fields.

The way forward

How can CGIAR add value to this field? What questions should agricultural research address and for which specific goals and contexts? How should impact be monitored? Who should we partner with? And how can we influence supportive policy? This section explores potential answers to these questions.

Agricultural research questions

Future research should begin by measuring total food intake, then assessing nutrient intake in various population groups (e.g. the entire family, children, and women of childbearing age). As well as providing the basic elements of food security through the production of staples, agriculture can be tailored to provide missing nutrients through production, the timing of harvest and supply, and by reducing the cost of desired micronutrients or food groups. Strategies to provide the missing nutrients from both plant and animal foods, including fish, should be considered. Nutritional and agricultural science can be blended in the design of country strategies to integrate seasonal food availability, or the use of supplementation, fortification, and biofortification programs. Nutritionally important traits can be included in breeding programs for key dietary components (principally plants but including the longer-term livestock species as well). There are opportunities to make value chains work better for the nutrition and income of the poor, as well as producing seasonal food substitutes. Similarly, in the 'design' of agricultural production processes, there are opportunities to incorporate gender- and labor-sensitive traits, thereby allowing other household influences on nutritional enhancement to come into operation. Finally, there is the requirement to examine the unintended consequences of agriculture (e.g. on water quality, including increased

waste, toxins, and agro-chemicals) that affect food safety, sanitation, and human health.

Thus, nutrition-sensitive agricultural research needs to be demand-driven, using a mix of qualitative and quantitative methods to answer different research questions. The sequencing of interventions can be critical, and researchers must plan long-term studies with the knowledge that responses can vary over time and it may take many years before effects can be detected. Community participatory approaches to learning are important, as is the use of mobile technology to influence behavior. Studies also need to consider the influence of urbanization, modernization, globalization, and structural transformation links. CGIAR has the most to provide from choosing to work with societies that are representative of major regional issues in these fields, rather than selecting minority populations, whose way of life may be overtaken in the time needed to yield results.

Monitoring the impact of research

Program impact pathways in nutrition-sensitive agriculture are more web-like than linear, with various mechanisms leading to improved nutrition and health. The four most prominent kinds of metrics used to measure nutrition are: (1) subjective food security assessment; (2) food consumption-based measures; (3) anthropometric measures; and (4) clinical assessment. Each of these can be chosen to suit the type of agricultural innovation, its expected impact pathway, the target group, the intended sample size and regional coverage, and the available financial and human resources.

Demonstrating actual, rather than potential, impact from investments in agricultural research will require credible *ex ante* designs with clear objectives and management of feedback loops. The complete causal chain between agriculture/income and nutrition/health must be mapped, including health system reform, gender, and governance. Research design must anticipate potential unintended effects, either through

agriculture's direct impact on nutrition through changes in the quantity, quality, and diversity of foods produced, or through indirect income effects, occupational health hazards, zoonoses, or water-borne vectors of infectious diseases. Because it is challenging to measure impact in multi-sectoral interventions, collaboration between research institutions and implementing partners is critical. Indicators must be valid for different kinds of interventions and need to be selected carefully to review effects across large agricultural investment programs. Sample sizes need to be considered well in advance. Designing effective agricultural research that can lead to measurable nutrition and health outcomes will require a wider set of evidence and new, integrated approaches. As Per Pinstrup Anderson emphasized in his comment to *The Lancet* series, randomized controlled trials, which are the gold standard in public health studies, are not easily applied to the agriculture sector, where treatments cannot be randomized and impact pathways are very long.⁵

Partnerships

There was unanimous agreement throughout the meeting on the need for a multi-sectoral research approach to delivering nutritional benefits, with new partnerships forged not just between the agricultural and nutrition sectors, but also with sociologists and anthropologists for a more nuanced understanding of cultural and gender issues, as well as agencies delivering sanitation, wider health care practices, and social protection. The private sector was identified as the *de facto* 'supplier of food', whereas governments have the responsibility for national strategy and regulation of food security, nutrition, and food safety. The private sector works at the 'plate' end of the value chain, with a good grasp of consumer demand, production in bulk, and marketing. CGIAR and its nutrition agency partners should work increasingly in private–public partnerships – and be open to the many levels of such partnerships –

to achieve impacts from nutrition-focused agricultural programs. Strategic partnerships must be launched from the design phase and balance research rigor with the practicalities of program implementation. Research should assess the capacity required to deliver effective nutrition-sensitive actions and incorporate training at various levels into study design.

