

# REPORT 2023

Nestlé Foundation

for the study of problems of nutrition in the world





"Live as if you were to die tomorrow. Learn as if you were to live forever."

Mahatma Gandhi

**FOCUSED AND GLOBAL** – THE FOUNDATION FOR THE STUDY  
OF THE PROBLEMS OF NUTRITION IN THE WORLD

**HUMAN RIGHTS** – BASED FOCUS AND PRACTICE

**RESEARCH** – HIGH-IMPACT RESEARCH FOR DEVELOPMENT

**INNOVATION** – FOR SUCCESS

**LOCAL CAPACITY BUILDING** – AS A BASIS FOR IMPROVEMENT

**SUSTAINABILITY** – A KEY MISSION

**ENDURABLE NUTRITION** – THE PRESCRIPTION FOR SUCCESS

**PUBLIC HEALTH** – ORIENTED

# THE FOUNDATION AT A GLANCE

**EVIDENCE-BASED** – PROACTIVITY

**PARTNERSHIP** – FOR LONG-TERM SUCCESS

**SOLUTION** – ORIENTED ACTION RESEARCH

**enLINK - ing** FOR A BETTER WORLD



CAPACITY BUILDING



*enLINK-ing* FOR A BETTER WORLD



PUBLIC HEALTH ORIENTED

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# PRESIDENT'S MESSAGE

Low and middle-income countries (LMICs) have been increasingly faced with the challenge of the double burden malnutrition (DBM). The World Health Organization (WHO) defines DBM as the simultaneous presence of undernutrition and overnutrition (such as overweight, obesity, or diet related non-communicable diseases), a reality now seen in at least one out of every three LMICs. Urgent transformative action based on evidenced based research are necessary to steer the world towards a sustainable and resilient trajectory. In 2023, WHO declared that the 2030 agenda for sustainable development aimed at transforming our world, highlighting the need to address the issue of DBM globally. In addition to addressing caloric intake, it is crucial to consider other aspects of proper nutrition, including the availability of micronutrients and the promotion of healthy diets. Studies indicate that the increasing consumption of ultra-processed foods and sugar on a global scale significantly contributes to the obesity crisis worldwide, including LMICs.

A particular emphasis should be placed on ensuring optimal nutrition during the critical first 1000 days, from the start of pregnancy to the child's second birthday and the importance of breastfeeding.

Strengthening local food systems will be vital in preventing future widespread shortages and in guaranteeing food security and optimal nutrition for all. The Nestlé's Foundation report addresses these challenges and underscores its ongoing role in supporting research initiated by investigators from LMICs to combat the double burden of malnutrition.



Petra S. Hüppi  
President





# PROJECTS INITIATED BY THE FOUNDATION

One of the Foundation's main aims is to foster scientific and technological knowledge related to nutrition in low/middle-income countries. The Foundation advances nutritional science by supporting investigator initiated nutrition research projects in established institutes and universities and by giving focused support to existing nutrition schools and educational programs. The Foundation does not support industry sponsored research. Sponsorship bias such as in research funded by industries or other commercial enterprises is more likely than publicly funded research to produce results in line with the funder's commercial interests. This research therefore might not lead to an equitable improvement of local conditions.

The promotion of local capacity for independent, implementable research is a central aspect of the Foundations activities. Research ideas or concepts are typically owned by the local researchers and their institutions. The Foundations grant review process can be viewed as an educational opportunity for applicants to receive feedback and insights on their proposals, aiding in their professional development and enhancing their grant-writing skills. To further fulfil the role of the Foundation and also encourage sustainable improvement in nutrition in low-/middle income countries, the enLINK Initiative for positive change was introduced in 2004. This encompasses a strict adherence to a set of interrelated principles presented thereafter.



# THE enLINK INITIATIVE

- **Promoting local capacity for independent nutrition research**

- Anchoring of research capacity and innovation locally
- Promoting local generation of research ideas
- Promoting local ownership and empowerment
- Promoting critical-evidence-based thinking and research
- From idea to implementation: Assistance from the germ of a research idea and project through its sustainable implementation
- Openness towards specific, local research ideas
- Conflict-of-interest-free and bias-free research support
- Culturally sensitive research and solutions
- Ecosystem-compatible research
- Food justice and the right to food-based research

- **Strengthening local expertise, know-how, and skills**

- Promoting access to information
- The enLINK digital library
- Promoting local knowledge exchange and generation
- Needs-based, targeted assistance
- Network-system capacity building
- Conflict-of-interest free capacity building
- Enhancing stamina

- **Nestlé Foundation Research for Development (NFR4D) program**

Sustainability and public-health relevance have been and will remain key aspects for all activities of the Foundation. Research projects need to result in short- and long-term public-health implementation. Knowledge and know-how have to be sustainable at all levels of the population, meaning that the knowledge has to be implemented and become part of daily life. Knowledge has to trickle down to the population.

The vast experience of the Foundation's Council members as well as the Foundation's past activities led to the creation of the enLINK Initiative in 2004, an initiative which illustrates the proactivity of the Foundation regarding its core issues.

This initiative focuses on information transfer in the area of nutrition and malnutrition as well as on the resolution of specific research questions and their implementation at the public-health level. The core competence and activity of the Foundation is the support of nutrition research in low-income countries. The enLINK initiative is an add-on to our key activities to improve the research capacity.

The name enLINK comes from the old English verb "to enlink", meaning "to chain together" or "to connect, as by links". The analysis of the semantic relations of "enlink" reveals related words which illustrate our central concepts and aims: to connect, to join, to associate, to unite, to tie, to conjoin.

Our mission is to link and join cultures; to associate and conjoin institutions and people locally to study and diminish the problems of malnutrition globally.

Malnutrition can only be solved by "enlinking" –connecting–different strategies and approaches. Malnutrition has to be addressed universally by joint strategies which address many levels, looking at the level of medical issues (such as infection) and hygiene



“Food systems are defined by political decisions and the differential power of actors to influence those decisions.”

Olivier de Schutter

(such as water quality), proposing changes at the level of agriculture as well as in the society at large, and, last but not least, working to improve the level of education and information.

The **enLINK** Initiative has five main levels:

1. **exploration in nutrition** – building practical research capacity: This is the main purpose and aim of the Foundation.
2. **education in nutrition**: This level of the **enLINK** initiative also implies the creation of research-based evidence and subsequent transfer of the knowledge to the population.
3. the **enLINK** library: At present, after having shipped 217 library trunks to 34 countries, only digital content is provided (free of charge) in the **enLINK** digital library ([www.enlink.org](http://www.enlink.org)).
4. **endurable nutrition**: All activities should be implemented and sustainable.
5. **Nestlé Foundation R4D initiative** – research for development (**NF-R4D**): Sustainable, targeted, concerted support of young researchers and their institutions.

The digital enLINK library is currently offering free full-text access to a few nutrition journals and more than 30 e-books—many of them indispensable classic textbooks—in the newest editions available. This digital library is accessible free of charge to registered users who all receive a personal password; registration is also free as long as the applicant comes from a low-



income country. The library is continuously updated and adapted to specific needs and in response to user feedback. Evidence and content which end up in textbooks are usually more practice-related than the research knowledge from latest findings, which is published in research journals. Therefore the weight of the library lies more in the e-textbook section to assure a good basic knowledge transfer as well as knowledge accessibility. A solid knowledge of the physiology and pathophysiology of nutritional sciences is the cornerstone for the development of nutrition research focused on basic needs and designed to drive concrete improvements.

The approach of the Foundation in the enLINK initiative reflects the need for multidimensionality to solve the problems of under- and malnutrition. Knowledge and know-how are the basis and beginning of every and any improvement.







# THE enLINK CIRCLE

## “I HAVE A DREAM”

“I have a dream”—the famous statement by Martin Luther King, Jr. The I Have a Dream speech was given three years before the Nestlé Foundation was created. Knowing the mindset of the creators of the Foundation, they most likely had a similar dream: a dream to make the world not only better but also more equitable, and to solve the problems of nutrition, as reflected in the name of the Foundation, The Nestlé Foundation for the Study of Problems of Nutrition in the World. At that time an indeed promising name, reflecting the spirit of the period as well the genuine and honest aim of the Founders not only to study the problems of nutrition, but also to solve the problems of nutrition with the help of the results of studies and activities by the newly created research foundation. As we all know, this aim has not been achieved—neither by the Foundation nor by the innumerable players in this field<sup>1,2</sup>. In today’s world more than 800 million individuals are still food insecure—a number in uptrend; food sovereignty (Table 1) and overall livelihood sovereignty are—sometimes even on purpose—subject to a worrying downtrend all over the world. Even in the US, a country which does not recognize the “right to food”, in 2022 7.7% of the households had a low food security and 5.1% very low food security<sup>3</sup>. Paradoxically, obesity rates are increasing globally<sup>4</sup>, especially also in the global South, pointing to the direct causality of the modern food system: how food is produced and eaten<sup>5,6</sup> is leading, along with other issues, to declining food sovereignty<sup>7</sup>.

### Food: A Common Good

It is worthwhile to recall that the Founders of the Foundation were, in their early years, still aware that

food has to be grown locally; accordingly, one of the first research projects of the Foundation was around the winged bean (*Psophocarpus tetragonolobus*). The Foundation initiated a *Psophocarpus* project with the aim to introduce the winged bean as a protein-rich legume into family gardens and agricultural practices in the Ivory Coast<sup>8</sup> (see also the 2015 Report, page 29), thus focusing on a key pillar for food sovereignty. These studies reflected the wisdom and dream of the Founders to give normal food a chance to reduce malnutrition and assure food sovereignty and food security. Retrospectively a more than honorable thought. In view of the aforementioned epidemiological data on malnutrition and obesity rates, a closer look at a few selected aspects of food along the pathway from field to fork is warranted. Due to space limitations only a few aspects can be discussed, as a kind of appetizing “food for thought” inspiring readers to become critical global citizens promoting an equitable, just, and environmentally sustainable food system, one in which food regains the status of a unique human good. These are key criteria which the Foundation respected until this year.

In many cultures food was appreciated as a gift of God<sup>9,10</sup>. The huge respect toward daily food was reflected in daily life including the culture of production, food handling and culture of eating. Harvest and crop-related ceremonies were important calendar marks during the year since everybody knew the crucial importance of this common (public) good<sup>11</sup> for assuring health, survival and also a peaceful life. Wikipedia defines common goods (economics) as “common-pool resources”, which “are defined in economics as goods that are rivalrous and non-excludable (...) [A]s common

"If they can get you asking the  
wrong questions, they don't  
have to worry about answers."

Thomas Pynchon



goods are accessible by everybody, they are at risk of being subject to overexploitation which leads to diminished availability if people act to serve their own self-interests<sup>12</sup>. Everybody was aware that food has to be grown locally, assuring short-term as well as long-term availability (e.g. by land and seed sovereignty), thus giving food the status of a unique human good<sup>11,13</sup> for each individual but also for society as a whole. Today food has been reduced to a simple commodity, a tradable good, a key item for financial speculation and profit generation<sup>14</sup> in complete dissociation with the initial characteristic as a human good and a human right. In the modern food system this gift of God as a key requirement for feeding people is ignored<sup>15</sup>. This commodification is a key driver for food insecurity and hunger<sup>16-18</sup>, increasing chronic diseases<sup>19-21</sup> and even contributing to local riots and armed conflicts, both well-known promoters of food insecurity<sup>22</sup>.

### Smallholder Farming and Food Security

Since the early days of agriculture, the key role of smallholder farms to assure food and nutrition<sup>23</sup> was an established fact and an absolute necessity: globally more than 80% of the farms are smallholder farms and they produce around 80% of the food in Asia and in sub-Saharan Africa<sup>23-26</sup>, thus assuring local food security and especially food sovereignty<sup>27</sup>. Despite their importance many smallholder farmers live in poverty, as do many non-farming people, and they cannot get out of the poverty trap due to the dominating systemic forces focusing on unaffordable solutions and financial and commercial concepts minimizing farmers' benefit while maximizing farmers' costs<sup>28,29</sup>. The aforementioned commodification of food is a key driver for the disruption of many functional local agricultural systems and crucial social relationships<sup>30</sup>. Any solution to feeding the world needs to be inclusive, equitable, and focused on all major components of multidimensional poverty (e.g. including education), keeping the focus on food security and especially food sovereignty.

Smallholder farmers produce mainly crops for local consumption. Due to their mixed cultures a higher biomass and crop output is generated than by monocultures<sup>26,31</sup>. The higher crop diversity leads not only to a larger output, but is also associated with an increased temporal stability of the harvest<sup>32,33</sup> and thus contributes to food security over long(er) periods. Smallholder farmers are inherently linked to food security and sovereignty, health and well-being, biodiversity and dietary variety, nature conservation, seed preservation, and ecosystem services, to mention just a few benefits.

Smallholder farmers assure crop diversity<sup>34</sup> and thus diet variety. Not surprisingly, the modern food

system also propagates dietary variety (most likely referring to the nearly 20,000 new processed foods introduced to the market each year). Despite the fact that 90% of the world's calories come from only twenty plant crops<sup>34</sup>, an even more worrying number is that 60% of the calories come from only four crops (wheat, rice, maize and soy)<sup>35</sup>. How can one assure nutrient adequacy and diet diversity with only four crops? The inverse relationship between crop and/or diet diversity and the reduction of micronutrient malnutrition is well known<sup>36</sup>, as is the positive relationship between the modern Western diet and metabolic diseases<sup>37</sup>. The latter is reflected in the disproportionately high rates of burden of premature CVD mortality and the more than five million premature cardiovascular deaths in low- and middle-income countries<sup>38,39</sup>.

Similarly, hidden hunger can be controlled by crop diversity<sup>36,40</sup> especially when addressing concomitant factors such as infection control, WASH, education, access to basic health care, etc. Nevertheless, supplementation and fortification approaches remain the usual strategy—an easier and more profitable approach, but not causal nor sustainable and not without risk<sup>41-43</sup>.

In the 2020 Annual Report we already addressed the future risk of not having enough farmers. In many countries farmers are an "endangered" or even "dying" species: they are displaced by a few powerful players in the modern food system. The globally desperate situation of smallholder farmers is also reflected in the tragic rise of suicide rates of farmers<sup>44,45</sup>, which is seen also in Europe (for example, in France farmer excess in mortality due to suicide was reported to be nearly 30% as compared to the population average<sup>46</sup>; it is also an issue in Switzerland<sup>47</sup>). There are many causes for the latter trends, including climate change and poverty, but a key factor is the loss of food sovereignty and the commodity status of food<sup>48</sup>. Not surprisingly there is an inverse correlation between farm size and farmer suicide rates<sup>49</sup>. Knowing the drivers allows for solutions: for instance, studies from India showed that education and reestablishing the key pillars of food sovereignty contributed to a trend reversal<sup>50</sup>. Along this line, in the last decades education free of conflicts of interest and biases was a key approach promoted by the Foundation. A recent example is a Foundation-supported project in Mozambique assessing the effect of a change from a predominantly conventional agricultural system to an agro-biodiversity-based approach on food security and crop output.

The many paradoxes are further reflected in the fact that indigenous crops, most being not only highly nutritious but also drought resistant (even more than modern crops)<sup>51</sup>, are nearly extinguished<sup>52,53</sup>



due to purposeful displacement by modern crops and loss of seed sovereignty<sup>54</sup>. Nevertheless, the promoters of the “bitter harvests”<sup>55</sup> continue to stress the importance of “indigenous crops” for food security. Recognizing the key role of these local crops, the Foundation is supporting a project evaluating the genetic diversity of cocoyam grown in Benin; in addition the researchers will collect data on the traditional ways to cook and eat cocoyams. Conserving indigenous knowledge is the basis for tomorrow’s use of indigenous and traditional crops<sup>56</sup>. The Foundation has encouraged many colleagues to create a registry of traditional food and cooking techniques on the African continent to preserve African food culture and population health.

### Do Not Forget Human Rights

A recent article was titled “Let Them Eat Rights”<sup>57</sup>; in other words, respecting and assuring human rights is a crucial requirement for food security and food sovereignty<sup>58,59</sup>. Similarly, a human-rights-based solution would not accept that more than 35% of calories grown are used for animal feed and nearly 5% for biofuel production<sup>60</sup>, while at the same time over 800 million people go hungry. According to a recent report based on 2018/2019 data, even in Europe up to 60% of cereal crops grown are used as animal feed and slightly more than 20% for human consumption<sup>61</sup>. No wonder there is not enough food to feed all the humans on our planet. Further, in the present context it has to be remembered that farm size correlates with animal feed production: the larger the farm, the larger the fraction which is grown for animal feed, the smaller the crop diversity, and the larger the food losses<sup>26,35</sup>—all key arguments for the right to life of small-scale farmers.

The megafarms producing mainly flex crops are self-explanatory proxy markers for the overall concentration and commodification in the food system. It has to be remembered that any concentration<sup>62,63</sup>, including the focus on a few crops, large-scale farming, agrochemicals and fertilizers, or seed monopolism<sup>54</sup>, not to mention land grabbing, are major drivers for inequality, food insecurity, poverty and finally global chronic disease risk.

