



# REPORT 2021

Nestlé Foundation

for the study of problems of nutrition in the world



**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

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**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

It is time to look back on our achievements in 2021, and we are proud to say that the Nestlé Foundation has supported nutrition research in many fields, including studying new ways to improve the quality of food and decrease toxic components; shed light on the impact of nutrition on orphan tropical diseases; establish the relationship of the double burden of malnutrition in the developing world; evaluate consequences of early postnatal growth failure in babies born too soon (15 million every year and most of them in developing countries); focus on nutrition not only in the first 1,000 days but also in adolescence, when the brain finalizes its complex functional organization and when the organism prepares for reproduction; and finally address questions of local agroecology to insert forgotten and neglected crops into the local food supply to increase food security.

This is particularly important in the current moment, as many developing countries will face a food crisis due to the recent pandemic and now also to a disruption in the supply of crops as a result of the Ukraine-Russia war. With a third of world wheat supplies coming from Ukraine and Russia, hunger could increase across the world and will again strike those countries hardest that are already battling food insecurity due to poor economic, climate and financial conditions. As outlined in this report, on all continents a huge

potential for local food production can be found in many still untapped resources in the form of forgotten and/or underutilized crops. There are over 30,000 edible plants, yet humans get more than 60% of their energy needs from three crops only, namely wheat, rice and corn (mais).

Maybe the ongoing food shortage crisis has to be regarded as an ultimate call to revive specific crops which are not only very nutritious, but which also show growth characteristics compatible with climate-related changes and drought. Many of these plants are drought resistant and evidence suggests that introducing crop variety with these forgotten crops would not only diversify food patterns, but would also make local agriculture more productive during periods of drought, thus counteracting food insecurity.

It is Nestlé Foundation's firm goal to help diversify food chains and continue to provide opportunities for local scientists to prove their concepts of sustainable nutrition and food security.



Petra S. Hüppi  
President



One of the Foundation's main aims is the transfer of scientific and technological knowledge to low-income countries.

The Foundation advances nutritional science both by supporting nutrition research projects in established institutes and universities and by giving focused support to existing nutrition schools and educational programs. The promotion of local capacity for independent, implementable research is a central aspect of our activities.

To further fulfil the mandate of the Council and also encourage sustainable improvement in nutrition, a proactive, strategic area of activities was introduced in 2004: the enLINK Initiative. This encompasses a set of interrelated efforts:

# PROJECTS INITIATED BY THE FOUNDATION

## THE enLINK INITIATIVE

- **Promoting local capacity for nutrition research**
  - Anchoring of research capacity and innovation
  - Promoting local generation of research ideas
  - Promoting local ownership and empowerment
  - Discouraging purely donor- or sponsor-driven research
  - 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
- **Strengthening expertise and know-how**
  - Promoting access to information
  - The enLink library
  - Promoting local knowledge exchange and generation
  - Needs-based, targeted assistance
  - Network-system capacity building
  - Promoting and furthering of researchers' stamina
- **Nestlé Foundation Research for Development (NFR4D) program**



# THE enLINK INITIATIVE

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

(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



"Don't find fault.  
Find a remedy."  
Henry Ford

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

## DEVELOP THE DEVELOPERS

Everybody and anybody—from the United Nations, politicians, different governmental and non-governmental organizations, industry and all kind of businesses—speak in the context of low-income countries, especially in relation to Africa, about “development”, as in “we need to develop the continent”. In view of the exceptional cultural heritage with the many knowledge societies and kingdoms of this continent from Ethiopia to West Africa, such statements are rather surprising, but at the same time historically understandable<sup>1,2,3,4</sup>. The word “development” is today a kind of epistemic mantra by dominating organizations from the Northern Hemisphere and is used to justify any form of project or activity in low-income countries and elsewhere where specific modern and foreign thinking and culture should be established. The etymology of the word development<sup>5</sup> is not completely clear, but the modern-day use means “to unfold more fully, bring out the potential”, or in an intransitive meaning, “come gradually into existence or operation”<sup>5</sup>. In the modern economically and financially driven world the final aim of development is the expansion of markets and the creation of financial profit for the “developer” and—to make the activity socially acceptable—also (although to a much smaller degree) for the final recipients of the development<sup>6,7</sup>. In view of the etymology of the word it is rather inappropriate to suggest to develop the African continent given its long history and culture. As outlined by the Swiss professor Gilbert Rist from the University of Geneva, the word “development” is an epistemic buzzword<sup>8</sup>: “everybody may use it as he or she likes, to convey the idea that tomorrow things will be better”<sup>9</sup>. It is a normal trait of all human beings to want to be better tomorrow; however, everybody wants to decide based on his or her own