Breaking silos and building convergence across sectors requires: (1) clear and measurable goals; (2) performance indicators that relate to the community level; (3) local management of various government interventions; and (4) frequent and transparent monitoring of progress toward goals. Integrated programs that combine multiple approaches must consider the balance among the different approaches, evaluate the magnitude of their impact, and determine the best sequencing of interventions.

Policy and institutional approaches

A policy environment that gives incentive to all players along the agriculture–nutrition pathway is needed, but quite often it is breakdowns in policy that block progress. What is the effective governance for nutrition-sensitive actions to actually have an impact on nutrition? What kind of institutional mechanisms need to be established to allow health objectives to be embedded in food, agriculture, and trade policies?

Food and agriculture policies should increase incentives to ensure the availability and affordability of diverse, nutritious, and safe foods that are produced and distributed in environmentally sustainable ways. Policy support is needed for proper monitoring of access to, and balanced intake of, safe, diverse, and nutritious foods. As well, policies should include measures that protect and empower the poor and women, such as safety nets during shocks or seasonal shortages, land tenure rights, and equitable access to productive resources and markets. Capacity within the various institutions needs to be assessed and training programs adequately

funded, to effectively improve nutrition through the food and agriculture sector. Finally, policy must support multi-sectoral strategies to improve nutrition within national, regional, and local governments.⁶

Conclusion and recommendations

Many of the basic approaches for promoting a truly intersectoral approach to enhancing impacts on human nutrition have been advanced and are clearly gaining broad acceptance from the nutrition community.⁷ Global initiatives such as the Scaling Up Nutrition movement are bringing ministerial and sectorial efforts on nutrition together in an increasing array of developing countries. As the Science Forum has shown, agriculture clearly has a larger role to play in relation to nutrition, education, and social support programs than it does presently. But what does the commitment of agricultural research to improved nutrition and health outcomes look like in practice?

- It is clear, specific, and transparent about what agriculture can contribute to nutrition.
- It operates within an expanded, demand-driven research agenda that takes into account the role of agriculture in relation to nutrition, gender, education, and social support programs.
- It engages across sectors and uses outcome-appropriate research methods, both quantitative and qualitative.
- It is actively involved in public health dialogue, priority-setting, and integrated research.

Recommendations from the Science Forum 2013

1. Research toward nutrition outcomes needs to be specific and distinguished from food security.
2. Agriculture can assist (despite the current paucity of evidence in the literature) and needs to be part of the public health dialogue. There needs to be clarity and honesty about what agriculture can realistically contribute.
3. Governments and the research community need to take the broader view, i.e. consider diet as a whole, as there may have been too much emphasis on micronutrients as one-by-one deliverables. This does not undermine the necessary experimentation that CGIAR is conducting on the biofortification of staple crops through the HarvestPlus program, but rather calls for additional effort on whole-diet approaches.
4. Agricultural research needs to focus on contributions to diet diversity (cost reduction), diet quality, and food safety.
5. Agricultural programs need to be measured by appropriate and more proximal indicators than stunting.
6. The importance of women is increasingly recognized in effective approaches and delivery (household decision-making, labor, caring, the 1000 days paradigm) – but it is still necessary to bear in mind the needs and targets of whole households for achieving better nutrition.
7. Farming plays many diverse roles in developing countries. However, there is a need to recognize that many players in the food system are businesses and to seek appropriate public–private partnerships (PPPs) for research and delivery (inputs, value chains, and products to the plate).
8. Agriculture has a role to play in relation to nutrition, education, and social support programs. Sectors need to be coordinated and work together to deliver nutrition outcomes.
9. The importance of qualitative approaches to increase understanding of linkages must be recognized.
10. There may be new research to conduct at the articulation between fields – we must look for, and report, evidence (through appropriate evaluation methods).

