
A GLOBAL RESEARCH AGENDA FOR NUTRITION SCIENCE

Outcome of a collaborative process between academic and
non-profit researchers and the World Health Organization



THE SACKLER INSTITUTE
for NUTRITION SCIENCE

a program of  The New York
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ABOUT THE ORGANIZATIONS

THE SACKLER INSTITUTE FOR NUTRITION SCIENCE

The New York Academy of Sciences, in partnership with The Mortimer D. Sackler Foundation, established The Sackler Institute for Nutrition Science to create a coordinated effort to support and disseminate nutrition science research. The Sackler Institute is dedicated to advancing nutrition science research and knowledge, mobilizing communities, and translating this work into the field. The Sackler Institute is generating a coordinated network across sectors, disciplines, and geographies that promotes open communication; encourages exchange of information and resources; nurtures the next generation of scientists; and affects community intervention design and public policy changes. Visit us online at www.nyas.org/nutrition.

THE NEW YORK ACADEMY OF SCIENCES

The New York Academy of Sciences is an independent, not-for-profit organization that since 1817 has been committed to advancing science, technology, and society worldwide. With 25,000 members in 140 countries, the Academy is creating a global community of science for the benefit of humanity. The Academy's core mission is to drive innovative solutions to society's challenges by advancing scientific research, education, and policy. Please visit us online at www.nyas.org.

WORLD HEALTH ORGANIZATION

The WHO is the directing and coordinating authority for health within the United Nations system. It is responsible for providing leadership on global health matters, shaping the health research agenda, setting norms and standards, articulating evidence-based policy options, providing technical support to countries, and monitoring and assessing health trends.

In the 21st century, health is a shared responsibility, involving equitable access to essential care and collective defence against transnational threats.

EXECUTIVE SUMMARY

The Sackler Institute for Nutrition Science, a program of the New York Academy of Sciences, in collaboration with the World Health Organization (WHO), led an initiative to identify global research gaps in nutrition science. This report, *A Global Research Agenda for Nutrition Science* (2013), is the culmination of a two-year process to accelerate global commitment, cooperative work, and funding to uncover scientific solutions to malnutrition.

More than two billion people are affected by malnutrition—both under- and overnutrition—in developed and developing countries. Malnutrition is a risk factor for mortality and morbidity across the lifecycle and contributes to suboptimal cognitive development in children and lower productivity in adults. According to the United Nations' Standing Committee on Nutrition (SCN), malnutrition is the principal contributor to disease worldwide.

Many organizations are performing cutting-edge research to understand the physiological basis of nutrition-related problems, designing behavioral interventions, and working to advance policy. However, stakeholders across functional and geographic sectors agree that there is a need for a prioritized nutrition science research agenda that is easily accessible and can be translated into application and public policy changes.

To respond to this challenge, the New York Academy of Sciences, in partnership with The Mortimer D. Sackler Foundation, established The Sackler Institute for Nutrition Science in 2010. The first initiative of The Sackler Institute was to develop a global research agenda that identified research gaps, which would then stimulate research and develop innovative interventions to the challenges of nutrition science.

A collaborative process identified three Focus Areas, concluding with the identification of critical knowledge gaps in nutrition science.

RESEARCH GAPS IN FOCUS AREA 1

Environmental and Societal Trends Affecting Food and Nutrition Among Vulnerable Groups

- Modeling an enabling environment for health and nutrition
- Measuring economic and sustainability trade-offs for nutrition and health outcomes
- Describing the interactions between the food system and nutrition
- Integrating individual- and household-level factors underlying economic vulnerability and food insecurity
- Developing nutrition-centered approaches in climate change

RESEARCH GAPS IN FOCUS AREA 2

Unresolved Issues of Nutrition in the Lifecycle

- Role of nutrition in Developmental Origins of Health and Disease (DOHaD)
- Characterizing normal growth during early life
- Characterizing and assessing optimal growth and development during early life
- Describing and understanding contextual factors
- Creating a food-based systems biology of nutrition and human health in mother and child
- Describing and understanding contextual factors
- The relationship between markers of malnutrition (e.g., stunting in children, low height, or BMI in women) and functional outcomes
- Topics in knowledge related to describing and understanding contextual factors
- Understanding and driving basic science related to the systems biology approach of nutrition

RESEARCH GAPS IN FOCUS AREA 3

Delivery of Intervention and Operational Gaps

- Knowledge related to inputs of nutrition intervention
- Managing the upstream, midstream, and downstream processes
- Outcomes in terms of service and product delivery and utilization

The global burden of under- and overnutrition, food security, and increases in non-communicable diseases (NCDs) remains alarming. Action must stem from a globalized, collaborative approach to carry out research and disseminate findings relevant to nutrition science. The identification of the research gaps presented in this *Agenda* must be of focus at a global, regional, national, and local level. Through well-managed collaboration, researchers, academia, private industry, funding agencies, and policy makers can lead the chain of events necessary to mitigate malnutrition.