cultural beliefs and circumstances how to make his or her tomorrow better, rather than discuss how to define the term “better”. Everybody has his or her own ideas for improvement and does not want to be forced into a better tomorrow by culturally foreign and often inappropriate strategies. In this context a statement Melinda French-Gates’ mother made to her should be remembered: “make your own decisions, otherwise somebody else will decide for you”<sup>10</sup>. A very wise and important message—for all of us. Nobody likes to be determined or developed by others. The latter is actually a basic principle of the Nestlé Foundation: all our supported projects are investigator-initiated and investigator-owned. There are no donor- or sponsor-driven projects initiated or sponsored by the Foundation. The applicants know best what is needed for their advancement as well what is locally needed. This approach by the Council of the Foundation is most welcomed by the applicants and remains unique in the world of nutrition research. It reflects the Foundation’s respect for the applicants as equal partners and is in most instances also a recipe for sustainable improvement.

As we all know, many activities—mainly humanitarian and medical initiatives—which were performed under the umbrella of development have indeed led to a huge improvement in the areas of public health and basic medical care or education, and have resulted in millions of lives saved—think only of tuberculosis, malaria, diarrheal diseases, or HIV and many other disease conditions. Contrary to these medical success stories, the economic development activities with the aim of poverty reduction have often promoted an increasing inequality<sup>11</sup>, affecting most strata of the population and workforce, including the



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LIQUEUR PRINER

medical profession. The brain drain phenomenon due to the suboptimal local working and living conditions is very well known. We know the saying, attributed to many different sources: "Health is not everything, but everything is nothing without health". Accordingly medical infrastructure and personnel is crucial. Despite decades of apparently state-of-the-art development aid, the number of medical doctors per 10,000 inhabitants in many African countries (such as Chad, Central African Republic, or Niger) is well below 1 (as compared to 26 and 43 in the US and Switzerland, respectively)<sup>12</sup>. Look at the hospital bed density (per 10,000 population) for instance in Chad or Mali (4 and 1, respectively) as compared to 60 in France or 46 in Switzerland; the same inequality can be reported for the number of hospitals, nurses or also the number of primary schools, to mention just a few key parameters for "development".

These numbers from the medical sector are well known and have remained pretty stable or even gotten worse during the last decades for many geographic areas in Africa. A surprising trend, although we know that the additional cost due to the lack of physicians and medical care is associated with a rampant morbidity and mortality, which sums up in Africa to at least 16 billion USD annually<sup>13</sup>. A modern society counting and judging "development" mainly by monetary terms should really undertake a serious strategic review to avoid a further increase and transnationalization of these inequalities<sup>14</sup> and increasing worsening of the living conditions of millions of people.

Again, the Foundation invests in local human capacity-building to strengthen and improve local know-how, which will translate into lower morbidity and lower mortality and overall improved standards of living with reduced inequality. This is reflected in the supported research activities. In our enLINK library, which was originally designed for nutrition researchers only, we added during the last few years many freely accessible medical textbooks, since nutrition and medicine are tightly interlinked and cannot be separated—neither in prevention nor in treatment. As we know from selected users, the enLINK library is a welcome source of up-to-date information for nutrition researchers, nutritionists, and also medical doctors. A promising initiative, but every specialized library needs local readers, and these numbers remain low or decline (e.g. MDs) despite development aid. (For free registration to use the enLINK library see [www.enLINK.org](http://www.enLINK.org).)

In view of the high morbidity and mortality tolls in low-income countries associated with COVID-19 we read—not surprisingly—statements such as "global solidarity is needed to overcome this health emergency and transform this crisis into a development accelerator for the continent."<sup>15</sup>

This statement is theoretically very correct and it sounds rather familiar—again the authors use the word development, without defining it. Solidarity is certainly important, especially during a crisis, but not only during crisis. Solidarity in non-crisis circumstances is the basis for solidarity in crisis. We all heard the same words during and after the Ebola crisis a few years ago, or in the context of other health disasters such as meningitis or cholera outbreaks, and finally in the context of repeated severe famines, wars or climate-related catastrophes. The COVID-19 crisis would have been much smaller and most likely somehow controllable as in other places if earlier calls had been heard and implemented—if there had been solidarity in non-crisis times, if we had initiated solidarity-based activities and not "development aid". Maybe it is now high time to remember the etymology of the word "development" and bring our assistance into "full operation" "to unfold more fully" the local potential according to the local needs.