### The Usual Episteme

The common epistemic narrative around hunger and food (in)security says that only modern agriculture and high-input industrial agricultural systems can assure food safety. These latter mantra-like statements cannot deny the unequivocal evidence that smallholder farmers are the guardians of food security (see above)<sup>23,26,51</sup>. The Swiss President of the 65th UN General Assembly, Altbundesrat Joseph

Deiss, mentioned already in the 2011 Report of the Foundation that there is enough food available to nourish the whole world, but we have to address a straightforward, simple key question: “La question en soi est simple : l’humanité sera-t-elle capable, à tous les niveaux, d’adopter des comportements qui l’écartent de l’autodestruction et la maintiennent sur le chemin de l’harmonie, du bien-être et de la pérennité ?” (In itself, the question is a simple one: will humanity be capable, on all levels, of adopting behaviors that move us away from self-destruction and keep us on the path of harmony, well-being and sustainability?) Maybe some readers can explain why the global players avoid the implementation of the aforementioned simple and efficient humanity-based approaches recommended by Mr. Deiss. Most of us are well aware that it would be easy to feed everyone if we adopted the latter concepts as well as basic ethical and human-rights-based rules, pursued a decommodification of the food system, and reallocated a small fraction of today’s detrimental investments from, for instance, food waste, tobacco, alcohol or weapons<sup>64</sup>.

### Today Determines Tomorrow

Most of us know the saying “Those who control food, control your life”. The building block for health, well-being, a peaceful livelihood, happiness or almost anything you name is the adequate availability of nutritious food. It might be high time to follow the recommendation from Mahatma Gandhi that “the future depends on what you do today”. Looking at the over 600 research publications resulting from grants of the Foundation during the last 58 years one can easily recognize that only a small fraction of the results have been implemented. This constellation is in agreement with the well-known policy-implementation gap, which is due to many individual and systemic barriers<sup>65</sup>. Further, the compilation of publications (available on the Foundation website) shows that up to now the Foundation was able to adhere to most of the pillars of food sovereignty as guidance for the supported research activities (see Table 1). To assure food sovereignty, food justice and food security—as the creators of the Foundation intended—we must urgently move from dreaming to action.

**Table 1**

The Pillars of Food Sovereignty (adapted according to 66)

<b>1. Focus on food for people</b>	<ul style="list-style-type: none"> <li>• Right to sufficient, healthy and culturally appropriate food</li> <li>• Food is not a “commodity”</li> </ul>
<b>2. Values food providers</b>	<ul style="list-style-type: none"> <li>• Supports sustainable livelihoods</li> <li>• Respects the work of all food providers</li> </ul>
<b>3. Localizes food systems</b>	<ul style="list-style-type: none"> <li>• Reduces distance between food providers and providers and consumers</li> <li>• Puts providers and consumers at the center of decision-making in food issues</li> </ul>
<b>4. Puts control locally</b>	<ul style="list-style-type: none"> <li>• Ensures the rights of local communities to inhabit and use their territories</li> <li>• Rejects land grabbing and the privatization of natural resources</li> </ul>
<b>5. Builds knowledge and skills</b>	<ul style="list-style-type: none"> <li>• Respects traditional and indigenous knowledge</li> <li>• Participatory and decolonial research methods</li> <li>• Appropriate technology and data sovereignty</li> </ul>
<b>6. Works with nature</b>	<ul style="list-style-type: none"> <li>• Diverse low-external input agroecological systems provide important ecosystem functions, and support resilience and adaptation in the face of climate change</li> </ul>

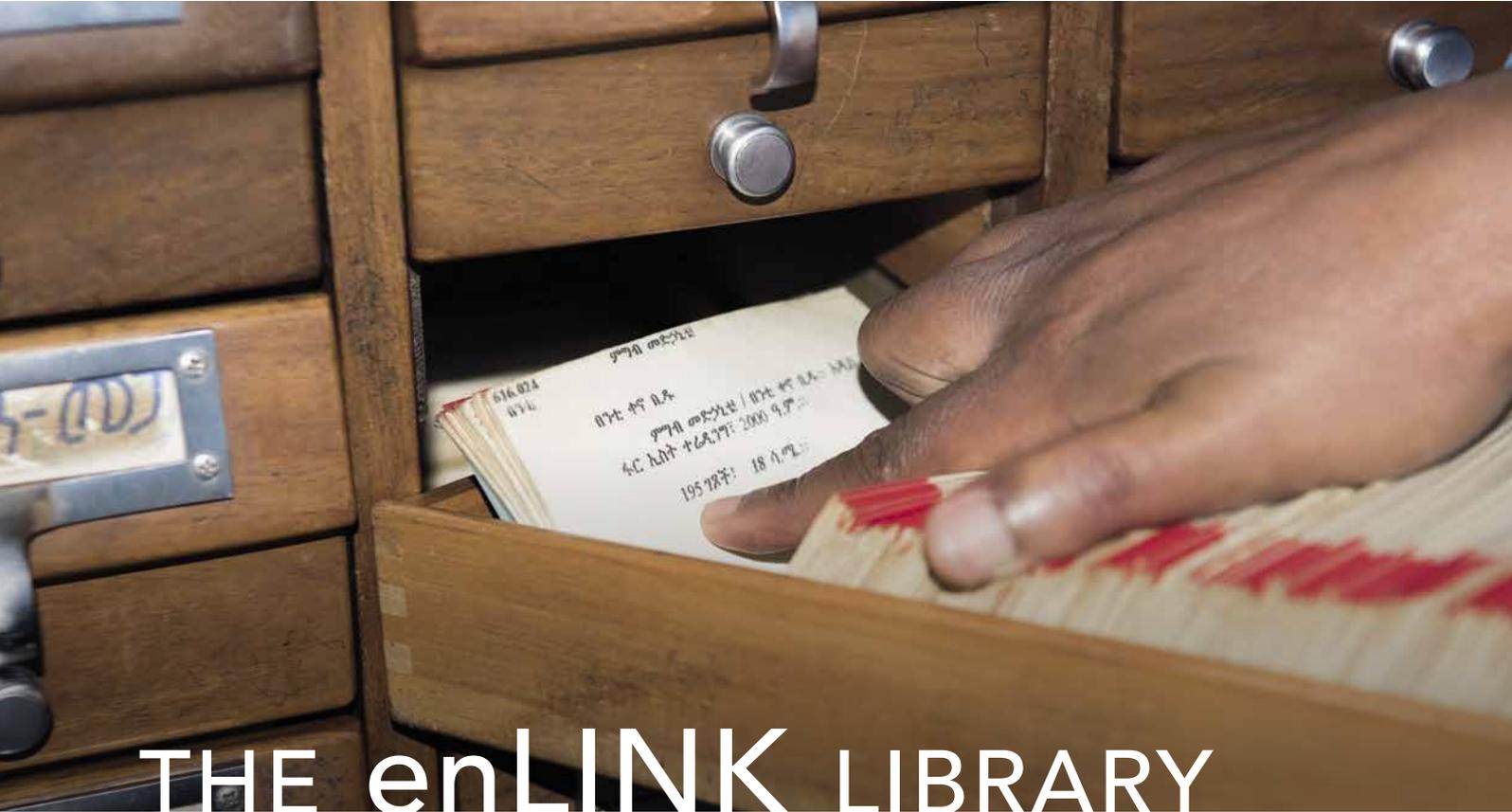
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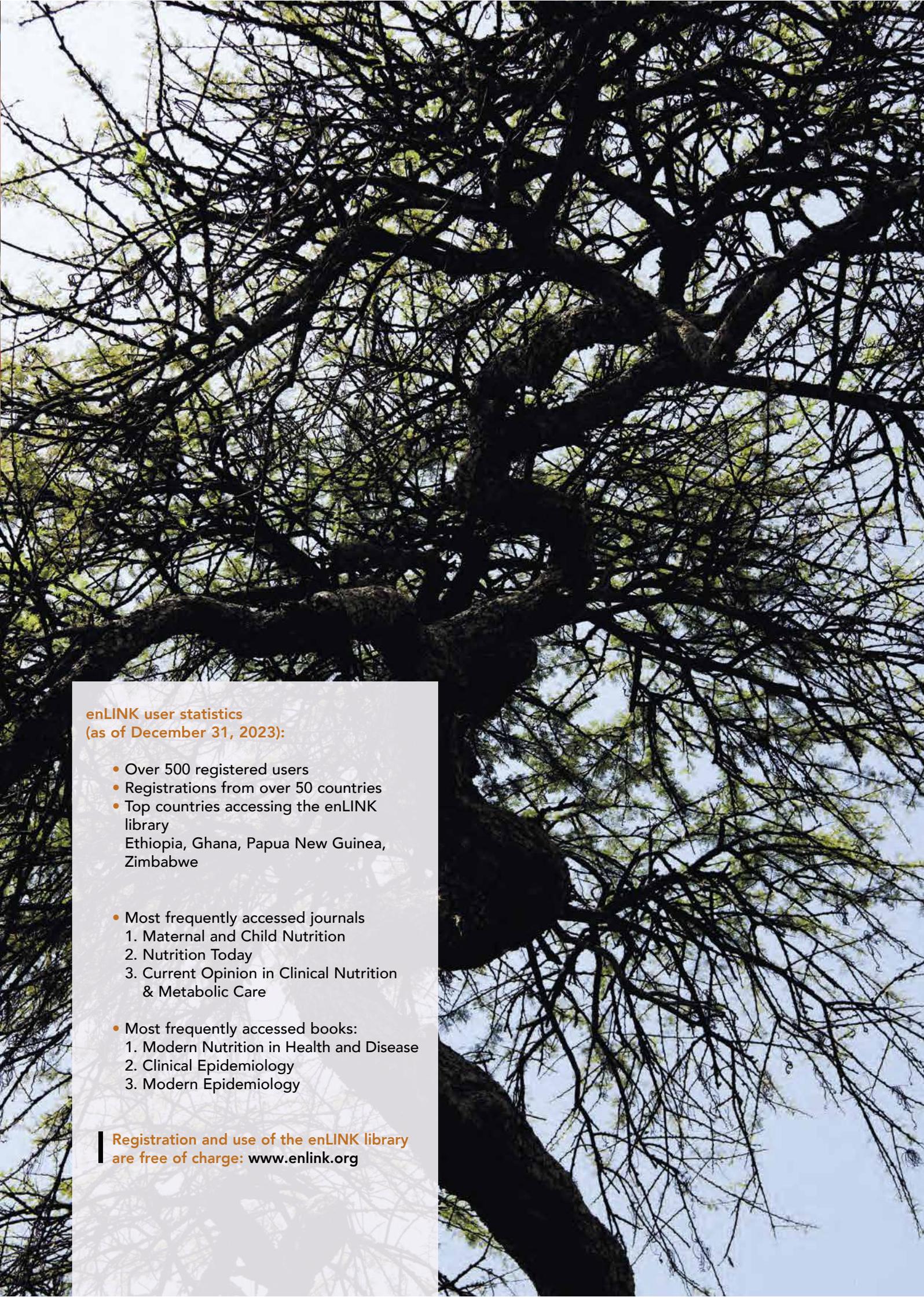
# THE enLINK LIBRARY

During 2023 the digital enLINK library continued to be appreciated as an information source for researchers and students in low-income countries. As in the past, the enLINK library was promoted within the Foundation's network and the statistical data support the key role of mentors in encouraging users (mostly students) to access the library. Young students need to be motivated to "go to the library". In view of the universal access to information on mobile devices, knowledge acquisition often becomes of secondary importance, since everything can be found within a millisecond in the internet<sup>1,2</sup>. The latter constellation underlines the key role of the mentor to motivate the student and create self-driven curiosity for professional advancement. Further, the key role of professional librarians and library services to provide guidance and also motivation in the increasingly digitalized world cannot be stressed enough<sup>3</sup>.

To our surprise, in recent years we have regularly been told that any form of a library—including the enLINK library—is an outdated concept in today's modern world, one that does not contribute to development or advancement in nutrition research. Several scholars even mentioned that they stopped accessing the enLINK library, since the content is not updated on a regular, i.e. weekly or at least monthly basis, and that textbooks are too "static" (whatever that means) for any advancement. Further, it was said that neither academic nor public libraries contribute to development in low-income-countries. For most of us, these are indeed quite worrying statements.

These views deserve a closer examination in the context of development and capacity building (one of the main aims of the Foundation for nearly 60 years). The basis of any advancement is knowledge in agreement with the old saying "knowledge is power". For most readers the prominent role of the Library of Alexandria in Egypt (founded by the Ptolemaic Dynasty, 330-283 BBC), the "House of Wisdom" (the Grand Library of Bagdad founded in the eighth century) or the British Library (founded in 1753)—to mention just a few classical libraries—are well known as centres of science and education fostering progress and advancement. The success of these libraries was not only based on their stored knowledge; these libraries were also places of social and scientific discussion, disputes and critical constructive exchange, places of intellectual and academic freedom, and last but not least places promoting the freedom of speech, to mention just a few of the key characteristics of the classical libraries<sup>4,5</sup>. Despite the ongoing digital transformation, the aforementioned library culture could in an ideal setting be maintained and even further promoted.

In the increasingly data- and information-technology-driven world it is not surprising that the number of libraries is declining<sup>6</sup>. This is disheartening since a recent study about the role of public libraries in Africa underlined their crucial role in community development in areas such as health, employment or agriculture<sup>7</sup>. Another important aspect is mentioned on the website of the African Library & Information Associations & Institutions<sup>8</sup>: "The Civil



**enLINK user statistics**  
(as of December 31, 2023):

- Over 500 registered users
- Registrations from over 50 countries
- Top countries accessing the enLINK library  
Ethiopia, Ghana, Papua New Guinea, Zimbabwe
  
- Most frequently accessed journals
  1. Maternal and Child Nutrition
  2. Nutrition Today
  3. Current Opinion in Clinical Nutrition & Metabolic Care
  
- Most frequently accessed books:
  1. Modern Nutrition in Health and Disease
  2. Clinical Epidemiology
  3. Modern Epidemiology

**Registration and use of the enLINK library are free of charge: [www.enlink.org](http://www.enlink.org)**

Rights Room in the Nashville Public Library asks a poignant question—'If not us, then who? If not now, then when?' This can only be answered when we understand who we are & what brought us to our present state of being. That is one of the reasons why Libraries need to be in every African community as they represent voices long dead but still speak. They tell us who we are. If we forget where we came from, how can we know where we are going?"

The enLINK library can be viewed from the same perspective—the enLINK library is not only a source of established knowledge for research and education but also enables the user to evaluate, for instance, on-going trends in nutrition and food science, which are nowadays only rarely related to better health and well-being<sup>9,10</sup>. Information-technology- and data-driven approaches are all too often founded in epistemologies of the creators or promoting organization<sup>11</sup>, not paying much attention to the principles of earlier library culture nor to the principles of digital humanism<sup>12</sup> or local culture, thus likely to hamper a sustainable equitable development.

It cannot be stressed enough that libraries have contributed hugely to development and play a crucial role in attaining the Sustainable Development Goals (SDG)<sup>13</sup>. Despite the established importance of libraries they are hardly perceived by the global development players and are not regarded as "agents for development and innovation"<sup>13</sup>. The insufficient or even lacking perception is in part rooted in the development agenda, which is largely driven by the interest of the donors in the Global North<sup>13</sup>, and the increasingly purely data-driven decision-making process which does not pay attention to the accuracy of the data<sup>14-16</sup> nor to the local social-human dimensions<sup>17</sup>.

Everybody—even the well-known global data "hunters and gatherers"—know best that the most important things cannot be measured. The data-driven society all too often does not pay enough attention to what really counts at the end of the day: health and well-being, human relationships, mutual respect, human rights or the right to food, to mention just a few. In the context of a library, data about the usage of a library—e.g. by "clicks or hits" for a specific digital resource or the number of times a book has been borrowed—does not reflect the true human and societal value behind the access to a specific information source. Nevertheless, these statistical data are crucial for "library business", but not for the "business" of capacity building, since even a single unique usage can lead to a solution of a highly relevant problem e.g. in health, nutrition research or agricultural practice, or assist an individual in his or her further career—a scenario which many enLINK users reported.

Access to the enLINK library in 2023 was similar to earlier years. Once again, the classic textbook *Modern Nutrition in Health and Disease* had the most hits, reflecting once more the importance of this "bible-like" basic nutrition knowledge source, followed by the book *Clinical Epidemiology*. Of the few scientific journals offered, access was highest for review-type journals and articles—reflecting reader preferences but also the need to get complete, holistic information about a specific topic, as available in the more than thirty textbooks on the enLINK site.

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“Education is a human right with immense power to transform. On its foundation rest the cornerstones of freedom, democracy and sustainable human development.”

Kofi Annan







# NEW RESEARCH PROJECTS

In 2023 the Council decided to fund  
10 research projects:

COMPLEMENTARY FEEDING

NUTRITION EDUCATION FOR HEALTH PROFESSIONALS

ZINC BIOFORTIFICATION

DECISION-MAKING AND CHILD NUTRITION

NUTRITION EDUCATION IN SCHOOLS

NCD RISK FACTORS IN CHILDREN

# NEW RESEARCH PROJECTS

FORGOTTEN CROPS

AGROBIODIVERSITY

BREASTFEEDING

# COMPLEMENTARY FEEDING

## Efficacy of Developed Pigeon-pea-based Porridge on the Nutritional Status of Children Aged 12-24 Months in Rural Areas of Tanzania

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Children in Tanzania are often poorly fed, mainly with cereal-based porridge made from either maize or finger millet or a blend of these cereals, characterized by a comparatively low nutrient content. Pigeon peas (PPs) are rich in protein, minerals, and vitamins. Despite the favorable nutrient pattern little has been done on the use of PPs on enriching children's complementary food in Tanzania. The proposed cluster randomized controlled trial aims to test the efficacy of a developed pigeon-pea-based porridge (PIPP) on improving child's macro- and micronutrient status (focusing on physical growth and vitamin A and iron status). The main intervention will be feeding children with porridge composed of different ingredients: two villages will receive the developed PIPP and maize porridge. To reduce spillover effects the porridge flour will be prepared and packed at Sokoine University of Agriculture and transported to the study site for the intervention. Mothers will be trained to prepare the porridge flour at the end of the intervention and the approach will be promoted.