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INTRODUCTION

The process for this *Agenda* began with the convening of a high-level Research Advisory Group, at the New York Academy of Sciences, comprised of a seven-member international panel of nutrition experts from both the nonprofit and academic sectors. This Group identified the following three topic areas as critical “Focus Areas” on which to concentrate future research.

1. Environmental and Societal Trends Affecting Food and Nutrition Among Vulnerable Groups

2. Unresolved Issues of Nutrition in the Lifecycle

3. Delivery of Intervention and Operational Gaps

Fifty-five researchers organized in Focus Area Working Groups, developed more than 20 critical gaps in knowledge from the broad Focus Areas. A web-based consultation secured feedback from more than 100 stakeholders in the nutrition science community—from both developed and developing countries—on these critical areas.

The conclusion of this process was presented during a landmark conference entitled *A Global Research Agenda for Nutrition Science* held in New York on December 17 and 18, 2012 (see www.nutritionresearchagenda.org for details). The conference was attended by 145 participants from around the globe, representing more than 20 different academic institutions, as well as government representatives, implementing agencies, the United Nations, NGOs, donors, think tanks, and the private sector.

FOCUS AREA 1: ENVIRONMENTAL AND SOCIETAL TRENDS AFFECTING FOOD AND NUTRITION AMONG VULNERABLE GROUPS

DEVELOPMENT OF RESEARCH TOPICS

The Working Group identified and submitted for consultation 14 research topics blocked around the following themes.

- Measurement and modeling of multi-level factors that influence nutrition, particularly factors affecting the double burden of malnutrition
- Examining policies that harm or promote human nutrition and their differential net impact on various health and nutrition outcomes, both short- and long-term
- The food system overall—linking production, processing, and distribution of foodstuffs
- Factors underlying economic vulnerability and food insecurity
- Climate change, population trends, and environmental sustainability

The consultation reflected the complexity of adopting a holistic approach. Research topics are defined differently depending on a particular focus (under- or overnutrition), geography (urban or rural), and food production perspective (small or mass scale). Multiple conceptual approaches are available to describe the causal and correlation pathways, associating food system approaches, policies, behavior, and their connections with the overall economic and policy environment. Finally, the sense of urgency oscillates between a better understanding of what is going on through improved model designs, and the identification of what works through evaluation of existing and future programs and interventions.

Points of convergence also emerged, stressing the following elements in research.

- Thinking and acting holistically (focus on research that can evaluate multiple inputs and address several outcomes together)
- Developing alliances (where is the most convergence of goals and incentives?)
- Building feasible, pragmatic approaches to research
- Building recognition that nutrition both influences, and is influenced by, human, social, and economic development
- Connecting nutrition, economics, and environment
- Capitalizing on the strengths of many disciplines through collaboration and communication
- Placing biology within the social/economic/natural environment
- Paying attention to measurement and delivery issues

RESEARCH TOPICS

Research Topic 1: Modeling an Enabling Environment for Health and Nutrition

This research topic highlights the need for an analytical toolbox to describe and model an enabling environment for health and nutrition that connects nutritional quality, environmental sustainability, and economic viability.¹ This requires adding the dimensions of household vulnerability and livelihood levels, including in subsistence economies; and policies (using multi-disciplinary approaches including: climate change researchers, scientists working on health system strengthening, economists evaluating the cost of the double burden, environmental and urban engineers).

¹ After further consultation, the concept of profitability was replaced by viability, which better reflects the notion that economic aspects are merged with society and the environment.

Research Topic 2: Measuring Economic and Sustainability Trade-offs for Nutrition and Health Outcomes

In a real world of very complex and ever-changing interactions, there is a need to better measure economic and sustainability trade-offs in terms of nutrition and health outcomes. This requires clarifying a subset of specific result issues related to measurement and metrics.

- Enhancing measurement of nutritional quality, status, and outcomes
- Defining an adequate time scale to measure outcomes
- Identifying (and finding reinforcement strategies) where there are opportunities for double- and triple-wins between nutrition, economic viability, and environmental sustainability

Research Topic 3: Describing the Interactions between the Food System and Nutrition

In addition to trade-offs, specific aspects of the interactions between the food system and nutrition must be better described and understood.