Climate and nutrition are strongly interlinked. We know that despite huge efforts, carbon dioxide emissions continue to rise and are today higher than 30 years ago<sup>16</sup> and it is a fact that globally the "wealthiest 10% were responsible for as much as half of the cumulative emissions since 1990 and the richest 1% for more than twice the emissions of the poorest 50%"<sup>16</sup>. These data clearly show who would need "development aid" to reduce emissions. Nevertheless, mantra-like climate-action plans have been formulated and targeted to specific groups—even targeted at those who are not necessarily responsible for the climate disaster. Again the crucial question is, why is there no downward bending of the emission curve?<sup>16</sup> The answer to this key question can be found in one of the most widely read (and must-read!) articles on climate in 2021 by Swedish authors working with Isak Stoddard from Uppsala University<sup>16</sup>. As expected, the authors identified many associated factors to explain the lack of climate improvement, such as climate governance, the fossil fuel industry or geopolitics and economics<sup>16</sup>. However, as the authors write, they also identified causes which we know from other areas: "a common thread that emerges [...] is the central role of power, manifest in many forms, from a dogmatic political-economic hegemony and influential vested interests to narrow techno-economic mindsets and ideologies of control"<sup>16</sup>. It is really time to change our rationale and approach to find global solidarity for health, socioeconomic equality and the other global threats for our future so that anybody and everybody can live a safe and happy life. It is time to go back to the existing evidence and remember the fact that "All things are subject to interpretation; whichever interpretation prevails at a given time is a function of power and not truth" (Nietzsche<sup>17</sup>). It seems that it is prime time to "develop" the developers.

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# THE enLINK LIBRARY

During 2021 the digital enLINK library remained a very welcome basic information source for many users in low-income countries, yet at the same time during the last reporting year the usage was lower than in periods before the COVID-19 pandemic. One might easily blame COVID-19 as the major culprit for the lower access rates to the enLINK library and other online digital educational sources (as outlined already in last year's report). Certainly the pandemic has a non-negligible effect on IT infrastructure availability and usage. Nevertheless, as we all know, COVID-19 is for many a welcome excuse in nearly all aspects of life and work. Obviously for any critical mind in certain contexts it is an unacceptable excuse: we know that 82% (!) of students in sub-Saharan Africa have no access to the internet<sup>1</sup>—independent of COVID-19. In numbers that means that 800,000 to 900,000 adult Africans have no access to the internet, and—to provide some perspective—for some in Africa one gigabyte of mobile data costs nearly 20% of their monthly income<sup>2,3</sup>. Many only have access to the internet through mobile devices since internet penetration is non-existent<sup>3</sup>.

Based on our inquiries the lower enLINK access rates are indeed due to lacking connectivity while not on a university campus. Not surprisingly the highest enLINK library access rates were from Ghana, a country with a rather good internet penetration rate and also in the lower range of pricing per gigabyte of mobile data<sup>3</sup>. Further, this country has an active group of nutrition researchers and promoters of nutrition research. Reading and keeping up with new developments is mainly assured by reading books

and journals—apparently this is more common in Ghana than in other African countries. A creative mind is rooted in reading.

It is interesting that the classic textbook *Modern Nutrition in Health and Disease* had the largest numbers of hits during the reporting period, showing the importance of this “bible-like” basic knowledge source, which should be read by any person active in the area of nutrition and food science. Further, during the reporting period two manuals of therapeutic nutrition showed the highest access rates, one of them addressing the nutritional therapy of diabetes. This increased usage of diabetes-related resources parallels the increasing rates of obesity as well as diabetes in Africa in recent decades and the ongoing tsunami of diabetic patients<sup>4,5</sup>. The globalization of metabolic diseases is a reflection of the globalization of modern food and modern lifestyles. Nevertheless, it is difficult to reconcile the uncontrolled promotion of diabetes (as well as NCD) risk factors, including a unhealthy diet with energy-dense processed food, while at the same time access to and availability of life-saving insulin (and anti-diabetic drugs) remain very poor in Africa<sup>6</sup>. Disease prevention slogans are repeated in a sermon-like manner, yet the major threats to population health are not directly addressed in a causal approach<sup>7</sup>. If internet accessibility and penetration rates were identical to the penetration rate of the “imported” consumable disease promoters there would be no digital gap. Maybe some of the readers might have an explanation for this apparently hardly disputed dangerous constellation.



**enLINK user statistics**  
(as of December 31, 2021):

- Over 500 registered users
- Registrations from over 50 countries
- Ghana was the top country in accessing the enLINK journals, followed by: Ethiopia, Benin, Kenya
- Top 3 countries accessing enLINK books: Ethiopia, Ghana, Tanzania
- Most frequently accessed journals
  1. Topics in Clinical Nutrition
  2. Clinical Nutrition Insight
  3. Journal of Pediatric Gastroenterology and Nutrition
- Most frequently accessed books:
  1. Modern Nutrition in Health and Disease
  2. Manual of Nutritional Therapeutics
  3. American Diabetes Association Guide to Nutrition Therapy for Diabetes

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

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# NEW RESEARCH PROJECTS

In 2021 the Council decided to fund 7 research projects:



MYCOTOXINS

ADOLESCENT NUTRITION

BURULI ULCER DISEASE

EXTRAUTERINE GROWTH RESTRICTION

COMPLEMENTARY FOOD

# NEW RESEARCH PROJECTS

AGRO-ECOLOGY

VITAMIN A

# MYCOTOXINS

**Towards a decision support system to control mycotoxin contamination in raw milk production in Kolokani and Kita regions, Mali - MILKSAFE**

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Bamako  
Mali

USD 38,500

Mycotoxins are toxic secondary metabolites produced by a variety of fungal species, such as *Fusarium* or *Aspergillus*, among others. Contamination of feed with mycotoxins can cause severe health problems in dairy cattle. Dairy cows with a high feed uptake and rapid ruminal flow are susceptible to gastroenteritis, reduced reproduction, reduced milk production and high impact on their health linked to contamination level. Lactating cows fed with aflatoxin-contaminated feed metabolize the toxin and transmit aflatoxin M1 into the milk, thus leading to a high exposure risk in humans. Maize and peanut silage are the main components of dairy feed in the study region (Mali), and therefore one of the main sources for mycotoxin uptake in dairy cows. This research aims to provide dairy farmers in Mali with a user-friendly prediction model, able to foresee mycotoxin contamination based on weather, cultivation, harvest and silage conditions. The prediction model will be constructed based on mycotoxin analyses of maize and peanut silages across Kita and Kolakani, and on our own research focusing on physical methods to prevent mycotoxin contamination. Fifty silages will be selected based upon geographical spread, cultivation technique and silage conditions. These silages will be sampled once during harvest and two to three times during feeding every month for one year, and analyzed for mycotoxins and fungal contamination. This research will be divided into three separate work packages, with the following topics: impact of harvest date and dry matter content on mycotoxin contamination; assessment of mycotoxin contamination in the milk; and applying a detoxification method in the silage based on biochar utilization. These results will help in constructing and validating the prediction model and will provide farmers with some technical solutions to solve the mycotoxin problem in dairy products.

# ADOLESCENT NUTRITION

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

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USD 20,000

In Lao PDR, significant proportions of adolescents are anemic (19.4%), stunted (11.8%), underweight (5.3%) and overweight (11.1%). Despite their nutritional needs, nutrition programs usually overlook this age group. A school-based pragmatic intervention will be elaborated to improve dietary habits in adolescents exploring the use of a food-based recommendations approach, grounded in detailed work to describe and understand current dietary habits and the local food environment in and around schools and the home. This study will comprise three parts: (1) analysis of existing dietary intake data in adolescents attending schools (N=405 7-day 24-hour recall data) using WHO Optifood linear programming to identify affordable, available and acceptable foods that can best meet daily nutrient requirements; (2) qualitative research to understand the food environment, food choices, and facilitators/barriers of healthy eating behaviors in adolescents; (3) generation of a school-based intervention strategy. The qualitative research will comprise photo voice, photo elicitation interviews, focus group discussions with students, key informant interviews, and direct observation. The qualitative data will be analyzed using thematic analysis to identify themes and map out connections and contexts with Geographic Information System (GIS) data. The strategy to be developed will focus on three themes based on social cognitive theory: (1) better food and diet, (2) adolescents as change drivers, (3) schools as a facilitative environment. The results will be implemented throughout all of Lao with the assistance of the MOH and Ministry of Education.

# BURULI ULCER DISEASE

Impact of nutritional biomarkers in the pathogenesis of Buruli ulcer disease

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USD 14,773

Buruli ulcer (BU) is a neglected tropical skin disease caused by *Mycobacterium ulcerans* reported in poor rural communities in some parts of Africa. Nutrition is known to play a role in the pathogenesis of infectious diseases like leprosy and tuberculosis, yet little is known regarding the diet of communities in Ghana where BU is endemic, nor about the level of risk malnutrition poses to disease predisposition, nor how good nutrition may help ameliorate progression in those with the disease. It is hypothesized that inadequate diet may play a role in susceptibility to BU disease, and/or severity of presentation, but this has not yet been investigated. The researchers previously undertook a preliminary survey of food consumption patterns and nutrient intake to determine the dietary status of 21 BU patients and 22 matched controls across three sites in Ghana. This showed that approximately 20% of both patients and controls were underweight, all participants had a low dietary diversity (DD) score, and none had an adequate intake of protein. When comparing patients to controls, overall mean DD (2.0 vs. 2.4 out of 14), as well as zinc, selenium, and vitamin B12 intake, was significantly lower in patients. In the current study it is planned to study BU from the perspective of the nutrition, infection, and immune response paradigm. The serum status for zinc, selenium, and vitamin B12, as well as those of the acute phase reaction markers C-reactive protein (CRP) and interleukin 1 $\beta$  (IL-1 $\beta$ ), in a larger group of 80 BU patients and 80 matched controls, will be assessed. It is hoped that this project will help to better understand the role of diet in the pathogenesis of BU.