# NUTRITION EDUCATION FOR HEALTH PROFESSIONALS

## Effectiveness of Culturally Customized Maternal Nutrition Education for Health Professionals in Improving Birth Outcomes in Ethiopia: Parallel Cluster Randomized Controlled Trial

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Sub-optimal dietary intake is one of the main causes of undernutrition during pregnancy and of adverse birth outcomes in Ethiopia. Maternal nutrition education on healthy diet during pregnancy is a cost-effective intervention to improve maternal and child nutrition. However, nutrition education during pregnancy is not properly implemented in the country. The overall aim of this project is to investigate the effectiveness of culturally customized maternal nutrition education for health professionals in improving their counseling capacity in Ethiopia. The hypothesis to be tested is: Does giving maternal nutrition education to health professionals improve their counseling capacity? A two-arm parallel cluster randomized controlled trial will be conducted, considering health institutions as a cluster and nonadjacent clusters as control groups. All health professionals in selected clusters will be included. Data will be collected before and after the intervention using a structured questionnaire. The intervention will be culturally customized maternal nutrition education for health professionals working in antenatal, delivery, and postnatal care units in the intervention group. Education will be given for five days monthly for four months using education guide. Counseling practice of health professionals will be the primary outcome, while knowledge of health professionals will be the secondary outcome.

# ZINC BIOFORTIFICATION

Efficacy of Zinc-Biofortified Rice for Preventing Zinc Deficiency in Bangladesh: A Randomized Control Trial

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In Bangladesh more than half of the women of reproductive age have zinc deficiency. Entering pregnancy with a low zinc status can result in adverse pregnancy outcomes, congenital malformation, and low birthweight (LBW). While biofortification of staple food with zinc is a viable approach to alleviate zinc deficiency, to date there is only limited data on the efficacy of biofortified crops, and the results of available studies have shown a mixed outcome due to different methodological flaws in these trials. In this Randomized Controlled Trial (RCT) the efficacy of Zinc-biofortified rice (ZBR) for improving zinc status among women of reproductive age in Bangladesh will be examined using an improved study design and methodology. Eligible women will be recruited from rural areas and allocated randomly into either an intervention or a control group. The intervention group will presumably consume ~9mg of zinc per day (based on calculation from raw rice) for three months, as compared to ~5mg in the control group.





# DECISION-MAKING AND CHILD NUTRITION

Intra-household Decision-Making Status, Barriers  
and Association with Child Nutritional Status

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In this cross-sectional study the effect of the household decision-making status on infant and young child feeding practices and its relation to child nutritional status in rural districts will be studied. The intra-household decision-making, which focuses on quantifying couples' decision-making, will be classified as either: the husband makes the final decision, the wife makes the final decision, or the final decision is made jointly between wife and husband. It is hypothesized that joint decision-making will result in better nutrition as well as better growth and overall outcomes than the single-decision approaches. A total of 1,678 households will be included in the study. Data will be collected using a pre-tested and structured questionnaire over the duration of the study; further clinical non-invasive growth and nutritional parameters will be collected. The nutritional status of the children will be compared between the solo versus the joint decision-making. The results will be used for optimizing the present guidelines and will be integrated in the ANC procedures.

# NUTRITION EDUCATION IN SCHOOLS

## Empowering Preschool Teachers to Integrate Nutrition Education in their Routine Teaching to Advance Child Health

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Despite improvements in food production and healthcare services, the burden of malnutrition in Uganda has remained unacceptably high. Stunting (chronic undernutrition) and anemia (proxy for micronutrient deficiency) are currently estimated at 29% and 53% respectively among under 5-year-old children. Conversely, Uganda's positive economic growth is associated with the adoption of western lifestyles characterized by an increased prevalence of overweight, obesity, and associated chronic diseases. This triple burden of stunting, micronutrient deficiencies, and overweight/obesity pose a threat to national development given the high costs to healthcare, losses in human-resource capacity (mental and physical), and premature mortalities. This study will develop and test a nutrition-education intervention to reduce both undernutrition and overweight/obesity among preschool children (3-5 years old). The main objective of this proposed research is to develop a pilot nutrition education program for preschool teachers that can be used to train preschool teachers so as to improve their nutrition knowledge and their beliefs about the dietary and physical activity needs of children with the long-term aim to reduce both undernutrition and overweight/obesity among preschool children (3-5 years old).

# NCD RISK FACTORS IN CHILDREN

## Nutrition Education Intervention Targeted at Some Risk Factors of NCDs Among School-aged Children in Greater Accra

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Non-communicable diseases (NCDs) pose a serious threat to human development and are impeding the achievement of at least four of the global sustainable development (SDG) goals. This is because they are known to be the leading cause of premature deaths in both developed and developing countries. Although studies indicate that dietary and physical activity behavior during childhood can be linked to adult NCDs, studies investigating NCDs among children and adolescents are few in Ghana, and mostly focus on obesity. This study therefore aims to assess the prevalence and associated risk factors of hypertension, diabetes, and obesity in urban and rural settings in the Greater Accra region. This cross-sectional study includes children (9-15 years) attending public and private basic schools. Dietary data, diet quality and food environment data (home and school) are being collected through observations and a semi-structured questionnaire. Anthropometric and blood pressure measurements of both children and parents are being taken; blood analysis will focus on fasting glycaemia and lipids. The information from this study will be used for future implementation of interventions and policies that aim to curb the rising trend of NCDs in Ghana.

# FORGOTTEN CROPS

## Valorization of Genetic Resources of Cocoyam in Benin

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Two different types of cocoyam are grown for food and income generation at the household level in tropical regions of Africa, Asia, Oceania and America. They are considered an ancient crop in Africa. The species are important sources of fiber, vitamins and minerals with a moderate glycemic index. They have much nutritional and economic value, which could contribute to poverty reduction and improved food security in Africa. They are appreciated by consumers and have an immense utilization in traditional cultures. They are resilient to climate change with good adaptation to the landscape. Unfortunately their production and valorization remain low. They are considered a Neglected and Underutilized Species (NUS) in Benin Republic. Little research has been conducted on either species, and what has been carried out essentially concerns farmers' knowledge of production and conservation of the species in certain villages of south Benin as well as production constraints. These studies identified the lack of seeds, production techniques, and variety with long life cycle as problems. It is thus important to deepen the studies on cocoyam for food security by collecting existing genetic resources of cocoyam, assessing their diversity and identifying high-performance varieties, taking into account the preference criteria of producers, consumers, and processors, and updating the seed production techniques. It is in this context that this project is initiated to promote cocoyam (taro) cultivation in Benin. Genetic diversity of cocoyam grown in Benin will be evaluated through agro-morphological and molecular characterization in order to eliminate duplicates within local varieties and to confirm the agronomic performance recognized by producers. Furthermore the physico-chemical composition of the different organs (leaves, corms and stem) of cocoyam will be determined in order to know the nutritional value of cocoyam consumed.

# AGROBIODIVERSITY

## From Conventional Agricultural System to Agrobiodiversity: Influence on Food and Nutrition Security

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Although more than 60% of the rural population in Mozambique practice agriculture, the diet and nutrition of rural households is quite poor. This situation has worsened in recent years with successive losses of crops due to extreme weather events and irregular rainfall. Agrobiodiversity contributes significantly to improving the food and nutritional security of smallholder families. However, little is known to what extent such a contribution can be decisive in the context of southern Niassa. This study aims to evaluate whether an agrobiodiversity-based approach can improve food security, food diversity and nutrition. The study will be carried out in the district of Cuamba and consists of three phases: a) baseline research to characterize the local agricultural context, attitudes and food practices with questionnaires and assessment of the willingness of families to adopt agro-biodiverse systems; 2) training and participatory design of agroecological transition; 3) monitoring and research to assess the acceptability and effect of agrobiodiversity in improving food security, diversity and nutrition. It is hypothesized that agricultural practices based on the concept of agricultural biodiversity will make the local food system more sustainable and resilient and increase long-term food-security.

# BREASTFEEDING

Effects of Breastfeeding Education Interventions during Pregnancy on Breastfeeding Practices in Rural South Ethiopia

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Breastfeeding practices vary from setting to setting and affect newborns' growth and development. In Ethiopia, a sizable proportion of newborns (19%) do not feed colostrum; instead, pre-lacteal foods are given until colostrum is partly or fully removed. This delays timely initiation, and affects exclusive breastfeeding. Furthermore, avoiding colostrum and giving pre-lacteal foods make newborns more susceptible to infections and diarrheal diseases. Additionally, of the 26% of newborns exposed for pre-lacteal feeding, 27% initiate breastfeeding late and 41% do not exclusively breastfed. These problems of breastfeeding usually occur due to limited access in the wider community to health information about the harmful effects. This community-based, cluster randomized controlled trial using a three-arms parallel group design will evaluate the effects of breastfeeding education interventions on breastfeeding practices in rural South Ethiopia. Five hundred and ten pregnant women will be enrolled between the end of the first trimester and early second trimester (<16 weeks) of pregnancy. The three arms are: mother alone, mother with mother-in-law, and control arm (routine care). Interventions will be given at home in eight phases: six times during pregnancy (monthly starting from the fourth and up to the ninth month), and two times after delivery (within one week and in the last week of the third month). The outcomes are prelacteal feeding, colostrum feeding, early initiation and exclusive breastfeeding.





# BREASTFEEDING

Breastfeeding Decision-making and Practices Among Working Mothers and the Role of External Influences in Urban Nigeria

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Sub-optimal breastfeeding is a major determinant of child undernutrition. In Nigeria, only 29% of all children under six months old are exclusively breastfed (half of the WHO global target), and the prevalence is even lower for children of working mothers. The study aims to understand working mothers' decision-making processes regarding breastfeeding and the influences of the family and workplace on breastfeeding during the transition phase upon return to work. Understanding mothers' decision-making experiences regarding breastfeeding during the transition phase upon return to work is crucial to develop possible intervention points for breastfeeding promotion. This mixed-method study will use a cross-sectional study design to achieve the following aims: (1) understand the perspectives of mothers regarding the decision-making process around breastfeeding upon return to work, and (2) understand the influence of (a) social networks and (b) the workplace environment on mothers' breastfeeding perspectives and practices upon return to work. Upon completion of the study the results will assist the development of locally appropriate interventions to improve breastfeeding rates among working mothers in urban Nigeria.



# OTHER ACTIVITIES

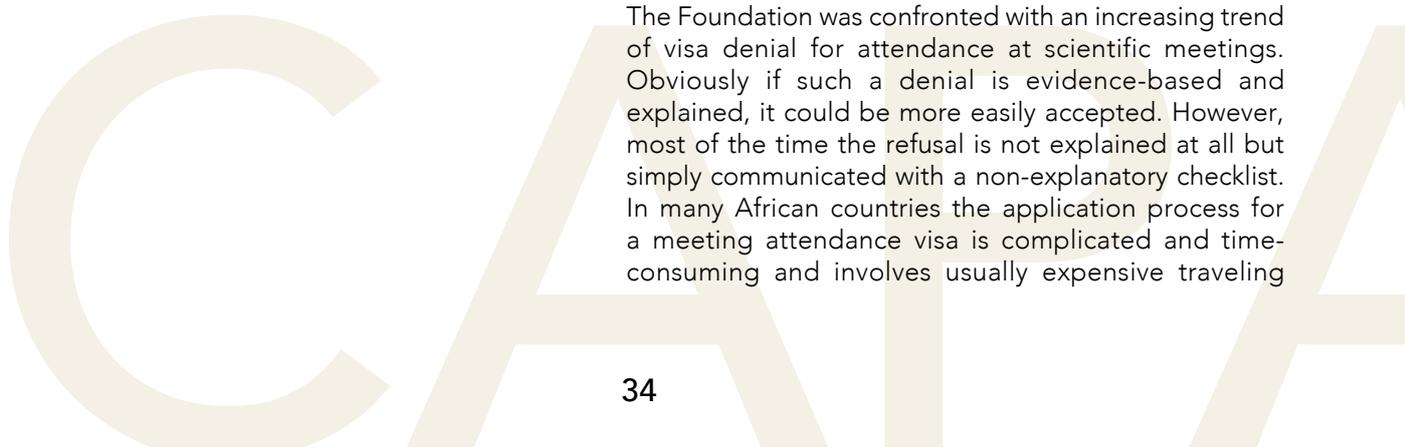
**One of the major aims of the Nestlé Foundation is the transfer of sustainable capacity-building knowledge to low-income countries through the promotion of nutrition research. Only local capacity with meaningful equivalent partnering assures sustainable local improvement. Despite the interconnected, economically globalized world, each region and country has its particular cultural and societal food-related characteristics, which have to be preserved. Heterogeneity in culture, education and food assure innovation and sustainability.**

**During 2023 the Foundation's main activities focused on continuing support of nutrition research projects, along with support for specific capacity-building activities for grant recipients. As in the past, the Foundation again demonstrated flexibility in providing assistance according to specific needs for further advancement (such as support for conference attendance, networking, delivery of certain scientific articles, etc.), taking into account local situations and circumstances.**

## **DISSEMINATION OF RESEARCH RESULTS – AND THE PROBLEM OF VISA DENIALS**

The dissemination and subsequent implementation of research results are crucial for any improvement. It is the policy of the Foundation to support grant recipients for conference attendance to present data from Foundation-supported research projects. This support is offered for both loco-regional and also international meetings. Attending scientific meetings is of great importance for all researchers, especially for those from low-income countries, to learn about the most recent scientific developments and trends and to increase their professional network and explore options for collaboration. In view of the limited resources in many low-income countries, such contacts play even a larger role in career advancement than in the global North. Everybody knows that continuous education—including attending scientific meetings—is a key component for any scientific capacity-building. Also during the last year, the Foundation supported young researchers, PhD students and post-docs from Africa, allowing them to attend international scientific conferences. There is no doubt that such support is more than appreciated. Nevertheless, despite optimal assistance from all individuals involved, the success rate of such crucial capacity-building support seems to become more and more difficult, if not entirely impossible.

The Foundation was confronted with an increasing trend of visa denial for attendance at scientific meetings. Obviously if such a denial is evidence-based and explained, it could be more easily accepted. However, most of the time the refusal is not explained at all but simply communicated with a non-explanatory checklist. In many African countries the application process for a meeting attendance visa is complicated and time-consuming and involves usually expensive traveling





(often even into another country). Not to mention the financial burden created by non-refundable conference attendance fees. This creates huge costs for the applicant, which count even more in the case of a visa denial. Our perception of the increased visa denial rates is in agreement with reports in the literature. It seems to be a growing problem for the international scientific community, which even led to the publication of a policy report from The Royal Society entitled “The borders of science”<sup>1</sup>, addressing researcher mobility to the UK. In the foreword, Sir Adrian Smith, President of The Royal Society, writes that “researchers move frequently back and forth across borders to collaborate and share ideas. This dynamism drives innovation, keeps science at the cutting edge, and ensures that the benefits of research feed downstream into society”. The latter has been the aim and mandate of the Foundation for nearly 60 years already. It seems that the world gets more and more unequal, affecting especially those who live and work in suboptimal—that is, the least well-equipped—conditions. In such a context, as one of our African colleagues has pointed out, we should remember Ghana’s first president Dr. Kwame Nkrumah, who stressed the importance of Africa-centred knowledge<sup>2,4</sup>.

## PUBLICATION ASSISTANCE

As in the past, during this reporting period the Foundation has continued to cover publication fees and page charges in different journals for research projects supported by the Foundation.

## NFR4D STUDIES

The ongoing NFR4D project at USSEIN University in Senegal is advancing, and the whole USSEIN and multidisciplinary as well multi-institutional collaborative team made progress in the further institutional development as well as the planned research project. Thanks to the motivation and efforts of the whole Senegalese team, they have largely been able to compensate for the delay and gap caused by COVID-19. The intervention part of the planned study entitled “Development of complementary foods based on local products to improve iron status of school-age children in Senegal” is ongoing.

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“For he who has a hammer the world looks like a nail.”

Johan Galtung

Also this year the world continues to be dominated by power and wars. The right to healthy food and a fulfilling, peaceful life seems to become an unattainable utopia for the majority of the world.

The old saying “Those who control food, control your life” is now the reality nearly globally. This scenario—as outlined by Mrs. Vibeke Bjornlund and Prof. Henning Bjornlund in the second contribution—is also reflected in modern “post-colonial” solutions to reduce food insecurity by changing the agricultural

practices. These and other fundamental changes in the food system—driven by a few key players ignore not only the right to food but also the huge local knowledge base and culture in the South—is leading to a fast-paced and uncontrollable change in the disease pattern in low-income countries (LIC). As a result we see a shift towards the classic chronic diseases, as illustrated by Prof. Lemma Getacher, who outlines the pandemic of double-burden diseases in LIC.