- Evaluating the effects of government policies for production and trade on supply and demand for certain types of food and the impacts on nutrition
- Assessing how agricultural diversity affects dietary quality in different contexts
- Assessing the economic viability and environmental sustainability of dietary guidelines and recommendations

Research Topic 4: Integrating Individual- and Household-level Factors Underlying Economic Vulnerability and Food Insecurity

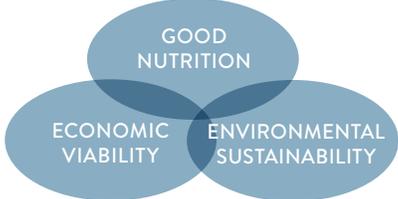
- What are the incentives for individuals to spend the resources (including time) to obtain healthy diets?
- How to connect women's economic empowerment with enhanced nutritional status for women and children?

Research Topic 5: Developing Nutrition-centered Approaches in Climate Change

Nutrition-centered approaches in climate changes need to incorporate population trends, various types of food systems (production, processing, trade patterns, and consumption), access to water, sanitation, and overall environmental sustainability, with the capacity to produce various scenarios and projection of nutritional outcomes.

Figure 1 describes the relationship between factors and outcomes in understanding and modeling. Factors are food system and nutrition, individual- and household level-factors, and climate change/population trend. Outcomes are good nutrition, economic viability, and environmental sustainability.

FIGURE 1: UNDERSTANDING & MODELING THE RELATIONSHIP BETWEEN FACTORS → OUTCOMES

Food system and nutrition	Government policies affecting production and trade, supply and demands (content and delivery)	 <p>Policies, guidelines, and interventions move these circles closer together or farther apart.</p> <p>How do we measure trade-offs, time-scales, and opportunities?</p>
	Agricultural diversity—link with dietary quality in various contexts and consensus on measurement	
Individual- and household-level factors	Dietary guidelines and recommendations and their viability and sustainability	
	Incentives to spend resources to obtain healthy diet	
Climate change, population trend	Women’s economic empowerment (or lack of)	
	Modeling integrated predictions and projections on nutritional outcomes	

FOCUS AREA 2: UNRESOLVED ISSUES OF NUTRITION IN THE LIFECYCLE

DEVELOPMENT OF RESEARCH TOPICS

The Working Group focused on the mother and child, with a linkage to the wider themes of women’s health in general; and with the recommendation that particular attention to double burden contexts.

The work was divided into three interconnected themes and incorporated the results of the open consultations and recent research findings in published literature.

Theme 1: Preconception to Early Childhood (First 1,000 Days and Beyond)

According to the United Nations Children’s Fund (2013) more than 20 million babies, an estimated 15% globally, were born with low birth weight.² These babies are often affected by severe short- and long-term health and developmental consequences. Poor nutritional status and nutrient intake for women before, during, and after pregnancy not only impact a woman’s health status and productivity, but also may have detrimental effects on birth weight, nutritional status, and early childhood development. Despite the critical role of maternal nutrition, few nutritional interventions for mothers have assessed a wide range of outcomes at sufficient scale.

Fetal and early postnatal life is a period of rapid growth and development and especially vulnerable to nutritional perturbations. Theme 1 identified issues in nutrition knowledge during the first 1,000 days from pregnancy through age 2. This period provides a crucial window of opportunity for reducing malnutrition and its adverse effects.

² United Nations Children’s Fund (UNICEF), Improving Child Nutrition: The Achievable Imperative for Global Progress, New York: UNICEF, 2013, www.unicef.org/media/files/nutrition_report_2013.pdf

Theme 2: Moving from Single Nutrients to a Systems Biology Food-based Approach

Traditionally, human nutrition research has largely focused on evaluating one nutrient at a time. Demonstrating the health impact of nutrients, such as Vitamin A, folic acid, iron, and iodine has helped shape nutrition interventions and policy in both developing and developed countries. While understanding the role of these individual nutrients in improving health outcomes is critical, a need also exists to use a more comprehensive approach that examines the effects of whole foods, suites of nutrients, and entire diets to complement the current scientific knowledge on single nutrients or isolated compounds.

Food-based systems biology approaches can be effective tools to address the full spectrum of malnutrition in populations globally. Using an integrated view of food systems and human metabolism will help the understanding of how foods interact with the human biological system. This approach considers entire suites of essential nutrients and other components in food that together have an influence on functional outcomes, including immune function, reproductive health, cognitive development, adult chronic disease, and others.

A food-based approach also can help identify strategies to improve functional outcomes during critical phases of human development; in particular, pregnancy and early childhood. This type of approach can improve the general quality of the diet (e.g., by increasing fruit, vegetable, and animal product intake), while providing additional benefits by reducing consumption of less nutritious carbohydrates and fats, and increasing other micronutrients such as essential fatty acids and phytonutrients. This strategy is consistent with the need to lower the global risk of chronic disease and overweight that is exacerbated by consumption of poor-quality diets.