## EXTRAUTERINE GROWTH RESTRICTION

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

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USD 68,288

The peak of fetal growth occurs during the last trimester of gestation, a period when premature babies are no longer in uterus and are subjected to multiple injuries, especially the quality of the neonatal care. In Colombia, a middle-income country, Kangaroo Mother Care (KMC) is nearly routine, and has enabled the reduction of neonatal mortality, but it is not always initiated at birth or in the Neonatal Care Unit (NCU), because many NCUs still have restricted entry to mothers. In these units, breastfeeding failure, prolonged fasting, slow enteral advancement and infections are common, resulting in EUGR at discharge when hospital stay has been prolonged. A quality monitoring carried out in two ambulatory Kangaroo Mother Care Programs (KMCP) working with the Kangaroo Foundation in Bogotá, Colombia, during the last 10 years, and receiving infants from more than 20 NCUs in the city, showed that 39% of the 6500 premature infants appropriate for gestational age (PTAGA), <35 weeks at birth, with at least two weeks of hospital stay, presented a weight below 2 standard deviations (SD) at entry in the KMCP; 14% still have their weight under 2 SD when reaching 40 weeks and 23% at 12 months of corrected age. There is evidence showing that nutritional status at this period is directly related with future neuro-motor, sensorial and psychomotor development. A prospective cohort study of PTAGA will be studied to identify risk factors for EUGR and to recognize the growth pattern of these babies during their first year of life and the variables associated with the growth pattern emphasizing the prevention of potential harm and nutrition.

## COMPLEMENTARY FOOD

**Study of effectiveness of a complementary food based on the mixture of locally produced food in the malnutrition prevention of children from 6 to 23 months old**

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USD 19,950

Inadequate complementary feeding (CF) is one of the main causes of malnutrition worldwide. The most crucial period to meet required nutritional needs for a child are the first thousand days of life completed during the CF. Incidence of malnutrition increases abruptly for the period 6-18 months old. It becomes difficult to make up the deficits acquired at this age later in childhood. It was shown that adequate CF ranked among the high-impact effective interventions for child survival when based on local food, and can prevent 6-20% of child mortality in developing countries. However, there is no evidence on the effectiveness of local additional food recipes nor for MASO31 in the Congo. MASO31 is the local maize-soy blend based in 3-1 proportions. MASO30 is the local maize-based recipe without soy commonly consumed as CF. In the Kapolowe health zone a double blind RCT will be undertaken to assess the effectiveness of MASO31 to increase z-score (WHZ, WAZ, HAZ) in preventing malnutrition. Two hundred twenty study children will be randomized to receive daily doses of 150g (7-11 months old) or 200g (12-20 months old) of MASO31 or MASO30 porridge. Paired t-test will compare matched z-score (WHZ, WAZ, HAZ) averages within each group of children. The study will lead to the formulation and recommendation of an effective and safe CF.

## AGRO-ECOLOGY

**Exploring the potential of agro-ecology to restore community diet diversity and food security in a vulnerable rural area of Colombia**

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The potential of agroecology to reactivate agricultural production and improve food security through diversified home gardens—fruits + vegetables (FV) and eggs—in school and homesteads will be explored in Damasco, a poor Colombian rural community, whose food production base was disrupted in the past by violence, conversion to cattle ranching, increased droughts and the COVID-19 pandemic. More than 70% of the locals eat less than two FV servings per day. Due to COVID-19 many have lost their jobs and have difficulties obtaining fresh food. Due to school closures, children cannot rely on school nutrition programs, which in many cases are their primary food source. Deploying a pilot number of diversified home gardens aimed at enhancing local production will initiate the restoration of food provisioning to households and thus contribute to food security. As homestead production translates into increased household consumption of FV and eggs, dietary diversity will increase, translating into improved nutrition for women and children. Quantities of produced food in the gardens will be assessed regarding quantity and composition as well as the contribution to the daily nutrient intake and needs of the children. To ensure more consumption of FV + eggs in Damasco, a small women's run kitchen/eatery that sells locally produced food and dishes at a low cost will be established.