# VISION

THE DOUBLE BURDEN OF MALNUTRITION

MONOCROPPING AND IMPLICATIONS



# DOUBLE BURDEN OF MALNUTRITION

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## **CONFRONTING THE CHALLENGES OF THE DOUBLE BURDEN OF MALNUTRITION: UNDERSTANDING THE DRIVERS AND POSSIBLE SOLUTIONS**

### **Introduction**

The coexistence of contrasting forms of malnutrition, encompassing both undernutrition and overnutrition, is known as the double burden of malnutrition (DBM). It is a critical public health challenge that has significant impacts on individuals, communities, and nations globally<sup>1</sup>. This essay aims to analyze the causes of this phenomenon and explore pathways to address and overcome the challenges associated with it. By understanding the underlying factors and developing comprehensive strategies, we can work towards improving nutrition outcomes and reducing the burden of malnutrition on populations<sup>2,3</sup>.

Globally, DBM is a critical contributor to morbidity and mortality, particularly in low- and middle-income countries (LMICs). It poses a grave threat which endangers the future of populations and leaves lives hanging in the balance. Stunting, thinness, and overweight/obesity are the most prevalent and devastating manifestations of DBM worldwide. Outrageously, approximately 820 million people (1 in 9) suffer from hunger, while one-third of the global population (1 in 3) is affected by overweight or obesity. This DBM presents a major challenge

to human health and well-being across the globe<sup>4-8</sup>. Moreover, worldwide, an estimated 1.9 billion adults are overweight, with over 600 million classified as obese. Furthermore, approximately 462 million adults are underweight. Among children, around 155 million are stunted, 52 million are wasted, and 41 million are overweight or obese. These statistics highlight the significant burden of malnutrition and obesity-related issues on a global scale, emphasizing the need for comprehensive interventions and policies to address these challenges and promote healthier lifestyles<sup>1</sup>. The prevalence of DBM in Africa is also increasing alarmingly<sup>9</sup>.

The United Nations Decade of Action on Nutrition has launched a global initiative aimed at ending widespread hunger and eradicating all forms of malnutrition. Aligned with the Sustainable Development Goals (SDGs), this effort addresses both undernutrition (wasting, stunting, and micronutrient deficiencies) and overnutrition (overweight, obesity, or diet-related non-communicable diseases)<sup>10,11</sup>. Two SDG goals directly relevant to the DBM are goal 1 (“end poverty in all its forms everywhere”) and goal 2 (“end hunger, achieve food security and improved nutrition, and promote sustainable agriculture”). Target 1.1 under goal 1 seeks to eradicate extreme poverty, defined as people living on less than \$1.25 a day. Target 2.2 under goal 2 aims to end all forms of malnutrition, meeting internationally agreed targets for stunting and wasting in children under five years of age, and addressing the nutritional needs of adolescents, pregnant and lactating women, and older persons by 2030<sup>10</sup>.

#### **Drivers of the Double Burden of Malnutrition**

The driving forces behind DBM include early-life nutrition, diet quality, biology-related factors, epigenetics, food environments, food systems, socioeconomic factors, and poor governance<sup>1,4,11,12</sup>. Among these, dietary quality, early-life nutrition, socioeconomic factors, and food environments are the most modifiable drivers. These factors are shared for both undernutrition and overnutrition universally<sup>12,13</sup>. According to the UNICEF model, the major causes of malnutrition can be categorized as immediate causes (inadequate/excess dietary intake and diseases), underlying causes (inadequate access to food, inadequate healthcare practices, inadequate health services, and unhealthy environments), and basic causes (poor knowledge of nutrition, lack of education, poor socioeconomic status, cultural beliefs, poor agricultural practices, poverty, poor governance, and household disparities)<sup>14</sup>.

#### **The Way Forward: Possible Solutions**

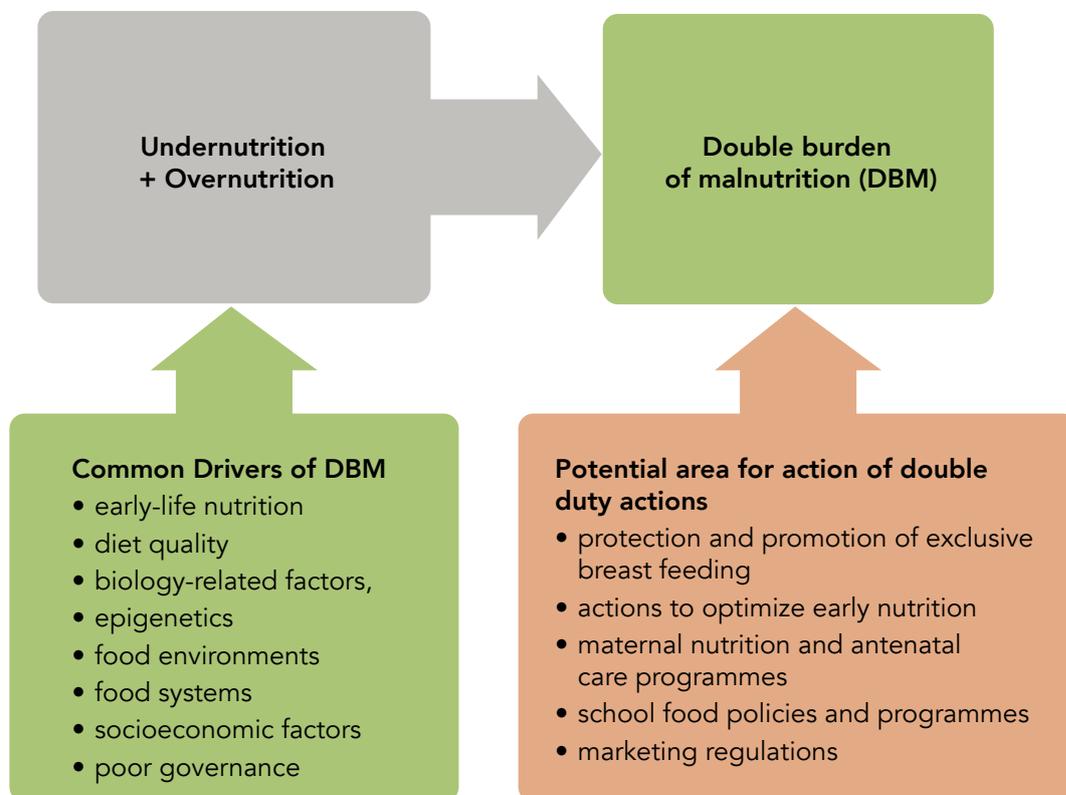
##### **Double-duty Actions: The Possible Solution to Tackle DBM**

The 2017 WHO policy brief and the 2020 Lancet Series on the DBM highlight that overweight and obesity are forms of malnutrition that now coexist with the



persistent problems of nutritional deficiencies in most countries around the world. Especially in LMICs they form a “new nutrition reality” that will require new interventions, strategies, programs, and policies to be successfully overcome. Hence, the WHO report and Lancet series of publications recommend double-duty actions to end DBM<sup>(1,15-17)</sup> as the previous interventions addressing malnutrition contradicted each other, disintegrated, and were not focused. Besides, although different forms of malnutrition can co-exist simultaneously in LMICs, most previous nutrition interventions targeted only one form, namely undernutrition. These interventions lead to a slight reduction of undernutrition but not overnutrition<sup>1,15,17</sup>.

Double-duty actions (DDAs) are interventions, programs, and policies that have the potential to simultaneously tackle the burden of both undernutrition and overnutrition comprehensively (Figure 1). These interventions can be achieved in three ways: first, through not harming the existing interventions on malnutrition; second, by retrofitting the existing nutrition interventions to address all sorts of malnutrition; and third, through the development of de novo integrations aimed at the DBM. These actions reflect the shared drivers and platforms of contrasting forms of malnutrition<sup>1,15,17</sup>.



**Figure 1:** The potential movements of double duty actions

Double-duty interventions also have the potential to improve nutrition outcomes across the spectrum of malnutrition through integrated initiatives, policies, and programs. It is not a zero-sum game in addressing contrasted and confounded forms of malnutrition in the global population. According to the WHO 2017 policy brief, double-duty actions include about ten packages. These packages are categorized as health services packages; social safety net packages; educational setting packages; and agriculture, food systems, and food environment packages. These include protection and promotion of exclusive breast feeding; actions to optimize early nutrition, maternal nutrition and antenatal care programmes; school food policies and programmes, and marketing regulations<sup>(1,15,17)</sup>.

### Food-systems Sustainability: Other Possible Solutions

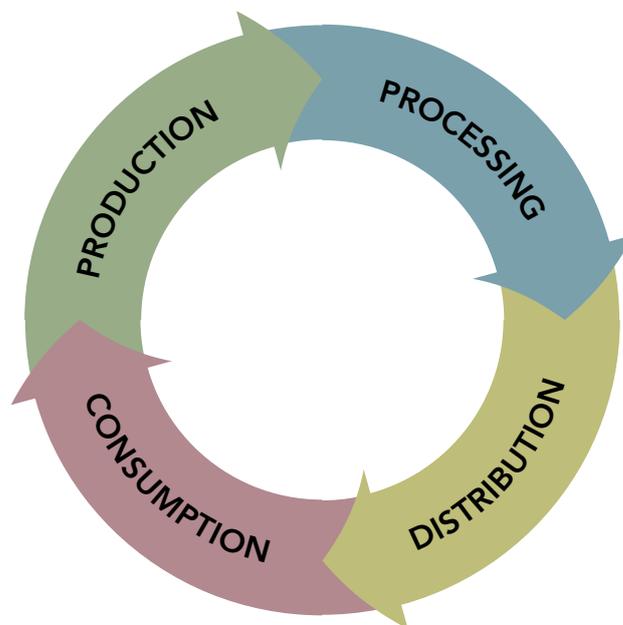
Food-systems sustainability refers to the ability of food production, distribution, and consumption systems to meet present needs without compromising the ability of future generations to meet their own needs<sup>(18,19)</sup>. It encompasses various aspects, including environmental, social, and economic dimensions. From an environmental perspective, sustainable food systems aim to minimize negative impacts on

ecosystems, conserve natural resources, reduce greenhouse gas emissions, and promote biodiversity. This involves adopting practices such as organic farming, agroecology, efficient water management, and responsible waste management. Social sustainability in food systems focuses on ensuring equitable access to safe, nutritious, and culturally appropriate food for all individuals. It involves addressing issues such as food security, food justice, fair labor practices, and community engagement in decision-making processes. Economic sustainability in food systems involves fostering economic viability for farmers, food producers, and businesses while promoting fair trade practices, reducing food waste, and supporting local and regional food economies<sup>(18)</sup>. Achieving food-system sustainability requires collaboration among various stakeholders, including governments, farmers, producers, consumers, researchers, and civil society organizations. It necessitates transformative changes in food production and consumption patterns, policy frameworks, and market structures. By promoting sustainable food systems, we can work towards ensuring food security, reducing environmental degradation, improving public health, supporting local economies, and advancing social equity and justice.

## What is a food system?

### 1. Production

- Preparing soil and planting seeds
- Harvesting crops
- Breeding and raising livestock
- Breeding and raising fish



### 2. Processing

- Storing harvests
- Butchering meat and poultry
- Catching fish
- Milling grain
- Cleaning fruits and vegetables

### 3. Distribution

- Selling food at local market
- Shipping to regional or international locations
- Distributing via wholesalers
- or community programs

### 4. Consumption

- Purchasing food
- Storing food at home
- Cooking
- Eating
- Composting

Figure 2: The food system components

## Conclusion

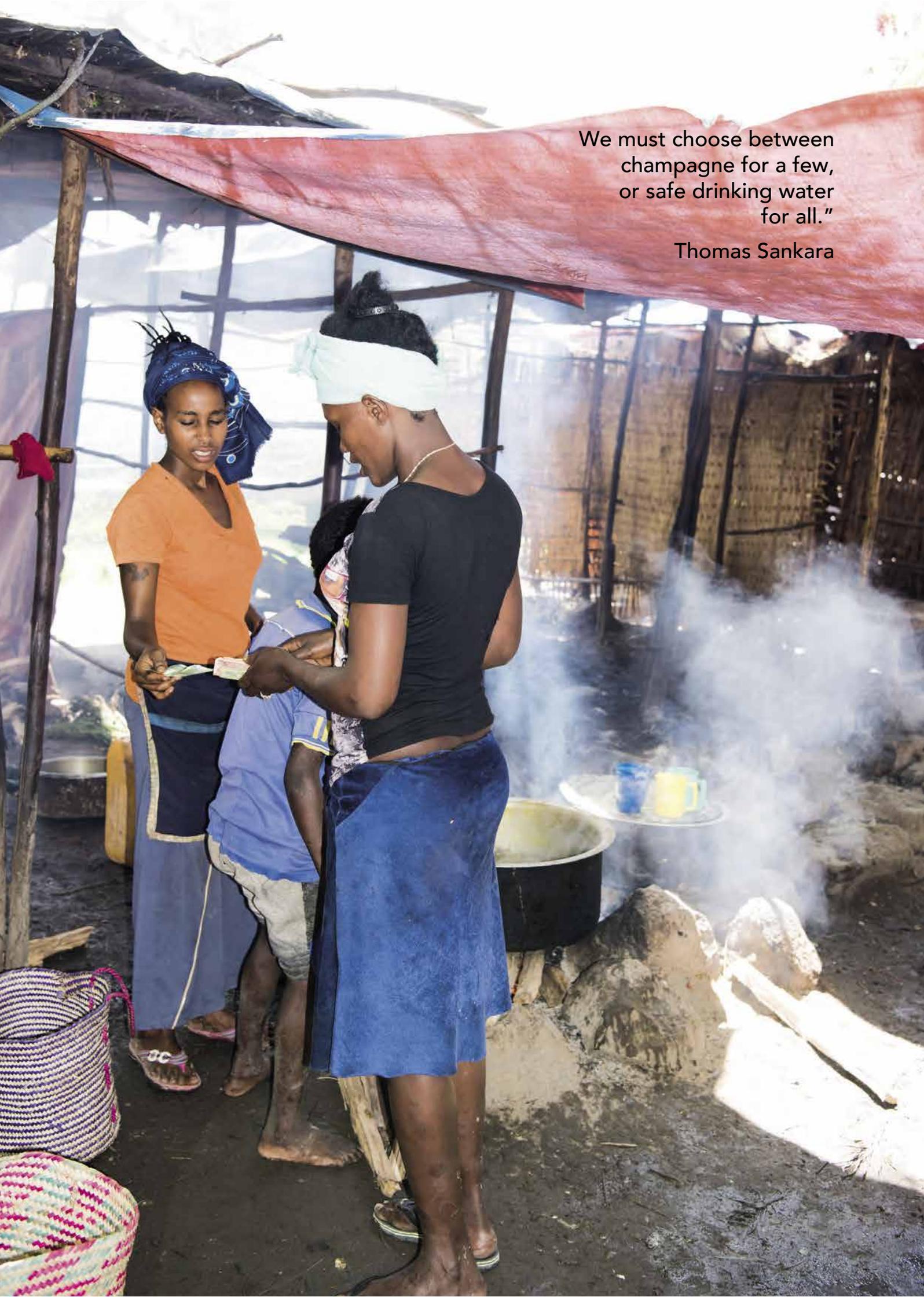
Confronting the challenges of the double burden of malnutrition requires a comprehensive and integrated approach that considers the complex interplay of socioeconomic factors, dietary patterns, education, health-care systems, policy frameworks, and sustainable food systems. By addressing these causes and exploring pathways to solutions, stakeholders can work towards improving nutrition outcomes and reducing the burden of malnutrition on individuals, communities, and societies. It is essential to prioritize collaborative efforts and engage multiple stakeholders to effectively confront this multifaceted issue and create a healthier future for all.

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We must choose between  
champagne for a few,  
or safe drinking water  
for all."

Thomas Sankara





# MONOCROPPING AND IMPLICATIONS

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## MONOCROPPING AND IMPLICATIONS FOR FOOD SECURITY IN SUB-SAHARAN AFRICA

Food security is when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. There are critical links between food security and poverty, health, education, and equity. Food security therefore influences the productive capacity of people in developing countries and, hence, nations' development potential. Monocropping is the practice of growing a single crop species year after year on the same land.

The link between monocropping and food security is not new. In 1845, monocropping of a single clone of potatoes caused an outbreak of phytophthora in Ireland, which destroyed the potato crop and led to famine, over 2 million deaths and mass migration. There has been growing concern over increased plant disease outbreaks from monocropping, which has reduced the production of critical staple foods

impacting the social and political stability of nations. For example, monocropping of Cavendish bananas caused an outbreak of fusarium wilt. In sub-Saharan Africa (SSA), the disease spread to plantains, which is the staple food for more than 100 million people. In Eastern Africa, cassava mosaic devastated Uganda's cassava production 1992-97, causing widespread food shortages and famine-related deaths.

There have been two key drivers of monocropping in Africa. First, the colonial powers produced monocropped sugar cane, cotton, and groundnut for export and corn and cassava to feed the workers, as they produce more calories per land and labour unit than traditional food crops. This significantly reduced access to the preferred nutritious staples, with lasting effects of malnourishment. Second, the introduction of the Green Revolution (GR) seeds in the 1960s and 70s, and then in 2008 the New Green Revolution (NGR).