Theme 3: Malnutrition, Infection, Developmental, and Functional Outcomes and Their Interaction with Nutrition Interventions

Promising interventions have targeted maternal macronutrient and micronutrient intake, but research is needed to better assess long-term impacts on maternal and child health. Trials examining multiple micronutrients have yielded inconclusive results. Some findings indicated that there may be combined effects of food and multiple micronutrient supplementations on growth and development of the offspring. Additionally, information on the optimal timing of food supplementation to malnourished pregnant women and complementary feeding during infancy is lacking.

Frequent illness can impair nutritional status as energy and essential nutrients are diverted away from growth and, conversely, poor nutrition can increase the risk of infection. Infections are common in the first two years of life and an integrated view of human metabolism and diet/food systems is critical to understanding the influence of nutrition on the balance of homeostasis during health and wellness. As research begins to examine the immune response and the intestinal microbiota, the pathways through which an infection may modify the impact of nutrition interventions on child growth remains unclear. Conversely, researchers also have to determine the mechanisms through which improved nutrition could reduce the impact of infection on child growth.

Collectively, a present need is to better understand the impact of infection and sub-clinical conditions on nutrition and child growth/development (including birth outcome), and the interactions between nutrition, infection, and NCDs.

RESEARCH TOPICS RELATED TO THEME 1: IMPROVING OUR UNDERSTANDING OF THE PRECONCEPTION TO EARLY CHILDHOOD PERIOD (FIRST 1,000 DAYS AND BEYOND)

An integrated systems biology approach is used to move towards understanding the influence of nutrition on the physiological balance of homeostasis during pregnancy and the physical growth and cognitive/motor/social-emotional development of the neonate.

Research Topic 1: Role of Nutrition in Developmental Origins of Health and Disease (DOHaD)

- How does nutrition influence the development of metabolic systems (healthy “microbiome,” immunity, etc.)? What are the common metabolic pathways involved in both under- and overnutrition? What are existing experimental models and translational research opportunities for studying the double burden of malnutrition?
- What is the role of nutrition during fetal growth and development, including the role of maternal nutrition and the maternal-fetal interface?
- What are the mechanisms for and potential causes of stunting and malnutrition during early life?
- What are the mechanisms for and potential causes of obesity and malnutrition during early life?
- What are the influences of parental nutritional factors and the long-term effects of multi-generational nutrition/malnutrition?
- What are the dietary requirements to support growth and optimize health during early life and later?

Research Topic 2: Characterizing Normal Growth During Early Life

- What mechanisms are responsible for the normal flux of nutrients in utero between mother and infant? What are some appropriate markers that reflect functional changes consequent to that flux?
- How should adequate state-specific intake regulation for both the mother (during pre-conception, pregnancy, lactation, and post-partum) and the child (in utero, during neonatal life, infancy, and early childhood) be determined?
- How should fetal malnutrition be characterized and assessed?
- Are current state-of-the-art measurements for assessment of “normal” appropriate? This would include revisiting definitions and criteria for measuring and assessing childhood growth (growth standards, definitions for preterm, stunting, catch-up growth, and moderate and severe acute malnutrition [SAM]).



Research Topic 3: Characterizing and Assessing Optimal Growth and Development During Early Life

- How can the contribution of optimal nutrition to growth and cognitive/physical development be separated and measured?
- What is the role of catch-up growth and rapid weight gain? When can they be considered beneficial during early life?
- Do appropriate developmental markers (subjective and functional) exist to assess “normal” child development? More specifically, can enhancement of function be detected within a normal range (subtleties in cognition/behavior beyond gross deficits)?
- How can optimal timing for nutrition interventions be predicted if the how, when, and for how long are unknown? Specific research topics include recommendations for treatment and prevention of SAM during 0-6 months of age.

Research Topic 4: Describing and Understanding Contextual Factors

- What are the risk factors and causes of adverse birth outcomes (preterm birth, low birth weight [LBW], and small for gestational age [SGA]) and how are they related to maternal nutrition, health, and environment?
- What is the relationship between maternal nutrition, maternal mental health, maternal empowerment, and their combined effects on care giving? Related to this, how can maternal “empowerment” be better defined and measured related to maternal and child health, nutrition, and development outcomes?
- Have current nutrition requirements been adapted appropriately for vulnerable populations (e.g., for preterm infants, specific disease states, and orphaned infants/children)? If not, what type of research can provide evidence for development of better recommendations?