# VITAMIN A

## Vitamin A bioefficacy of high provitamin A carotenoid maize in Mexican schoolchildren

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USD 100,100

Vitamin A, zinc, and iron are micronutrients of major concern. Maize is an important staple crop in the world, providing 20% of all calories to human consumers, with even higher consumption in Mexico. Producing more nutritious maize that is agronomically competitive could improve consumers' nutrient status. This project will breed maize that has enhanced levels of provitamin A carotenoids, with the major focus being  $\beta$ -cryptoxanthin, through agronomic practices and conventional plant breeding. We will test a high  $\beta$ -cryptoxanthin maize line in Mexican schoolchildren for vitamin A bioefficacy using stable-isotope-labeled retinol dilution techniques. This multidisciplinary project could make significant impacts on maize biofortification efforts globally by enhancing vitamin A and testing these new varieties for efficacy for the first time in Latin America. During the proposed study period, we will also be assessing retention of nutritional value after traditional processing and cooking methods, such as nixtamalization and tortilla preparation. This study uses a "field to table to health" approach with a globally important staple crop.





# 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. During 2021 a few general and specific capacity-building activities were supported. COVID-19 affected work and activities for all of us, but capacity-building activities continued as local circumstances allowed.**

## DISSEMINATION OF RESEARCH RESULTS

Due to COVID-19 hundreds of meetings have been postponed or cancelled, and many have moved online. All of us have experienced the advantages but also the disadvantages of the virtual meeting (un-)reality. Nevertheless, through modern IT and also “old fashioned” e-mails we were not only able to remain in contact with all our researchers, but also new research projects were developed and, as described in this report, also approved. Whenever needed, the Foundation offered local support to researchers such as assisting with access to literature, providing PDF files of research publications not available locally, and last but not least brainstorming ways to address unclear aspects in research projects by linking researchers globally and whenever possible on a South-South basis.

Most of the Foundation’s projects were and are based on personal contacts, personal assistance, personal motivation and last but not least personal respect for independent work. Based on so many rich personal relationships, even during the present COVID-19 pandemic the Foundation has been able to fulfil its mandate.

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 first NFR4D project at USSEIN University in Senegal is advancing, albeit with an unexpected delay due to COVID-19. Despite a lockdown situation at the University, the project is advancing and the food technology aspects of the study have been optimized with local knowhow. Despite the COVID pandemic the local team did its best and mobilized hidden and untapped motivational energy to advance the project despite pandemic-related drawbacks. This project should build local capacity and especially explore local, efficient and affordable solutions to improve nutrition. We all know that fortified products with a commercial premix are expensive and in the long run neither affordable nor sustainable. The NFR4D project at USSEIN looks for a food-based local solution with a high potential for sustainability: local ingredients,

local non-commercial production and local usage. If successful, the gained knowhow can be applied in other geographic areas of Africa. Local solutions for local problems—a key aspect of this study—has always been one of the major aims of all Foundation-supported research.

ACTIVITY



Despite continuous discussions and spreading of promises for help and a better future, for many people in low-income countries these promises remain only empty phrases. Formulating aims is much easier than implementing them. As outlined in a contribution by Prof. Reinert, it might be time to focus on key aims and small steps to promote health and well-being instead of being lost in a jungle of aims and goals. Whenever possible, the Foundation favours a food-based approach to improve nutrition and health. In view of today's trends and changes in the food system it is timely to recall the many forgotten and neglected crops. Each year thousands of new products are thrown

on the market, while at the same time nutritious crops disappear forever. To cover major areas of the world, we invited three leading scientists to address the topic of forgotten crops on different continents: Profs. Siddiqui and Li address this topic for Asia, Prof. Adeleke and Babalola for Africa, and Prof. Lugo-Morin for Central and South America. As summarized in these contributions there is huge—mostly intentionally untapped—potential in these crops. It is high time to reintroduce local food crops and not only focus on a few cash crops. In the last contribution, our new Council Member Prof. Lartey and Prof. Amuna outline strategies to enhance nutrition research on the African continent.



# VISION

DON'T FORGET THE BASIC DEVELOPMENT GOALS

UNDERUTILIZED CROPS IN ASIA

UNDERUTILIZED CROPS IN THE AMERICAS

UNDERUTILIZED CROPS IN AFRICA

RESEARCH CAPACITY IN AFRICA



# DON'T FORGET THE BASIC DEVELOPMENT GOALS

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The Sustainable Development Goals (SDGs) now infuse the efforts of the entire United Nations system, from UNICEF to the World Trade Organization. Each of these entities now places their ongoing projects within the SDG framework, justifying them in terms of meeting one or more SDG. Many organizations, both public and private, are voluntarily doing the same. Unfortunately, the SDGs are numerous, with 17 goals, 169 targets, and 232 indicators. The SDG project is therefore highly aspirational but too unwieldy to translate into effective policy. Even SDG supporters try to find ways to simplify them via reduction or network analysis.

A narrower range of development objectives appears in the form of the Basic Development Goals (BDGs), which consist of only seven goals and ten targets. The BDGs were explicitly developed in terms of human needs and the basic goods and services that satisfy these needs. The BDG framework thereby reflects a basic goods approach in which needs and the goods that meet them are defined as developmentally related to the human condition. These BDGs are the prerequisites for any specific conception of human well-being or flourishing, be it

standard economic notions or alternative notions of human development.