Monocropping became the predominant practice in the Midwestern United States as part of a government-subsidized industrial grain farming system. This system focused on increasing yield to optimize commercial return. This involved the development of new hybrid seeds, which were highly responsive to nitrogen and water. To retain high yields, farmers had to purchase seeds every year, which increased production costs. This system was driven by increasingly powerful horizontally and vertically integrated agri-businesses. The development of a small range of hybrid grain seeds for production on large acreages was lucrative for these businesses. The same agri-businesses produced and/or traded in seeds and inputs and also purchased the grain. This placed farmers in a price squeeze, and land and trade consolidation followed. Monocropping and specialization can seem appealing to farmers, as they can use the same seed, pest control, machinery, and production methods and increase their labour productivity. However, it is expensive for farmers and governments, due to high input costs and the need for subsidies, supply and demand management policies, and infrastructure. Monocropping replaced crop rotation, fallowing, intercropping and crop livestock integration, which collectively maintained soil fertility, provided genetic diversity, and controlled weeds, pests, and plant diseases. Monocropping therefore requires high levels of inorganic fertilizer. Genetic uniformity is associated with significant disease risk and pest outbreaks, which requires the intensive use of pesticides. The detrimental impacts of increased pesticide use (e.g. DDT) on food chains, public health and water sources were well-documented in Rachel Carson's *Silent Spring* (1962), which led to the first environmental regulations.

A hybrid seed research program was established in Mexico in 1943 to develop corn and wheat varieties

suitable for sub-tropical climates, and became a critical component of the GR. The yield increases were achieved by diverting the plant's energy from the production of vegetative matters to the primary product: the kernels. Hence, the livestock feed benefits previously derived from crop residues were diminished. The process also limited the plant's ability to extract essential nutrients from the soil, reducing the nutritional value of food. While corn yield more than doubled between 1920 and 2000, the concentrations of protein, oil, and several amino acids declined while starch increased.

The GR was introduced into India in the mid-1960s. Grain export to India under the US PL480 program made money available for the Indian government to introduce economic policies—such as subsidizing fertilizer and minimum crop prices—to incentivize farmers to grow wheat. By the 1980s, yields started to stagnate, and the environmental impacts became apparent: for example, depleted soils, lowering of water tables, water logging, soil salinity, and increasing frequency of pest and disease outbreaks. The socioeconomic impacts were devastating, often resulting in violence, with land-consolidation displacing smallholders, who then settled in urban slums. Food insecurity increased as wheat replaced nutritious and preferred staples such as pulses and beans. As this system became unaffordable, the Indian government reduced subsidies. Farmers in the GR areas protested violently, most recently in 2021 and 2024, and suicides among subsidized farmers escalated.

When the GR seeds were introduced in SSA in the 1960s and 1970s, they came without the package of US financial support available to India. Hence, they were mainly used for export crops. Governments' primary objective was to provide cheap food for growing, and politically powerful, urban populations. Smallholders had to grow staple food (e.g. corn), which was purchased by government agencies at prices often below production cost. Further, governments received US surplus grains as part of WB loans, which was sold in urban markets at low prices. These policies were barriers to the establishment of local food production and supply chains, indebted nations, and created import dependency, but not food security. Since the early 2000s, there has been a renewed focus on introducing this production system as part of a NGR to increase agricultural production. As part of the NGR, African governments committed to introduce enabling policies, provide fertilizer subsidies and set land and water aside to attract foreign companies to invest in large core farms and associated value chains. A key element of the NGR was to attach smallholders as contract suppliers to these value chains. The contracts commit the buyers to provide inputs and purchase the crops at agreed prices, subject to quality criteria. While this addressed issues prevalent

for smallholders in SSA, such as access to input and output markets and finance, it also exposed them to exploitation and has impacted their physical and economic access to preferred nutritious food in several ways. First, even though the price is agreed on, buyers control the scales and assess the quality, which causes conflicts, lowers household income, and reduces economic access to food. Second, contracts often stipulate that farmers cannot grow any other crops on the contracted land. Buyers fear that the inputs and farmers' time will be used for food production and lower contract crop production. This reduces farmers' physical access to food. Third, small food plots near cane fields in sugar-producing areas are often infected by pest and diseases originating in the canes or are accidentally burned when the cane is harvested. This reduces physical access to food. Fourth, the contract crops often increase on-farm labour demand, leaving little time for non-farm income-earning activities or tending home gardens. This increases households' vulnerability as they become dependent on income from one crop and must purchase their food. This exposes them to price gouging as there is little competition in rural areas and it reduces physical access to nutritious food since starchy rather than nutritious foods are predominant.

The NGR has until now mainly resulted in increased mono-cropped production of exports: sugar cane, corn, and soyabeans for biofuel and stock feed; and horticultural crops for Europe. Little value-adding takes place in SSA to create income-earning opportunities. Scarce land, water, and labour resources have been allocated to exports rather than the production of nutritious local foods. In the process, monocropping extracts critical nutrients from already depleted African soils, which reduces future productivity and the nutritional value of food crops. This has neither generated jobs or prosperity for smallholders nor improved local food production to improve the economic and physical availability of nutritious and preferred foods.

The expectation that earnings from exporting agricultural products would fund food imports to meet local needs has not materialized. Import dependency has exposed countries to global fluctuations in commodity prices caused by international conflicts, financial speculation, global trade policies, and manipulation of US interest and exchange rates. Hence, a shift away from import dependence is needed to strengthen local food production and food security. Botswana and Namibia have stopped importing what can be produced locally, incentivizing local supply chains. This encourages investment from the public and private sector, and collaboration between suppliers and retailers. To support this, Global North governments and institutions must focus their interventions on

those providing direct economic development for rural communities in the Global South. This can only be achieved by restraining the growing powers of foreign direct investment and instead fund the improvement and growth of local initiatives for value adding and domestic distribution infrastructures.

We argue that there are alternative production systems which are more suitable for African farmers and environments and go beyond the use of inorganic fertilizer to close the yield gap. Systems that improve soil fertility and provide food, jobs, and business opportunities for local communities should be paramount. Such systems would improve physical and economic access to preferred nutritional food for healthy and active communities and create inclusive economic development, the foundation for productive and prosperous populations and nations.

### Recommended readings

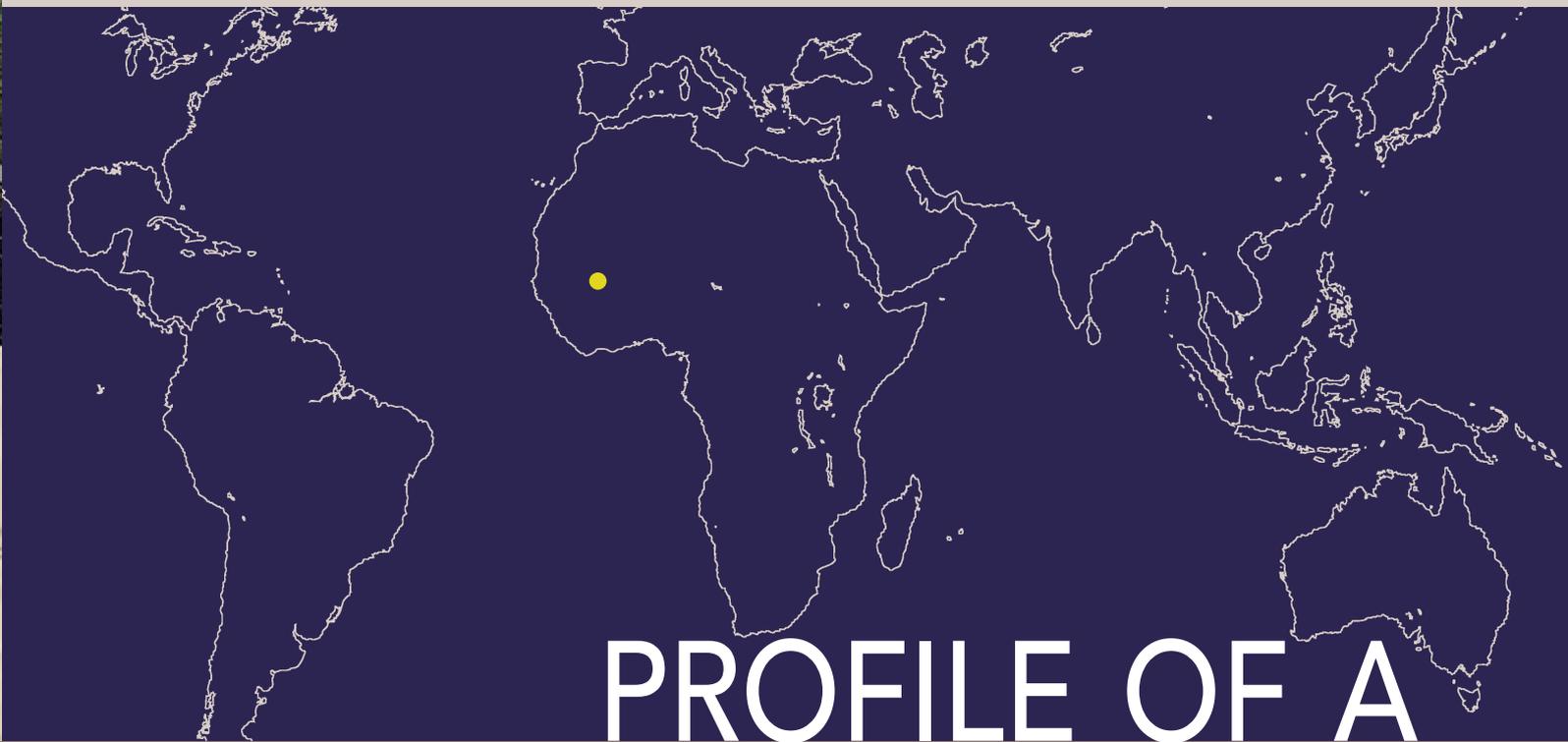
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“Earth provides enough  
to satisfy every man’s needs,  
but not every man’s greed.”

Mahatma Gandhi





# PROFILE OF A NUTRITION INSTITUTE



# IPR/IFRA DE KATIBOUGOU

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## INSTITUT POLYTECHNIQUE RURAL DE FORMATION ET DE RECHERCHE APPLIQUÉE (IPR/IFRA)

Mali, a huge land-locked West African country, extends from the desert areas in the North, over the semiarid grassland in the middle parts, to the forested Savanna-like areas in the South. In view of these different zones, specifically adapted local agricultural practices have played a key role in daily life and culture since historic times. The special geographic and climatic constellation of Mali is mirrored in farmers' continuous adaptation and development of agricultural practices, but also in the use of specific locally adapted food crops, one of them being rice. Not surprisingly, analysis of different local African rice species reveals that the very origin of African rice is located in the Inner Niger Delta areas in the northern part of Mali, where this crop has been grown and domesticated for more than 3,000 years<sup>1</sup>. Today it is known that African rice expanded from its Malian origin to other locations in Africa. The African rice strains adapted continuously to the locally changing environmental and specific climatic conditions and represented a key crop to ensure food security. The local African rice production started to decline upon the introduction of new Asian rice strains not adapted to the local conditions<sup>2</sup>. These historic facts underline that also in the modern world, in order to assure future food security, one should

# MALI

## AREA

Total:	1,240,192 km <sup>2</sup>
Agricultural land:	43%
Arable land:	6.8%

## POPULATION

Total (July 2023 est.):	23,293,698
Urban population (2022):	45%
Under age 15:	47%
Median age:	16.3 years (Male 15.6 years / Female 17 years)
Net migration rate (per 1000) (2023):	-1.8
Rate of urbanization ( annual rate of change, 2022.):	4.8%

## POPULATION GROWTH RATE

Total (2023 est.):	2.93%
Total fertility rate (2023 est.):	5.8 children born/ woman

## GDP

(per capita, PPP) (2023 est.):	USD 2,100
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## LIFE EXPECTANCY AT BIRTH

Total:	59 years
Male:	59 years
Female:	61 years

## MORTALITY RATES

Neonatal mortality rate:	38/1000
Infant mortality rate (at birth) ( 2024 est.):	55.8/1000
Under-five mortality rate:	93.8/1000
Maternal mortality rate (2015 est.):	578/100,000 livebirths

## MICRONUTRIENT DEFICIENCIES

Households consuming iodized salt (2018):	89%
Vitamin-A supplementation (full coverage, 2022):	76%
Prevalence of anemia among women of reproductive age	59%

## OTHER PARAMETERS

Population below poverty line (2013 est.):	42%
Rate of urbanization (rate of annual change):	4.8%
Mother's mean age at first birth (2016 est.):	19.2 years
Contraceptive prevalence (2013):	20%
Health expenditure (% of GDP, 2020):	4.3%
Physician density per 1000 population:	0.1
Immunization, measles (% of children ages 12-23 months):	70%
Proportion of children < 5 years sleeping under insecticide-treated bed nets:	73%
Total adult literacy rate:	30%
Proportion of population using at least basic drinking water services	
National	84%
Urban	94%
Rural	74%
Adult HIV prevalence (2018 est.):	1.1%
Obesity (adult prevalence rate 2016):	8.6%
Internet users (% of the population, 2021 est.):	34%



rely on centuries-old locally grown crops and the know-how of farmers using local indigenous crops to assure a functional agricultural system adapted to the local climatic conditions. Both in general and as the cradle of African rice since ancient times, Mali has played a key role in agriculture, meaning agricultural practice and food production, and thus food security.

As a continuation of this long history of agriculture in Mali the Institut Polytechnique Rural de Formation et de Recherche Appliquée (IPR-IFRA) was created in 1965 by merging the Collège Technique Agricole (CTA) in Katibougou and the Ecole des Assistans d'Elevage de Bamako into one institute. The aim of this new institution was to assure access of the rural areas to a structured education in agricultural practices and related fields to assure, preserve and promote rural development. It is worth mentioning that the IPR is actually one of the oldest institutions in West Africa devoted to rural development. Already in 1897 the Station de Recherche Agronomique Expérimentale relocated from Kati to Katibougou, which can be regarded as the creation of the later IPR known today. In 1902 the Ecole des Maîtres Laboureurs was created, which in 1913 became a center for agricultural practice (Centre de Stage Agricole), which in turn later became the aforementioned CTA. In this short profile article the long and impressive history of the IPR will not be recapitulated, but it should be noted that in Mali (as in many other African countries) agriculture plays a key role in daily life, culture and obviously food security, so that the importance of promoting "rural development", including promoting and optimizing locally adapted agriculture practices and crops by a specific institution, is more than self-evident. In Mali these institutions were already created more than 100 years ago. The local interest in agriculture and rural development is not surprising, since it is assumed that the origin of systematic agricultural practices originated actually in Africa<sup>3</sup>—and this ancient knowledge should be respected, maintained, explored, and promoted in order to assure food security in our modern era of global disruption and also a global, non-sustainable modern food system.

The Rural Polytechnic Institute for Training and Applied Research (IPR / IFRA) is located in the village of Katibougou, approximately 70 km northeast of Bamako and 3.5 km from the city of Koulikoro. It covers an area of 380 ha along the left bank of the Niger River with the coordinates: 12° 56' north latitude and 7° 37' west longitude, at 326 m altitude. The Katibougou IPR / IFRA also has an annex in Bamako. Koulikoro is a well-known city since it is the terminus city for larger boats on the Niger River and in the past the terminal station of the railway connection to Dakar.

Currently the IPR/IFRA has five Departments of Teaching and Research (DTR), which are:

- Department of Agriculture
- Department of Livestock
- Department of Rural Engineering, Water and Forestry
- Department of Economic and Social Sciences
- Department of Fundamentals and Basic Sciences

IPR / IFRA is a higher-education institution, which has the main missions of

- Teaching in fisheries, agroforestry, agronomy, soil sciences, agro-economics, rural engineering, veterinary medicine, animal production and agricultural extension
- Training of rural communities
- Scientific and technological research
- Development and dissemination of knowledge and skills
- Carrying out production activities and providing services

Presently over 200 professors, educators, and researchers work at the IPR / IFRA. Almost 4,500 students are enrolled in different programs. The students come mainly from Mali, but also from other francophone African countries (Burkina Faso, Niger, Gabon, Senegal, Mauritania and Togo, among others), underlining the central role of the institute for all French-speaking countries in West Africa. This international student community creates a positive educational setting, enriching the scientific discussions due to the heterogeneous background of the students, and is thus an ideal setting for networking and establishing collaborations after graduation from the institute. The institute, which unites many different disciplines as well as a heterogeneous group of students, is an ideal setting to develop sustainable, locally adapted agricultural solutions to assure future food security. As mentioned above, the main endeavor of the IPR is both scientific and practical development in the area of agriculture, simultaneously respecting local knowledge and pursuing a positive eclecticism of new developments to meet local needs. Further, as illustrated with the example of African rice, new developments (historically the introduction of Asian rice or other non-local crops) are not always for the better and the IPR carefully chooses the best approach for further rural development and agricultural practices—in which food security is rooted—not ignoring the local cultural and climatic constellation and last but not least centuries-old local knowledge.

The research activities span different areas such as agro-physiologic-genetic research and plant biology, soil science, plant culture defense traits and biological control through specific local strategies, renewable energy, ethnobotanics, forestry, agro-

forestry and environmental protection, ideal agropastoral system research, and many others. This short listing underlines the multidisciplinary research activities of the IPR and the aim to find local, evidence-based multidisciplinary solutions to assure a functional rural and agronomical system characterized by food security and health for the population. To illustrate the research work of the IPR the specific research activities of the Department of Livestock are briefly outlined here.