RESEARCH TOPICS RELATED TO THEME 2: SYSTEMS BIOLOGY FOOD-BASED APPROACH

Research Topic 5: Creating a Food-based Systems Biology of Nutrition and Human Health in Mother and Child

- Understanding the links between food-based dietary guidelines and effects on metabolic systems and human biology
- Integrating knowledge on molecular mechanisms, human metabolism, nutrition requirements, and behavior to further nutrient-based recommendations and developing food-based dietary guidelines for the entire life course
- Understanding bioavailability of nutrients and micronutrients in whole foods (most importantly: human milk, animal products, and staple foods)

- Research on suites of nutrients, including fatty acids in developing countries, nutrients not typically associated with growth (phosphorus, potassium, magnesium), and some B vitamins (choline)
- Developing food-based interventions to modify diet quality and diversity and address over- and undernutrition

Research Topic 6: Describing and Understanding Contextual Factors

- How to describe and understand biomarkers to reflect exposure, status, and functions of individuals and populations across the lifecycle, and biomarkers for evaluating response to food-based interventions, biofortification, and other dietary interventions
- How to develop the entire food system to meet the health needs of the population, from food production and agriculture, to consumers and issues affecting availability and access of food products, including economics of food choice
- Can food systems realistically support healthy diets for the whole population?
- Developing food-based interventions to modify diet quality and diversity to address over- and undernutrition
- Can food-based approaches improve micronutrient status and do they require complementary interventions to ensure adequate intake?
- How to understand genetic variation among individuals and populations related to nutritional status and nutrient adequacy/deficiency

RESEARCH TOPICS RELATED TO THEME 3: MALNUTRITION, INFECTION, DEVELOPMENTAL, AND FUNCTIONAL OUTCOMES AND THEIR INTERACTION WITH NUTRITION INTERVENTIONS

Research Topic 7: The Relationship between Markers of Malnutrition (e.g., Stunting in Children, Low Height, or BMI in Women) and Functional Outcomes

- Developing an understanding of how nutritional status (over- and undernutrition) is related to response to illness (e.g., microbiome reaction, infection during pregnancy)
- What are the effects of environmental enteropathy and malabsorption on nutritional interventions and development of metabolic systems (immunity, healthy “microbiome,” etc.)?
- Nutrition and pharmacology: How do exposures to toxins in the environment and drugs of abuse interact with compromised nutritional status? Are common metabolic pathways affected in malnutrition for specific toxins (e.g., lead exposure)? What is the impact of scaling up preventive treatments for control of infections in malnourished individuals/populations, or those at risk of becoming malnourished?
- How do undernutrition and infection interact to influence the process of stunting in both mothers and children and what are the molecular mechanisms responsible?

Research Topic 8: Topics in Knowledge Related to Describing and Understanding Contextual Factors

- Definition of what aspects of “context” are most salient to describe and understand relative to health, wellness, and nutrition
- How to develop an understanding of genetic variation among individuals and populations related to nutrition and response to illness (e.g., microbiome reaction/development during infection, infection during pregnancy)

RESEARCH TOPICS RELATED TO THE METHODOLOGICAL COMPLEXITY OF ADDRESSING SYSTEMS-BASED NUTRITION RESEARCH

The benefits of food-based approaches may include nutritional improvement, food security, cost-effectiveness, sustainability, and human productivity. At the same time, nutrition science also is influenced by economic and environmental policies. These approaches pose their own challenges, requiring additional inputs, including nutrition education and behavior change, and strong inter-sectoral linkages with agricultural planning to supply populations with diets to meet desired health goals.

Research Topic 9: Understanding and Driving Basic Science Related to the Systems Biology Approach of Nutrition

- Integrating mechanisms of action studies and biomedical models prior to clinical interventions and preventative treatments (development and emergency settings)
- How to test the effects of combining nutrition with early stimulation (in a broad sense), and determine appropriate indicators/measures of success
- How to determine criteria and types of evidence needed to evaluate and interpret the impact of economic growth (especially for the dual burden of malnutrition and nutrition transition) and other contextual parameters
- How to deal with unexpected heterogeneity in studies involving various population groups