The BDGs and their targets are presented in the table below. Each BDG is motivated by its direct connection to basic needs:

- Goal 1, food security, is directed towards the satisfaction of basic caloric needs, vitamins, minerals, and other micronutrients.
- Goal 2, health, focuses on minimal health outcomes that, in turn, require primary health care services and requisite medical inputs.
- Goal 3, education, refers to the pre-primary, primary and secondary education services required for both social participation and remaining healthy.
- Goal 4, water and sanitation, are required for survival, basic health, and human dignity.
- Goal 5, energy, meets needs for lighting, refrigeration, air conditioning, and communication that support health and social participation.
- Goal 6, housing, focuses on protecting individuals from the elements, providing a space for food preparation and hygiene, and social participation.
- Goal 7, human security, is the set of basic services that protects bodily integrity and prevents against injury and death as a result of violence.

The BDGs have a close relationship to the fulfillment of the subsistence rights provisions of the UN system as recognized by Article 25 of the 1948 Universal Declaration of Human Rights (UDHR) and Article 11 of the 1976 International Covenant on Economic, Social, and Cultural Rights (ICESCR). Each of the BDGs can be mapped directly to the UDHR, the ICESCR, or other UN resolutions and declarations on subsistence rights. This direct link to established subsistence rights is another advantage of the BDGs.

Target 1.1 of the BDGs is to “Ensure access by all people to safe, nutritious, and sufficient food.” This is related to the critical issue of food security. The Food and Agricultural Organization estimates that about 770 million people were hungry in 2020 and that this figure would fall to about 650 million in 2030. In 2020, more than 2 billion were food insecure with 900 million being severely food insecure, 12 percent of the world’s population. The COVID-19 pandemic, conflicts, and climate change have made addressing this situation more difficult than in the past.

The Nestlé Foundation helps to address BDG Target 1.1 through local capacity building in the field of nutrition in low-income countries, focusing on food-based approaches to solving malnutrition. These activities address basic needs and food security and are part of the duties that accompany subsistence rights. In this way, they are very much compatible with the BDG approach to setting development policy priorities.

For references see last page of the report

**Figure 1:** Basic Development Goals and Target

| Basic Development Goal       | Target   |
|------------------------------|--|
| Goal 1: Food Security        | Target 1.1: Ensure access by all people to safe, nutritious, and sufficient food.  |
| Goal 2: Health               | Target 2.1: End preventable deaths of newborns and children under 5 years of age through universal primary health care.<br>Target 2.2: End the epidemics of AIDS, tuberculosis, and malaria.     |
| Goal 3: Education            | Target 3.1: Ensure that all children complete free, equitable and quality primary and secondary education.<br>Target 3.2: Ensure that all children have access to quality pre-primary education. |
| Goal 4: Water and Sanitation | Target 4.1: Achieve universal access to safe and affordable drinking water for all.<br>Target 4.2: Achieve universal access to adequate sanitation and hygiene for all and end open defecation.  |
| Goal 5: Energy               | Target 5.1: Ensure universal access to affordable and reliable electricity services.   |
| Goal 6: Housing              | Target 6.1: Ensure universal access to adequate, safe and affordable housing.  |
| Goal 7: Human Security       | Target 7.1: Significantly reduce all forms of violence and related death rates.  |



# UNDERUTILIZED CROPS IN ASIA

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## **A STRATEGY AND ROADMAP TO MAINSTREAM NEGLECTED AND UNDERUTILIZED CROPS INTO FOOD SYSTEMS IN ASIA**

### **Hunger and malnutrition in Asia: Status**

Achieving the second Sustainable Development Goal (SDG2) implies leaving no one behind regarding hunger and all forms of malnutrition. Currently, the Asia Pacific region faces a high prevalence of hunger and malnutrition. An estimated 350.6 million people were undernourished in the region in 2019 (about 51% of the global total), meaning that they have insufficient caloric intake<sup>1</sup>. The region also has a high prevalence of stunting (low height for age) and wasting (low weight for height), with an estimated 74.5 million children under five years stunted and 31.5 million wasted in 2019<sup>1</sup>. Micronutrient deficiencies (also known as 'hidden hunger'), especially vitamin A,

iodine, and iron, are high in the region and more severe in low-income countries. For instance, the prevalence of anemia among pregnant women (52%) and children under five years (58%) in South Asia exceeds the global prevalence (38 and 43%, respectively)<sup>2</sup>. Countries suffering from severe micronutrient deficiencies (Hidden Hunger Index > 25) include Nepal, India, Bangladesh, Bhutan, and Lao PDR<sup>3</sup>. A compounding issue is a parallel increase in overweight and obesity in the region: 15% of adults are overweight, with childhood obesity increasing<sup>3</sup>. The triple burden of malnutrition co-exists at the country and household level<sup>4</sup>.