### Department of Livestock

The Department of Livestock offers degrees (bachelors, masters and engineering) in animal sciences (production and health) and food technology.

Around thirty teachers are involved in teaching and research activities. The main research topics are:

- Identification and purification of enzymes of industrial, agronomic and environmental interest
- Food quality control
- Study and identification of the genetic diversity of food microorganisms (bacteria and fungi)
- Mycotoxin (aflatoxins and ochratoxin A) analysis
- Supporting innovation in the agri-food sector

The unit collaborates with the laboratory of molecular biology (LABOREM) of Bamako University and different foreign universities and institutes.

### Research in nutrition and food safety

Food safety encompasses all actions to be taken to produce nutritious and healthy food in order to protect consumer health. In this context, the department is mainly working on food contamination by mycotoxins (total aflatoxins and aflatoxin M1). Ongoing research activities around the control of mycotoxins in cow's milk will permit the assessment of the contamination level, human exposure, and related health risks. The activities of the research group focus on strategies to reduce mycotoxin contamination in major foodstuff (milk and cereals). The research on mycotoxins is in full development within the food technology unit. These research activities in our project entitled MILKSAFE are in part supported by a grant from the Nestlé Foundation. The main objective of the MILKSAFE project is to assess and reduce food mycotoxin (total aflatoxins and M1) contamination levels in milk in the greater Bamako area.

Mycotoxins are toxic metabolites, secreted by fungi such as *Fusarium* or *Penicillium*, which can be present in cereal grains. They can belong to three distinct families. They develop on plants, particularly during hot and humid periods during flowering or during grain storage, before processing. Mycotoxins cause yield losses and reduce food quality. They

are resistant to cooking and even sterilization. These contaminants (mycotoxins) are invisible to the naked eye and odorless but at certain levels can be harmful to human health. They have variable acute toxicity, with long-term effects such as cancer, DNA modifications or harmful effects on the fetus. These local research activities are very important and aim to evaluate mycotoxin contamination in foodstuff (milk and animal feed) and will finally result in suitable mitigation strategies and techniques.

The relevance of this locally initiated research work is supported by the fact that Mali has one of the largest cattle and goat populations in West Africa and milk as well milk products are widely consumed. The MILKSAFE research activities are still in progress, and it is hoped that implementable results will be available in one year. The MILKSAFE project focuses less on industrial milk production, and more on local, smaller-scale milk farmers to assist them in safe milk production. Small-scale farmers are crucial to assure local food security and provide locally grown food, including milk. The MILKSAFE project illustrates that local researchers develop locally adapted solutions, which usually have a higher sustainability and acceptability. This project underlines also the key role of small-scale farmers and the importance of assisting small-scale farmers to assure future food security.

**The nutrition and food safety research team was created in 2021:**

- Abderahim AHMADOU, PhD – Food Science and Nutrition, IPR/IFRA de Katibougou
- Fousseyni SIDIBE, PhD – Microbiology et Immunology, IPR/IFRA de Katibougou
- Adougnina KASSOGUE, PhD – Food Microbiology, FST/LABOREM
- Zoumana SANGARE, PhD student, IPR/IFRA de Katibougou
- Assitan TRAORE, Research Assistant, IPR/IFRA de Katibougou

The collaboration structures are:

**National**

- Institut des Sciences Appliquées (ISA)
- Institut d’Economie Rurale (IER)
- Laboratoire National de la Santé (LNS)
- Laboratoire National de Recherche en Santé Publique (INRSP)
- Laboratoire Central Vétérinaire (LCV)

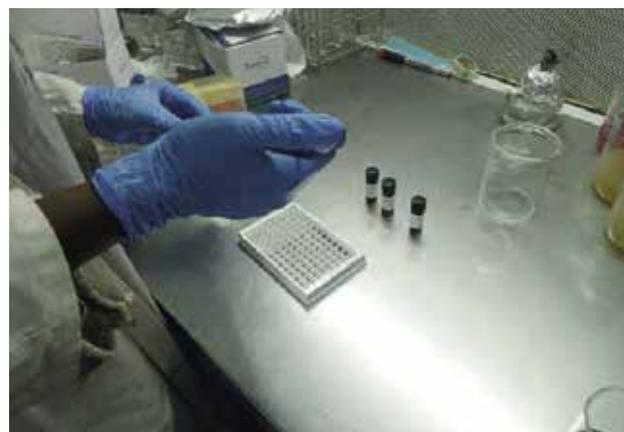
**International**

- ICRISAT
- CIRAD-Montpellier (France)
- Université d’Aix Marseille (France)

References on page 73



Lyophilization of samples

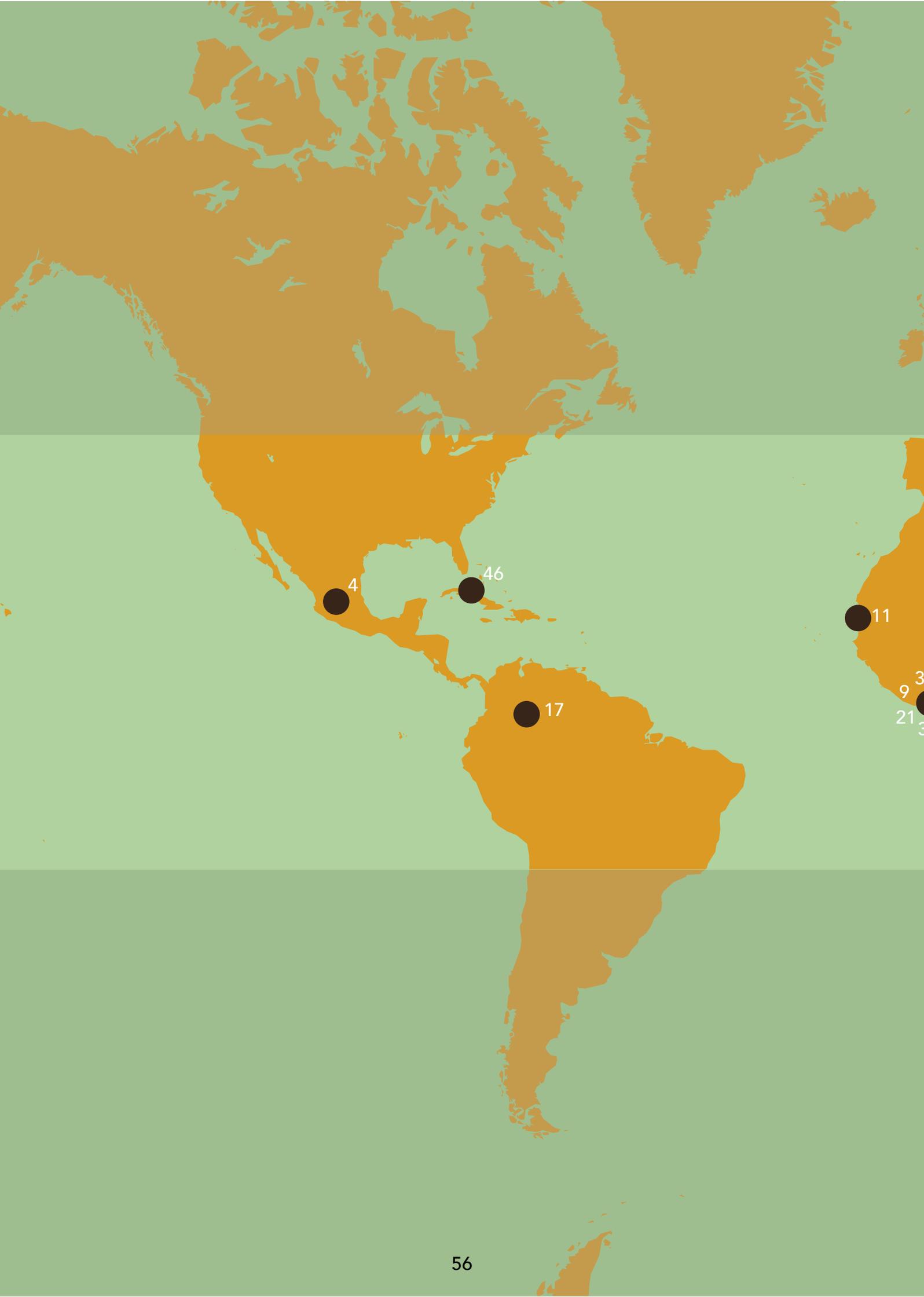


Preparing samples



Mycotoxin detection





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17

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3



# ONGOING PROJECTS



TITLE

PRINCIPAL INVESTIGATOR

MICRONUTRIENTS

- |   |  |  |
|---|--|--|
| 1 | 2016 / Processing and preservation of Moringa oleifera leaves for combating micronutrient malnutrition in Tanzania                               | Oscar Kibazohi / University of Dar es Salaam, Department of Chemical and Mining Engineering, Dar es Salaam, Tanzania   |
| 2 | 2019 / Iodine content in salt produced in Mozambique and the producers' knowledge about salt-iodization health benefits                          | Sergio P. Chibute / Eduardo Mondlane University Medical School, Department of Biochemistry, Maputo, Mozambique   |
| 3 | 2020 / Effect of composite foods powder intake on nutritional anaemia and growth status of young Ghanaian children                               | Egbi Godfred / University of Ghana, Noguchi Memorial Institute for Medical Research (NMIMR), College of Health Sciences, Legon, Ghana  |
| 4 | 2021 / Vitamin-A bioefficacy of high-provitamin-A carotenoid maize in Mexican schoolchildren   | Verónica López Teros / Universidad de Sonora, Hermosillo Sonora, México  |
| 5 | 2022 / Improvement of iron and zinc bioavailability in complementary food of children 6-23 months in South Kivu (DR Congo)                       | Marie Amelie Nabuholo / Université Cheikh Anta Diop, Laboratoire de Recherche en Nutrition et Alimentation Humaine (LARNAH), Département de Biologie Animale, Faculté des Sciences et Techniques, Dakar, Sénégal |
| 6 | 2022 / Impact of the consumption of spirulina on the vitamin-A status of mother-newborn couples: Chadian approach to the traditional food "Dihé" | Imar Djibrine Soudy / Biotechnopole Laboratory of INSTA/IRED, National Higher Institute of Sciences and Techniques of Abéché (INSTA-Chad), Njamena, Chad   |
| 7 | 2022 / Empowering Weekly Iron-Folic Acid (WIFA) supplementation program for adolescent schoolgirls in high-stunting areas                        | Ali Khomsan / IPB University, Department of Community Nutrition, Bogor, Indonesia  |
| 8 | 2023 / Efficacy of zinc-biofortified rice for preventing zinc deficiency in Bangladesh: A randomized control trial                               | Faruk Ahmed / Griffith University, Public Health, School of Medicine and Dentistry, Queensland, Australia  |
| 9 | 2023 / Pearl millet beverage powder enriched with baobab pulp to improve iron and anaemia status of adolescent girls in Ghana                    | Ambrose Atozona / Kwame Nkrumah University of Science and Technology, Department of Biochemistry and Biotechnology, Kumasi, Ghana  |

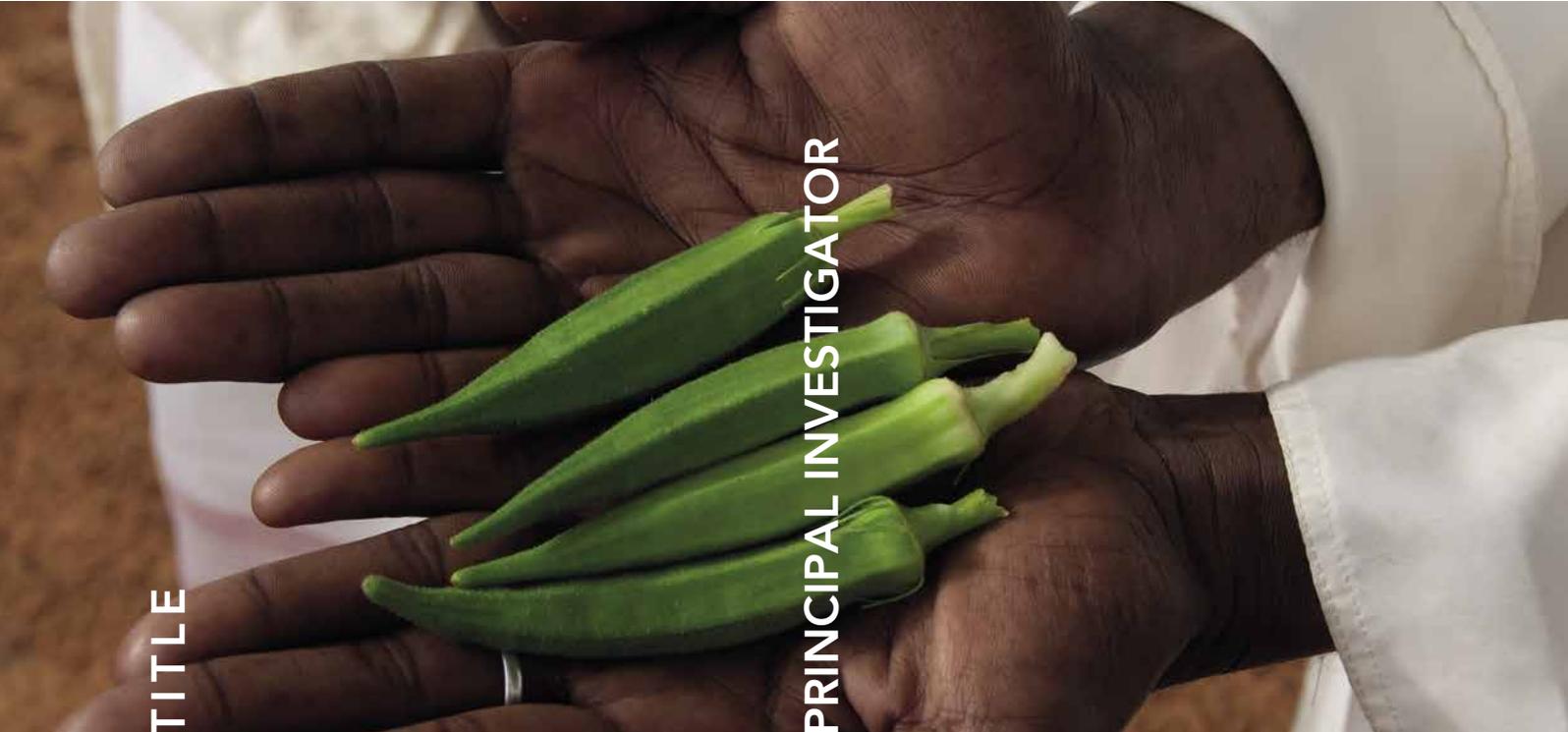
## INFANT AND CHILD NUTRITION

- |    |  |  |
|----|--|--|
| 10 | 2017 / Designing improved complementary feeding for infant and young children from locally available foods in rural western Ethiopia   | Fekadu Gemedo Habtamu / Wollega University, Food Science, Nekemte, Ethiopia  |
| 11 | 2018 / Development of complementary foods based on local products to improve iron status of school-age children in Senegal (NFR4D)   | Guillaume Antoine Baloucoune (initially awarded to Moussa Ndong) / USSEIN University of Sine Saloum El Hadj Ibrahima Niassé, Bureau de Liaison, Dakar, Senegal |
| 12 | 2019 / Does early initiation of homemade yogurt supplementation prevent stunting?: A pilot randomized controlled trial   | Kaniz Khatun E. Jannat / icddr, b, Infectious Disease Division, Environmental Intervention Unit, Dhaka, Bangladesh   |
| 13 | 2019 / Factors other than food supply that affect children's nutrition in Mongolia   | Sharavkhorol Erdenebileg / National University of Mongolia, The Mongolian University of Life Sciences, Ulaanbaatar, Mongolia                                   |
| 14 | 2019 / Peer groups to improve infant and young child feeding in post-emergency settlements in Uganda   | Joel J. Komakech / Oklahoma State University, University of Agriculture, Stillwater, Oklahoma, USA   |
| 15 | 2020 / Positive deviance in linear growth of children aged 6-23 months in Rwanda   | Jean de Dieu Habimana / University of Rwanda, Department of Human Nutrition, Remera Campus, Kigali, Rwanda   |
| 16 | 2020 / Effect of nutrition education of village doctors on health status of children   | Li Lei / Xiamen University, Public Health School, Xiamen, PR China   |
| 17 | 2021 / Feeding patterns and growth during the first year of life in a cohort of preterm infants with Extra-uterine Growth Restriction (EUGR) at hospital discharge followed in two Kangaroo Mother Care (KMC) programs in Bogotá, Colombia | Nathalie Charpak / Kangaroo Foundation, Bogotá, Colombia   |
| 18 | 2022 / Impact of a bean-based soup flour containing vegetables and sweet potato on children in Rwanda  | Marie-Rose Kambabazi / University of Rwanda, Department of Food Science and Technology, Musanze, Rwanda  |

TITLE

PRINCIPAL INVESTIGATOR





TITLE

PRINCIPAL INVESTIGATOR

INFANT AND CHILD NUTRITION

MATERNAL NUTRITION

19 2022 / Formulation of nutrient-rich recipes for complementary feeding of infants and young children in Douala, Cameroon