FOCUS AREA 3: DELIVERY OF INTERVENTION AND OPERATIONAL TOPICS

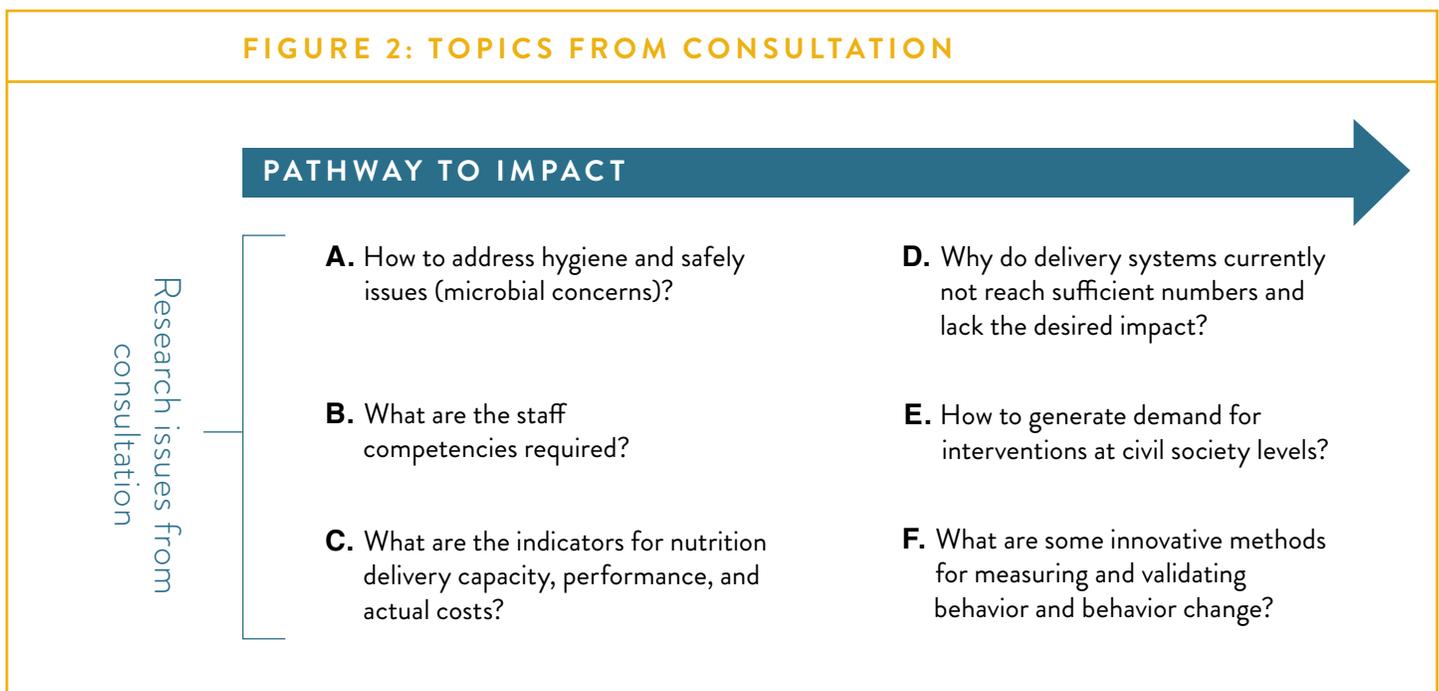
DEVELOPMENT OF RESEARCH TOPICS

Focus Area 3 delves into the issues related to delivery capacity and the delivery obstacles that need to be overcome, in addition to the cost-effectiveness of delivery conduits. These include critical context-specific issues as they relate to decision making and implementation of scaling up nutrition action. The Working Group identified the following initial research topics for consultation.

The Working Group identified the following initial research topics for consultation.

- Research to identify innovative methods for measuring and validating behavior and behavior change
- Research to identify required staff competencies and their impact on program effectiveness and sustainability
- Research on adequate indicators for nutrition delivery capacity, performance, and actual costs
- Research to understand and demand creation for interventions at civil society levels
- Research on implementation and impact pathways to improve agriculture-nutrition programs
- Research on why delivery systems do not reach sufficient numbers and lack the desired impact
- Research on the safe administration of micronutrients
- Research on optimal Infant and Young Child (IYC) feeding delivery systems and processes

Figure 2 describes the pathway to impact for the research issues uncovered from the consultation. Key questions are asked that influence the impact of interventions.





RESEARCH TOPICS

The Working Group recognized the area of delivery sciences as too nascent to concentrate only on a set of specific questions. Instead, a unifying approach to delivery science in nutrition around a better understanding of inputs, processes, and outcomes is required.

Research Topic 1: Knowledge Related to Inputs of Nutrition Intervention

- What are the best suited intervention designs and implementation plans, and adequate content and intensity of training and staff competencies?
- What are the commodities required and how to organize procurement and production?
- What are the strategies for demand creation?