Box 1: Some innovative approaches suggested during the breakout groups

- Protocol(s) for collecting food security and consumption data should be harmonized (e.g. dietary diversity scores).
- Survey instruments should also be harmonized, i.e. a minimum set of nutrition questions should be part of agriculture surveys. Similarly, nutrition surveys should contain a minimum set of agriculture questions.
- For biofortification to make sustainable contributions in the longer term, micronutrient fortification of staples needs to become a core breeding objective alongside yield, disease resistance, etc.
- Bio-informatics and genomics should be applied to food safety; there should be greater understanding of behavior and incentives for food safety; social network mapping and realistic synthesis methods could be used to study inter-sectoral and cross-institutional coordination; there is a need to collect and analyze panel data and present the results to policy-makers covering a range of relevant sectors and layers of government.
- The three-cornered approach of fortification, supplementation (including emergency rations), and agricultural diet diversification requires national/target area planning with governments, the private sector, and other partnerships.
- Value chain analysis can provide the framework to determine how demand (e.g. for certain diets) can be met by supplying the necessary production attributes (e.g. how large producers might supply more nutritious non-perishable processed foods) and food safety (in both short and longer value chains).
- New studies are needed to determine the mediating factors that modify the relationship between agricultural production and nutrition outcomes, as market institutions, household behavior, and disease exposure interact to influence how higher productivity translates into improved nutrition.
- Economic implications need to be examined, particularly the shift from a production-dominated research agenda to a stronger focus on consumption (both urban and rural) to a systems approach or scenario analysis. This will help put nutrition objectives into a food systems context to understand better how different food systems contribute to an appropriate diet.
- Encourage crop-neutral intensification, which promotes farmer choice and allows greater sensitivity to market signals. For research toward this SLO, there needs to be a shift in the balance of research efforts and resources from the three staple grains toward a more diverse portfolio of crops.
- Information and communications technologies have a key role to play in scaling up behavior-change messages.

How does this apply to CGIAR?

Prior to the Science Forum, CRP targets for nutritional/health outcomes were focused on the work of A4NH on biofortification, value chains, food safety, and policies, as well as the commodity programs largely seeking increased consumption of particular

commodities. Encouraging avenues could include vitamin A-rich sweet potato and the incorporation of pearl millet, finger millet, legumes, livestock, and fish products into the diet. We suggest that once the intermediate development outcomes targets by the CRPs are published, they should be reviewed for feasibility in relation to pathways highlighted

in the Science Forum documents. The means by which increased consumption will be achieved from research should be adequately discussed in the CRP theory of change and the anticipated pathway to impact. Claims should only be made according to feasible pathways, accountability mechanisms, and the creation of partnerships for their accomplishment. Concepts such as nutrition-sensitive landscapes and sustainable diets have also been promoted without clear conceptual underpinnings and metrics. These are key subjects for definition and research.

The ISPC and the Science Forum participants strongly reinforce the inclusion of agriculture and agricultural research as a key component of improving human nutrition in developing countries, in tandem with policy discussions on how to improve the coordination of sectoral approaches and the development of appropriate PPPs that can address malnutrition among the poor.

About the Science Forum

The Science Forum series is a flagship event initiated by the ISPC in 2009 under its remit of mobilizing science for development. Each Forum reaches out to scientific communities that are largely external to CGIAR but have potentially important contributions to make to its research portfolio and its system level objectives of improving food security, human nutrition and health, poverty alleviation, and environmental sustainability. The biennial Science Forum is organized in partnership with other CGIAR bodies and a host country, and aims to foster partnerships that best complement the expertise of the CGIAR and its partners on research initiatives and for development impacts.

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