Marie Modestine Kana Sop / University of Douala, Department of Biochemistry, Faculty of Science, Douala, Cameroon

20 2023 / Efficacy of developed pigeon-pea-based porridge on nutritional status of children aged 12-24 months in rural areas of Tanzania

Zahra Majili / Sokoine University of Agriculture, Department of Human Nutrition and Consumer Sciences, Morogoro, Tanzania

21 2017 / Underlying causes of poor dietary intake, nutritional status and birth outcomes in pregnant adolescents and adults (uninvited resubmission)

Reginald Adjetey Annan / College of Science KNUST, Department of Biochemistry and Biotechnology, Kumasi, Ghana

22 2020 / Folate and vitamin B12 assessment among women of reproductive age in Eritrea: A population-based study 2020

Kidane Amanuel / Xi'an Jiaotong University, Department of Epidemiology and Biostatistics, Xi'an, Shaanxi, PR China

23 2020 / An urban picture of overweight, gestational weight gain and pregnancy outcomes among slum and non-slum dwellers in Pune, India

Deshpande Swapna / Hirabai Cowasji Jehangir Medical Research Institute, Pune, India

24 2022 / Effects of maternal preconception nutrition on offspring body composition and cognition in adolescence

Nguyen Phuong Hong / Thai Nguyen University of Pharmacy and Medicine, Luong Ngoc Quyen Road, Thai Nguyen, Vietnam

25 2023 / Comparing the effect of solo maternal autonomy versus joint decision making on Infant and young child feeding practice and nutritional status in Southern Ethiopia

Kassahun Fikadu Tessema / Arba Minch University, Arba Minch, Ethiopia

26 2023 / Effectiveness of culturally customized maternal nutrition education for health professionals in improving their counseling capacity in Ethiopia: Parallel cluster randomized controlled trial

Yeshalem Mulugeta Demilew / Bahir Dar University, Department of Nutrition and Dietetics, School of Public Health College of Medicine and Health Sciences, Bahir Dar, Ethiopia

BREASTFEEDING

27 2019 / Effect of a drama-based intervention program on breastfeeding self-efficacy and breastfeeding outcomes of rural pregnant women, Ibadan, Nigeria

Yetunde Ogundairo Omotola / University of Ibadan, Department of Human Nutrition, Faculty of Public Health, College of Medicine, Ibadan, Nigeria

28 2020 / Promotion of exclusive breast feeding and young child feeding practices through m-Health: A randomized controlled trial

Rozina Nuruddin / Aga Khan University, Department of Community Health Sciences, Karachi, Pakistan

29 2022 / Effect of breastfeeding education and support provided to male partners on optimal breastfeeding practice in Ethiopia: A cluster-randomized controlled trial

Abageda Mulatu / Wachemo University, Department of Midwifery, Hosenna, Ethiopia

30 2023 / Breastfeeding decision-making and practices among working mothers and role of external influences in urban Nigeria

Victoria Adebiji / University of South Carolina, Arnold School of Public Health, Columbia, South Carolina, United States of America

31 2023 / Effects of breastfeeding education interventions during pregnancy on breastfeeding practices in rural South Ethiopia

Belayneh Hamdela Jena / Wachemo University, Department of Epidemiology, College of Medicine and Health Sciences, Hossana, Ethiopia

NUTRITION EDUCATION

32 2020 / Long-term effects of acute malnutrition on physical function: A 5-year prospective cohort study in Ethiopia

Tsinuel Girma / Jimma University, Department of Human Nutrition, Jimma, Ethiopia

33 2020 / Enhancing food literacy among Sri Lankan adolescents: Effect of school gardens in promoting healthy diets, behaviours and knowledge

Renuka Silva / Wayamba University of Sri Lanka, Department of Applied Nutrition, Makandura, Gonawila, Sri Lanka

34 2021 / Evidence-based nutrition intervention development to improve dietary habits of adolescents attending school in Vientiane Province, Lao PDR

Thidatheb Kounnavong / Nagasaki University (NU-TMGH), School of Tropical Medicine and Global Health, Nagasaki, Japan

TITLE

PRINCIPAL INVESTIGATOR





TITLE

PRINCIPAL INVESTIGATOR

NUTRITION  
EDUCATION

- |    |  |  |
|----|--|--|
| 35 | 2022 / Developing a nutrition educational program for burn survivors in Ghana: A pilot study                             | Jonathan Bayuo / Presbyterian University College, Agogo, Asante-Akyem, Ghana   |
| 36 | 2022 / Implementing a nutrition training package for rural women farmers in Tanzania                                     | Mbwana Hadijah Ally / Sokoine University of Agriculture (SUA), Department of Human Nutrition and Consumer Sciences, Morogoro, Tanzania       |
| 37 | 2022 / Improving knowledge of prevention of non-communicable diseases among children in Morogoro, Tanzania               | Safiness-Simon Msollo / Sokoine University of Agriculture, Department of Food Technology, Nutrition and Consumer Science, Morogoro, Tanzania |
| 38 | 2023 / Empowering preschool teachers to integrate nutrition education in their routine teaching to advance child health  | Kabahenda Margaret / Makerere University, Food Science and Technology, Kampala, Uganda   |
| 39 | 2023 / Nutrition education intervention targeted at some risk factors of NCDs among school-age children in Greater Accra | Jane Appiaduah Odei / University of Ghana, Department of Nutrition and Food Science, Legon, Accra, Ghana                                     |

FOOD SYSTEM

- |    |   |  |
|----|---|--|
| 40 | 2020 / A methodological framework to transform monoculture to complex rice system landscape in East Java, Indonesia | Uma Khumairoh / Brawijaya University, Malang, Indonesia  |
| 41 | 2023 / Valorization of genetic resources of cocoyam in Benin  | Aboudou Hack Arouna / National University of Agriculture, Laboratory of Plant, Horticultural and Forest Sciences, Ketou, Benin |
| 42 | 2023 / From conventional agricultural system to agro-biodiversity: Influence on food security and nutrition         | Cassamo Mahomed Ismail / Mozambique Agricultural Research Institute, Centro Zonal Noroeste, Cidade de Lichinga, Mozambique     |

- 43 2008 / Causes and control of food insecurity: A pilot model in the northwest of Iran Saeed Dastgiri / Tabriz University of Medical Sciences, Faculty of Medicine, Tabriz, Iran
- 44 2014 / A cohort analysis of the sustainability of food insecurity control programs in the northwest of Iran Saeed Dastgiri / Tabriz University of Medical Sciences, Faculty of Medicine, Tabriz, Iran
- 45 2017 / Consumer attitude and perception on consumption of edible insects in western Kenya Fanuel Kawaka / Technical University of Mombasa, Department of Pure and Applied Science, Mombasa, Kenya
- 46 2017 / In search of an EEG neural fingerprint of early malnutrition: A 50-year longitudinal study Pedro Antonio Valdes-Sosa / Cuban Neuroscience Center, Havana, Cuba
- 47 2019 / The effects of psychosocial stimulation on the development, growth and treatment outcome of severely malnourished children age 6-59 months in southern Ethiopia: A cluster randomized control trial (EPSoSAMC Study) Tesfalem Teshome / St. Paul's Millenium Medical College, Human Nutrition, Ethiopia
- 48 2020 / Enhancing nutritional benefits and safety of maize to improve the health of Africans Archileo N. Kaaya / Makerere University, Department of Food Technology and Nutrition, Kampala, Uganda
- 49 2021 / Towards a decision support system to control mycotoxin contamination in raw milk production in Kolokani and Kita regions in Mali (MILKSAFE) Abderahim Ahmadou / Institut Polytechnique Rural de Formation et de Recherche Appliqué (IPR/IFRA), Bamako, Mali
- 50 2021 / Impact of nutritional biomarkers in the pathogenesis of Buruli ulcer disease Aloysius Loglo / Kwame Nkrumah University of Science and Technology, Kumasi Centre for Collaborative Research in Tropical Medicine (KCCR), Kumasi, Ghana
- 51 2022 / Growth and development outcomes in severe acute malnutrition (SAM) children discharged from nutrition rehabilitation centers (NRC): A community-based follow-up study Kumar Rohitash / King George's Medical University, Department of Community Medicine and Public Health, Lucknow, Uttar Pradesh, India
- 52 2022 / Effect of double-duty interventions on the double burden of malnutrition among children under five years in Debre Berhan City, Central Ethiopia: A cluster randomized controlled trial Lemma Getacher / Debre Berhan University (DBU), Asrat Woldeyes Health Science Campus, Debre Berhan, Ethiopia
- 53 2022 / Safety aspects of edible grasshoppers consumed in Benin: Case study of malanville Sika Jeanne Gwladys Gnanvi / University of Abomey-Calavi (UAC), Faculty of Agronomic Sciences (FSA), Laboratory of Valorization and Quality Management of Bio-Ingredients (LABIO), Cotonou / Abomey-Calavi, Benin
- 54 2023 / Validation of ages and stages-III for assessment of cognitive, motor, and language skills of children in Ethiopia Hailu Hailemariam Reda / Hawassa Univesity, College of Agriculture, School of Nutrition Food Science and Technology, Hawassa, Ethiopia

## PUBLICATIONS

1. Cam Duong, Melissa F. Young, Phuong Hong Nguyen, Lan Tran, Shivani Patel, Usha Ramakrishnan. Temporal Dietary Diversity Patterns Are Associated with Linear Growth but Not Ponderal Growth in Young Children in Rural Vietnam. *J Nutr* 2023; 153:3083-3091 (doi.org/10.1016/j.tjnut.2023.06.030)
2. Christine N. Walters, Hasina Rakotomanana, Joel J. Komakech, Margaret Kabahenda, Jillian M. Joyce, Deana A. Hildebrand, Lucia Ciciolla & Barbara J. Stoecker. Breastfeeding among South Sudanese refugees in protracted settlements in Adjumani district, Uganda: facilitators and barriers. *Int Breastfeed J* 2023;18:18-30 (https://doi.org/10.1186/s13006-023-00549-1)
3. F. A. Razzaq, A. Calzada-Reyes, Q. Tang, Y. Guo, A. G. Rabinowitz, J. Bosch-Bayard, L. Galan-Garcia, T. Virues-Alba, C. Suarez-Murias, I. Miranda, U. Riaz, V. B. Lagomasino, C. Bryce, S. G. Anderson, J. R. Galler, M. L. Bringas-Vega and P. A. Valdes-Sosa. Spectral quantitative and semi-quantitative EEG provide complementary information on the life-long effects of early childhood malnutrition on cognitive decline. *Front Neurosci* 2023;17: 1149102 (doi: 10.3389/fnins.2023.1149102)
4. Joel J. Komakech, Sam R. Emerson, Ki L. Cole, Christine N. Walters, Hasina Rakotomanana, Margaret K. Kabahenda, Deana A. Hildebrand, Barbara J. Stoecker. A Peer-Led Integrated Nutrition Education Intervention through Care Groups Improved Complementary Feeding of Infants in Post-Emergency Settlements in the West-Nile Region in Uganda: A Cluster-Randomized Trial. *Curr Dev Nutr* 2023;7: 100042 (doi: 10.1016/j.cdnut.2023.100042)
5. Jonathan Bayuo, Joyce Pwara, Jephtah Davids, Anita Eseanam Agbeko, Pius Agbenorku and Paa Ekow Hoyte-Williams. Nutrition education programs for burn survivors: A scoping review. *Nutr Health* 2023;10: 1–7 (doi: 10.1177/02601060231203282)
6. Jordan José Seir, Mora Camilo José, Renault Pierre, Guerrero Carlos Arturo. Mouse intestinal villi as a model system for studies of norovirus infection. *Acta Virol* 2023;67: 24-41 (doi: 10.4149/av\_2023\_103)
7. Kaniz Jannat, Kingsley Emwinyore Agho, Sarker Masud Parvez, Mahbubur Rahman, Russell Thomson, Mohammed Badrul Amin and Dafna Merom. The Effects of Yogurt Supplementation and Nutritional Education on Malnourished Infants: A Pilot RCT in Dhaka's Slums. *Nutrients* 2023;15: 2986 (doi.org/10.3390/nu15132986)
8. Lan Mai Tran, Phuong Hong Nguyen, Melissa F. Young, Usha Ramakrishnan and Harold Alderman. Home environment and nutritional status mitigate the wealth gap in child development: a longitudinal study in Vietnam. *BMC Public Health* 2023;23: 286 (doi.org/10.1186/s12889-023-15156-2)
9. Melissa F Young, Phuong Nguyen, Lan Mai Tran, Long Quynh Khuong, Reynaldo Martorell, Usha Ramakrishnan. Long-Term Association Between Maternal Preconception Hemoglobin Concentration, Anemia, and Child Health and Development in Vietnam. *J Nutr* 2023;153: 1597-1606 (doi: 10.1016/j.tjnut.2023.03.015)
10. Melissa F. Young, Phuong Hong Nguyen, Lan Mai Tran, Long Quynh Khuong, Sara Hendrix, Reynaldo Martorell and Usha Ramakrishnan. Maternal preconception BMI and gestational weight gain are associated with weight retention and maternal and child body fat at 6–7years postpartum in the PRECONCEPT cohort. *Front Nutr* 2023; 10:1114815 (doi 10.3389/fnut.2023.1114815)
11. Melissa F. Young, Phuong Nguyen, Lan Mai Tran, Long Quynh Khuong, Sonia Tandon, Reynaldo Martorell, Usha Ramakrishnan. Maternal hemoglobin concentrations across pregnancy and child health and development from birth through 6–7 years. *Front Nutr* 2023; 10: 1114101 (doi 10.3389/fnut.2023.1114101)
12. Ogundairo Omotola Yetunde, Adepoju Oladejo Thomas and Olumide Olufunmilola Adesola. Use of Drama for Improving Breastfeeding Initiation, Exclusive Breastfeeding and Breastfeeding Self-efficacy among Rural Pregnant Women from Selected Communities in Two Local Government Areas (LGAs) in Ibadan, Nigeria. *medRxiv* 2023 (doi:10.1101/2023.08.03.23293594)

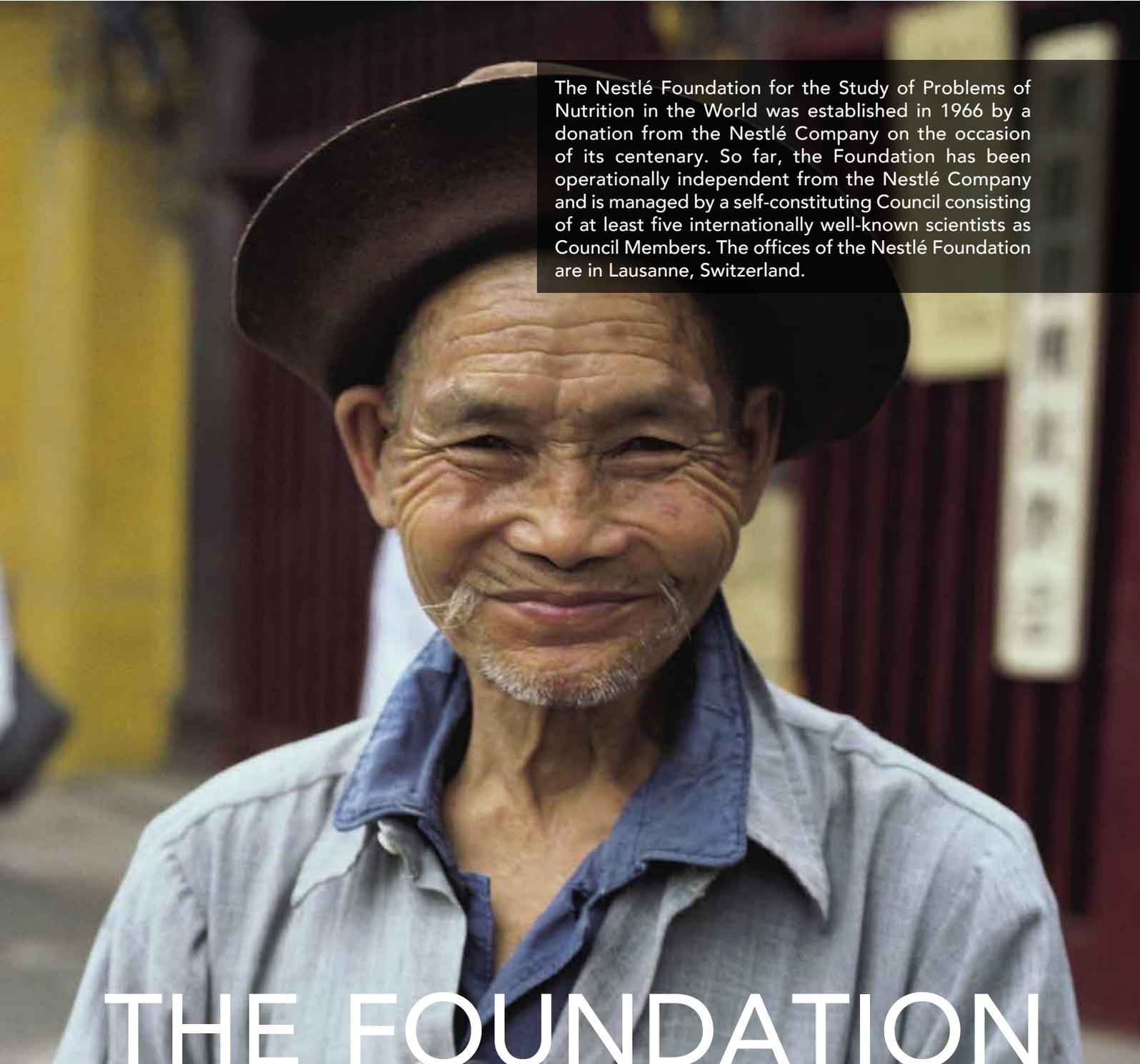
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14. Aloysius Loglo, Wilfred Aniagyei, Monika Mira Vivekanandan, Abigail Agbanyo, Evans Adu Asamoah, Richard Odame Phillips, Reginald Annan, Barbara Engel and Rachel E Simmonds. The role of nutrition in the pathogenesis of neglected tropical diseases: systematic review and meta-analysis. *Access Microbiology* 2024; preprint doi.org/10.1099/acmi.0.000800.v1
15. Joel J. Komakech, Sam R. Emerson, Ki L. Cole, Christine N. Walters, Hasina Rakotomanana, Margaret K. Kabahenda, Deana A. Hildebrand, Barbara J. Stoecker. Care groups in an integrated nutrition education intervention improved infant growth among South Sudanese refugees in Uganda's West Nile post-emergency settlements: A cluster randomized trial. *PLoS ONE* 2024;19:e0300334 (doi.org/10.1371/journal.pone.0300334)
16. Kassandra Roger, Phetsamone Vannasing, Julie Tremblay, Maria L. Bringas Vega, Cyralene P. Bryce, Arielle Rabinowitz, Pedro Antonio Valdes-Sosa, Janina R. Galler and Anne Gallagher. Early childhood malnutrition impairs adult resting brain function using near-infrared spectroscopy. *Front Hum Neurosci* 2023;17:1287488 (doi:10.3389/fnhum.2023.1287488)
17. Lan Mai Tran, Phuong H. Nguyen, Melissa F. Young, Reynaldo Martorell, Usha Ramakrishnan. The relationships between optimal infant feeding practices and child development and attained height at age 2 years and 6–7 years. *Matern Child Nutrition* 2024:e13631 (doi.org/10.1111/mcn.13631)
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The publications are available free of charge upon request.