Research Topic 2: Managing the Upstream, Midstream, and Downstream Processes

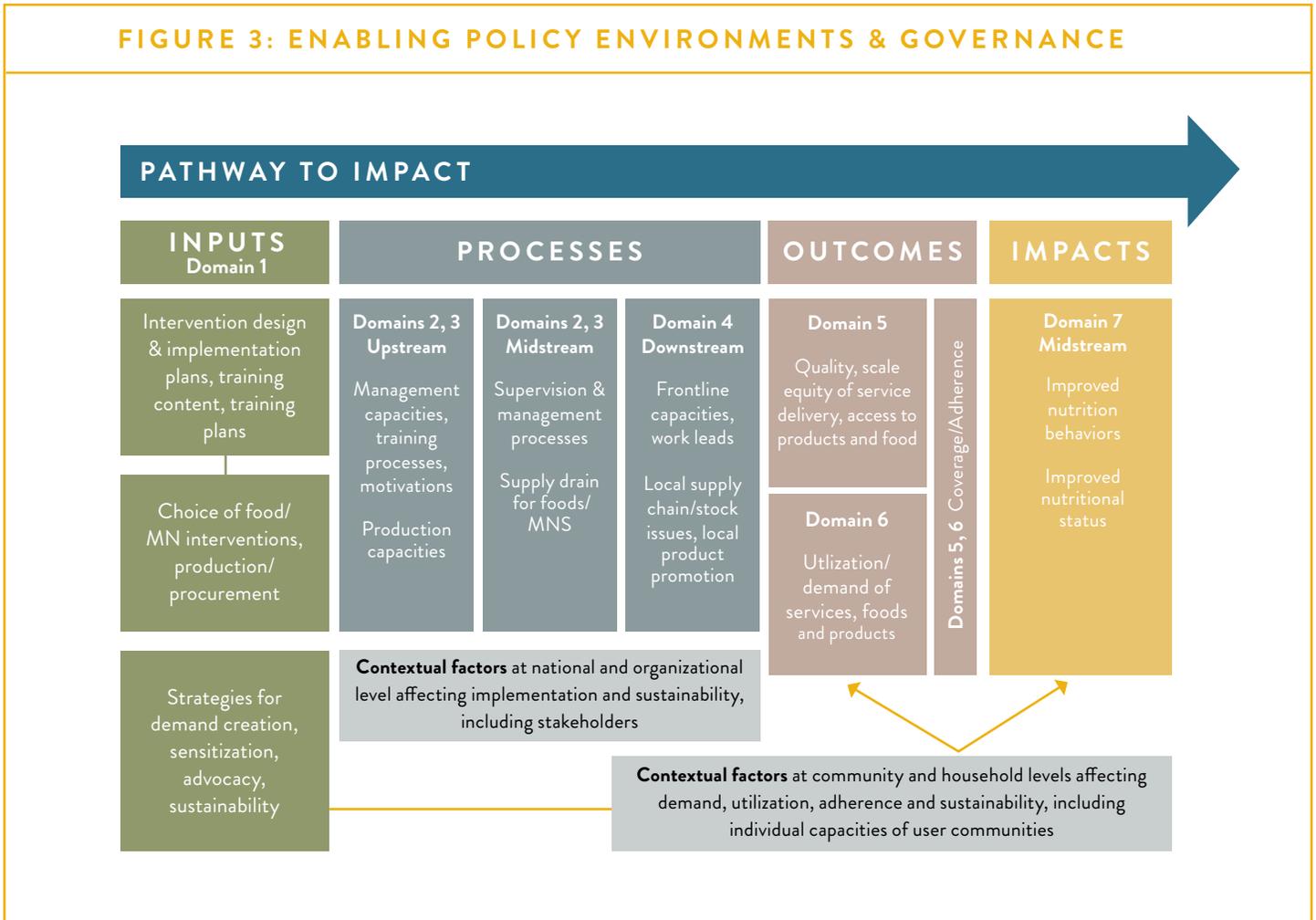
- How to evaluate and support management and production capacities and what level of training is required?

Research Topic 3: Outcomes in Terms of Service and Product Delivery and Utilization

- How are these aspects measured and compared to the expected outcomes of the intervention, integrating equity, coverage, and quality dimensions?

Figure 3 depicts the pathways to impact in policy and governance. The figure defines the inputs, processes, outcomes, and potential impacts.

FIGURE 3: ENABLING POLICY ENVIRONMENTS & GOVERNANCE



CONCLUSION: ACTIVATING A GLOBAL RESEARCH AGENDA FOR NUTRITION SCIENCE

These research gaps are intended to support and guide the research community and stakeholders in the field of nutrition towards focusing on pressing research needs.