ARIZONA  
CAFE &  
AGENCY



The Nestlé Foundation for the Study of Problems of Nutrition in the World was established in 1966 by a donation from the Nestlé Company on the occasion of its centenary. So far, the Foundation has been operationally independent from the Nestlé Company and is managed by a self-constituting Council consisting of at least five internationally well-known scientists as Council Members. The offices of the Nestlé Foundation are in Lausanne, Switzerland.

# THE FOUNDATION

## GUIDELINES FOR GRANT APPLICATIONS TO THE NESTLÉ FOUNDATION

### PURPOSE

The Nestlé Foundation initiates and supports research in human nutrition with public-health relevance in low-income and lower-middle-income countries according to the World Bank classification (see <http://www.worldbank.org>). The results of the research projects should ideally provide a basis for implementation and action which will lead to sustainable effects in the studied populations as generally applicable to the population at large. They should also enable

institution strengthening and capacity building in a sustainable manner in the host country, and further cooperation and collaboration between institutions in developed and developing countries.

The Foundation expects research proposals to be primarily the initiative of local researchers from the developing countries. However, the Foundation will be inclined to consider favourably those applications made jointly by scientists from developed countries

with those from developing countries provided it is clear that the initiative will result in capacity building and human-resource development in the latter and that the bulk of the budget is spent in the developing country.

## CURRENT POLICY

Sustainable improvement in human nutrition is one of the major issues in the portfolio of the Foundation. During more than 50 years, the Foundation has supported basic and applied research in nutrition in over 50 developing countries. In view of the past activities of the Foundation as well as the world's situation at the turn of the millennium, it was recognized that the public-health relevance of the supported research as well as aspects of sustainability, capacity building, and educational issues should have a higher priority. Thus, preference priority is given to projects which lead to sustainable developments with strong elements of capacity building, with a plan to implement the results of the research immediately and sustainably. Highly sophisticated nutrition research of mainly academic interest without public-health relevance has lower priority for support, as do solely laboratory-based studies or animal experimentation.

## RESEARCH TOPICS

At present the Foundation's work is primarily concerned with human nutrition research issues dealing with:

- (1) maternal and child nutrition, including breastfeeding and complementary feeding
- (2) macro- and micronutrient deficiencies and imbalances
- (3) interactions between infection and nutrition
- (4) nutrition education and health promotion.

The precise priorities and goals of the Foundation are modified from time to time to meet emerging public-health and nutritional needs in the developing world.

Studies in other areas of human nutrition research might also be considered, as long as they address problems of malnutrition in eligible countries (see above). Other areas of research (e.g., obesity, non-communicable diseases) may be considered for support if the applicants can offer specific and convincing evidence and justification for the choice of the research topic, especially when an innovative

approach is suggested. The Foundation prefers a food-based approach suggesting local sustainable solutions which are affordable for the whole target population. Projects with a questionable sustainability or projects with commercial, product-related solutions are not supported.

Funded projects are usually of one- to three-year duration. Projects with a high potential for effective and sustainable improvement of the nutritional status as well as a high capacity-building component will be funded preferentially. The budget of the projects must be appropriate and reasonable and has to be justified in detail.

One of the Foundation's main aims is the transfer of scientific and technological knowledge to target countries. In cases where Foundation-sponsored research projects are realized in collaboration with scientists at universities and research institutes in high-income countries, at least 75% of the budget has to be earmarked for use within the low-income country.

Research grant applications from high-income countries are only considered under rare and exceptional conditions.

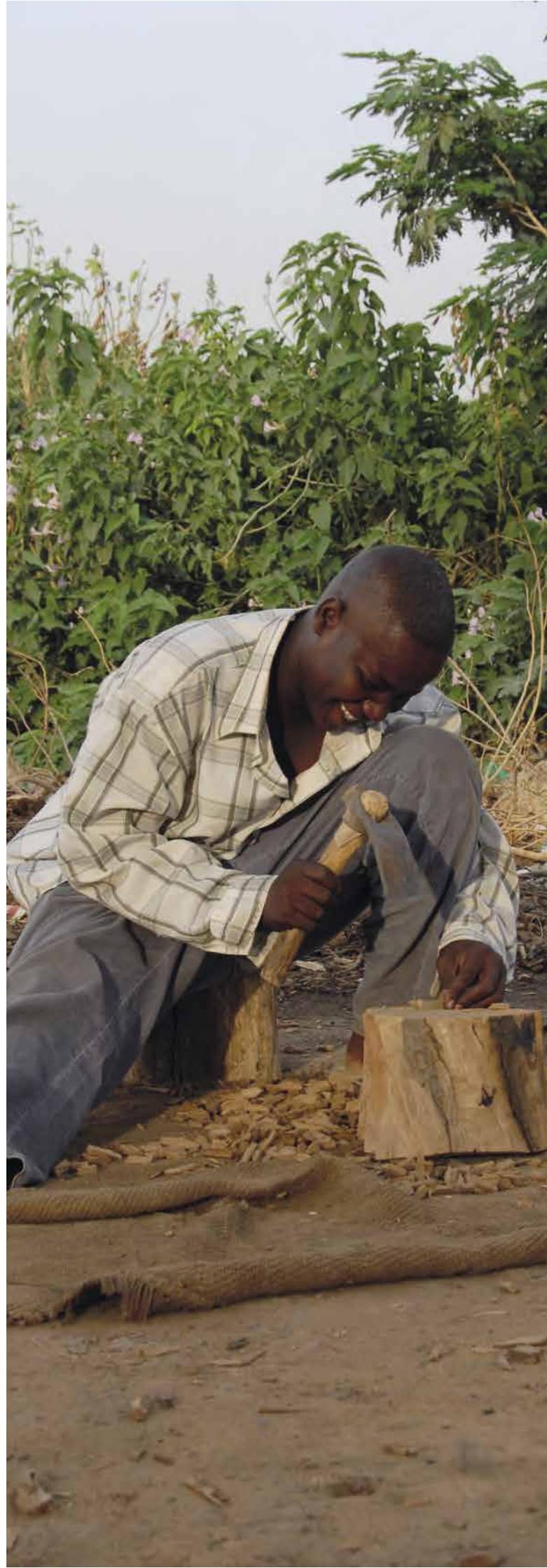
The Foundation does not normally fund:

- (1) projects with low public-health relevance
- (2) projects with doubtful sustainability
- (3) projects lacking transfer of scientific, technical, and educational knowledge, i.e. lacking a capacity-building component
- (4) nutrition surveys or surveillance studies (except when needed as a basis for a specific intervention study)
- (5) research on food policy, food production, and food technology, except when linked to an intervention with high potential for sustainable improvement of the nutritional status
- (6) non-food-based approaches (commercial drug- or product-dependent interventions lacking sustainability)
- (7) in vitro and/or animal experiments

## ELIGIBLE INSTITUTIONS

Eligible institutions are departments or institutes from universities, hospitals, and other institutions of higher education in low- or lower-middle-income countries. Joint applications from more than one institution (especially South-South) are welcomed. Joint applications from more than one institution involving a North-South collaboration may also be considered. For project applications demonstrating North-South collaboration, it is important that the following criteria are fulfilled: (i) the Principal Investigator is from the South and the proposal has relevance to nutritional problems of the South; (ii) the majority of the budget is earmarked for the South; and (iii) demonstration upon completion of the project of institution- and capacity building in a sustainable manner in the South.

The capacity-building component represents a core issue for all applications to the Foundation. This means that every application needs to demonstrate a training and human-resource and capacity-building component for the developing world. Ideally graduate students or young investigators should play a key role and, where possible, be designated as the Principal Investigator (PI), i.e. be the primary grant applicant, or Co-PI. Established researchers can nevertheless apply but need to clearly indicate the capacity-building component and the designated beneficiaries. Established investigators alone are not usually eligible to apply for a grant, except when they address innovative and exceptionally well-justified research questions in developing countries. Such applications need to clearly state the capacity- and human-resource-building components in the host country as well as the long-term sustainability of research in the host institution. Applications from individuals who are non-affiliated researchers and not attached to research or academic institutions can be considered only in very special cases.



## TYPES OF AWARDS

The Nestlé Foundation offers different award and grant categories, some of them using a modular approach; for example, the Pilot Grant Program represents the starting grant module for a later Full Grant Research application. The eligibility criteria as well as the research objectives and topics have to be fulfilled no matter what the award category (for further details see [www.nestlefoundation.org](http://www.nestlefoundation.org)):

<b>Grant type</b>	<b>Description</b>	<b>Budget (in USD)</b>
Training Grant (TG)	The Training Grant (TG) Program supports a small research project such as a MSc or PhD thesis project or another training endeavour.	<b>up to 20,000 in total</b>
Pilot Grant (PG)	The Pilot Grant (PG) Program provides support for pilot research that has a high potential to lead to a subsequent full research project grant. Usually the Foundation does not support nutritional survey research, but often to be able to identify areas of problems for potential intervention one has to collect baseline data. If a pilot study (pre-study or baseline study) will create the needed data for a larger research project, the PG program may assist this. The pilot study and PG usually represent the starting point for a later full research grant application (i.e., a SG or LG) to the Foundation.	<b>up to 20,000 in total</b>
Small Research Grant (SG)	The Small Research Grant (SG) provides support for a small research study. This may represent a continuation of a TG or a PG.	<b>up to 50,000 in total</b>
Large Research Grant (LG)	Full grant application of a complete research proposal according to the guidelines.	<b>up to 100,000 per year to a maximum of 300,000 for 3 years</b>
Re-Entry Grants	To encourage post-graduate students to return to their own countries and to aid them in establishing their careers, the Foundation will support a research programme for eligible candidates. The host institution will need to guarantee a post for the returnee and ensure career development within the host institution. Contribution of support to the eligible candidate from the host institution is essential, while support and collaboration from the overseas institution where the candidate trained is helpful.	<b>up to 50,000 in total</b>

## Institutional Support

Institutional support involves the support of research or educational projects in specific institutions in low- or lower-middle-income countries which contribute to a focused development of capacity and know-how and human-resource development in the corresponding institution.

## HOW TO APPLY

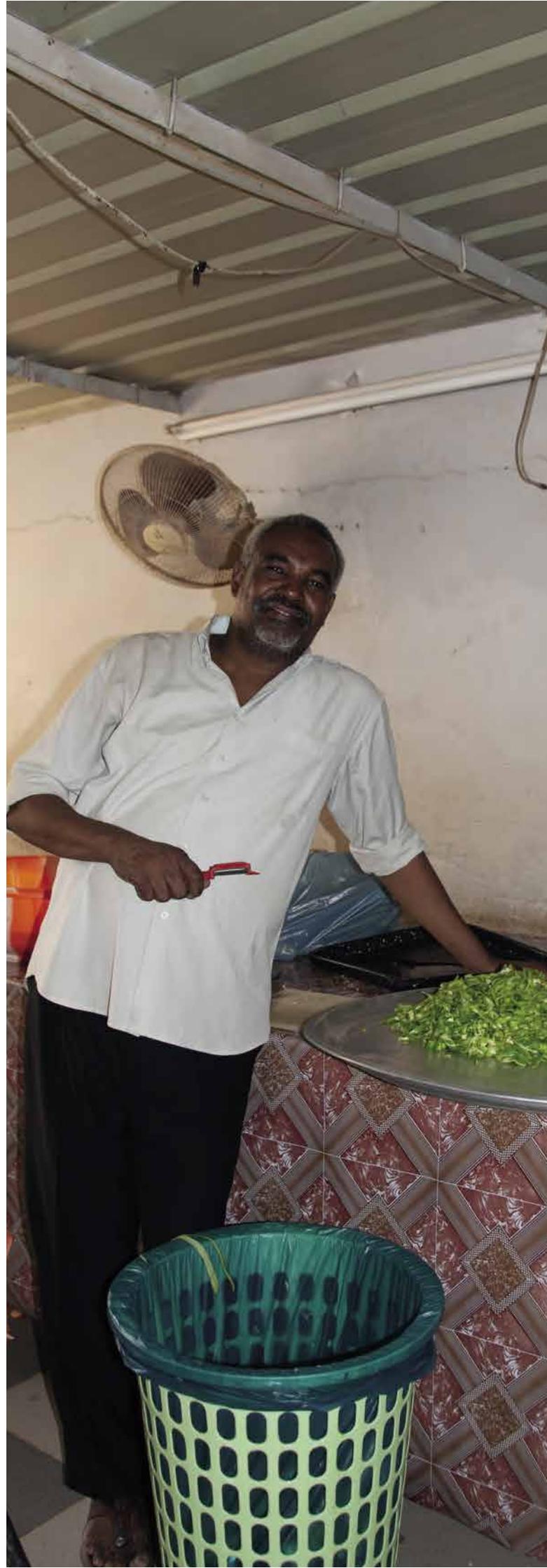
Interested scientists should first submit a letter of intent in which they describe very briefly the kind of project they would like to undertake, including an estimated budget. Instructions for the letter of intent are available on the Foundation website at [www.nestlefoundation.org](http://www.nestlefoundation.org). For submission of a letter of intent, only the downloadable form on our website should be used. If the suggested project is compatible with the Foundation's current funding policy, applicants will receive an invitation to submit a full grant proposal. The guidelines for the submission of a full grant proposal are also available on our website. Other formats will not be accepted, neither for the letter of intent nor for the full grant applications.

In the letter of intent and in the grant application, detailed, evidence-based information about the public-health relevance of the project as well as its immediate impact and sustainability have to be described. This part of the application is as important as the scientific section of the application.

Research grant applications are evaluated twice a year by the Foundation's Council, a group of independent international scientists. The funding of projects is primarily based on the scientific quality, public-health relevance in the short- and long-term, sustainability, capacity-building component and, last but not least, budget considerations. All grants will be paid in Swiss Francs (CHF) only.

Applications are accepted throughout the year, and the Foundation encourages applicants to submit their proposals early to allow sufficient time for internal as well as external reviews. All submissions—upon invitation after the approval of a letter of intent—should be made electronically by e-mail. Final deadlines for submission are January 10 and May 10 for the Spring and Fall Council Meetings, respectively.

**For more information consult**  
[www.nestlefoundation.org](http://www.nestlefoundation.org)



The Council of the Foundation consists of at least five Council Members and Advisors. All Council Members and Advisors are internationally well-known scientists with specific expertise in different fields of nutrition. The Council is self-constituting and operates independently. The Foundation is directed jointly by the Director and the President of the Foundation.

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From left to right: Dominique Darmaun, Petra S. Hueppi, Ann Prentice,  
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## PHOTO:

**Page 50/52/54:** Dr. Abderahim Amadou (Institut Polytechnique Rural de Formation et de Recherche Appliquée (IPR/IFRA), Main Campus, Katibougou, Koulikoro, Mali), **Page 55:** Dr. Adougnina Kassogue (IPR/IFRA), Main Campus, Katibougou, Koulikoro, Mali

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Cover: An old man collecting seeds in the garden around the Hëytgah Meschiti in Kashgar (Xinjiang, PR China). This picture symbolically reflects - besides others - also seed sovereignty - a key factor to assure global seed diversity, food security and food sovereignty - photograph by Paolo M. Suter

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Throughout The Report 2023 all gender-specific terms are to be considered to refer to both the feminine and the masculine form – except when referring to a particular person. In addition the singular denotes the plural.

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