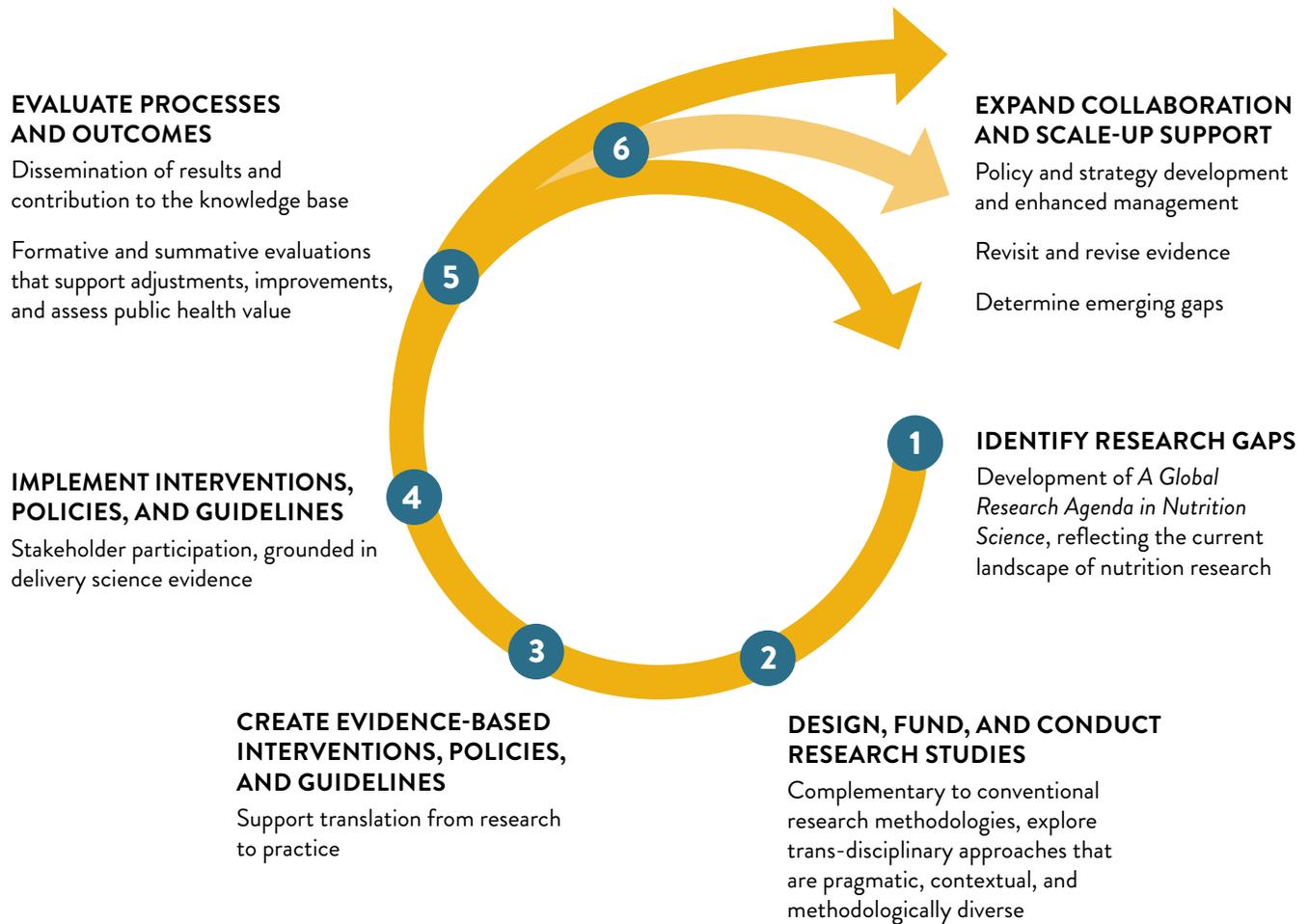
The publication of Focus Area-specific journal articles, in *Annals of the New York Academy of Sciences* will provide a more in-depth analysis of these research needs. This publication will include: an overview of current evidence; illustrations of the research gaps; and, guidance for new research endeavors in the nutrition field.

These articles will contribute to the ongoing efforts to enable a cohesive, transdisciplinary approach of nutrition research.

Then, specific research proposals focusing on the gaps identified in this *Agenda* will be developed. The Sackler Institute will hold working sessions and symposiums that will bring together key stakeholders to support these projects in nutritional, agricultural, and environmental sciences; public health; and policy.

Throughout these Focus Areas, the necessity to understand interactions and interconnections between multitudes of parameters has emerged as a critical challenge to researchers across disciplines. This *Agenda* brings attention to the importance of concerted efforts to analyze and incorporate the constantly growing body of evidence in such diverse fields as agriculture, the environment, social and behavioral science, and economics, which all affect nutrition science. Such transdisciplinary efforts are not limited to study designs³ – they must expand to the entire research-to-policy cycle that includes the design, implementation and evaluation of interventions and policies, as depicted in Figure 4.

FIGURE 4: THE ONGOING RESEARCH CYCLE OF NUTRITION SCIENCE



Now is a pivotal time for nutrition research and interventions. In 2013, during the pre-G8 “Nutrition for Growth” event, as much as \$4.15 billion USD in new funding was pledged directly in support of nutrition initiatives, through 2020. Additionally, the 2013 *Lancet Series on Maternal and Child Nutrition* estimated a cost of \$9.6 billion USD a year to implement 10 essential nutrition-specific interventions.⁴ The commitment of funding sources, in light of significant nutrition-related cost estimates, demonstrate a recognized need to support high-level, coordinated, and collaborative research and program implementation, in order to increase optimal nutrition globally.

⁴ Bhutta, Z.A., et al., *Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost?* The Lancet, 2013. 382(9890): p. 452-477.

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