### Food systems: Cause and issue

There is a clear relationship between malnutrition, low dietary diversity, and low production diversity<sup>5</sup>. A primary cause of malnutrition is an inadequate diet with insufficient nutrients, minerals, and vitamins in terms of quantity and quality for body growth and maintenance<sup>6</sup>. Poor dietary diversity leads to persistent malnutrition. Inadequate diets are low in fruits, vegetables, whole grains, nuts and seeds, milk, fiber, calcium, seafood and fish high in omega-3 fatty acids, and polyunsaturated fatty acids, and are high in red meat, processed meat, sugar-sweetened beverages, trans fats, and sodium<sup>7,8,9,10,11</sup>. An unhealthy diet is a major risk factor for non-communicable diseases, such as diabetes and heart disease<sup>12,9</sup>. Diets are a major output of food systems. Low dietary diversity often reflects low production diversity, which shapes nutrition.

The co-existence of triple malnutrition in the region indicates that current food systems fail to deliver sufficient and nutritious foods to meet the basic dietary requirements of the population while reducing environmental damage<sup>13</sup>. Low dietary and production diversity in Asian countries is rooted in the current food systems, which rely on a few staple crops, especially rice, leading to unbalanced diets and malnutrition. Meanwhile, most staple crops have reached the upper level of yield potential (80%), limiting the margin for increasing the total output for the growing population<sup>5</sup>. The production projection of staple crops is alarming when factoring in the climate change impact. For instance, climate change is predicted to decrease rice production in South Asia by 14% compared to a no-climate-change scenario<sup>14</sup>. Consequently, there are two major gaps for Zero Hunger in current food systems: 1) nutrition gap and 2) production gap<sup>5</sup>.

### Strategy: Structural transformation of food systems

Dietary diversification is the most effective way to address malnutrition, including hidden hunger and obesity, among the various food-based approaches: (i) diversifying diets, (ii) fortifying commercial foods, (iii) supplementation, and iv) biofortification<sup>3</sup>.

Agricultural diversification with sustainable intensification offers a tangible and affordable solution for Zero Hunger. To this effect, a structural transformation of food systems is needed to diversify local food production for local consumption. The target should be set to deliver sufficient, diversified, nutritious, and safe food that meets dietary requirements and is accessible and affordable while optimizing natural and human resources and preserving social and cultural traditions<sup>15,16,5</sup>. Ideally, it will close the nutrition and production gaps simultaneously.

The key entry point is identifying and integrating nutrient-dense, climate-resilient neglected and underutilized species (NUS) into food systems. Asia is home to a rich genetic diversity of plant species that have been cultivated and used as food sources for thousands of years. Many NUS have superior nutritional qualities—rich in micronutrients, minerals, protein, and fibre—and can grow on marginal land and tolerate environmental stresses<sup>5</sup>. NUS are key elements of the agrobiodiversity needed for sustainable agriculture. However, as with the rest of the world, many of these edible plants [originally >30,000 species<sup>17</sup>] have been replaced by a handful of staple crops<sup>18</sup>. Thus, the key to harnessing the great potential of NUS to bridge production and nutrition gaps—noting that not all NUS are nutrient-dense or resilient to climate change—is to scientifically identify suitable NUS and integrate them into food systems for sustainability and better nutrition for all.

### Roadmap: Close nutrition and production gaps

The strategic transformation of food systems should systematically set the direction to close the nutrition and production gaps at the macro- and micro-level. Optimal planning should be based on a series of evidence-based analyses, such as nutrient gap, production gap, priority food items, food system mapping, and value chain analyses. A four-step roadmap is suggested.

**Firstly**, undertake national nutrition- and production-gap analysis to set the grounds for what to produce at the macro-level<sup>19</sup>. It is important to assess nutrient deficits or surplus, including energy and major macro- and micro-nutrients at a national level by assessing the current nutrient demand and supply through i) nutrient-demand analysis based on population and nutrient requirements by age and sex as per national dietary guidelines, ii) nutrient-supply analysis by converting domestic production of food items into nutrient supply based on a food composition table, and iii) nutrient-gap analysis.

**Secondly**, conduct a prioritization exercise on NUS to identify what to produce to close the nutrition and production gaps. To prioritize food items, the FAO has developed a multi-dimensional selection methodology for Future Smart Food

based on four parameters: a) nutritional density, b) climate resilience, c) economic viability, and d) local availability or adaptability<sup>5,13,6,18</sup> (Figure 1). The methodology can be applied at national, sub-national, and local levels to boost local agricultural and food systems and requires research collaboration between different disciplines, including nutrition, agriculture (seeds, soil, water, etc.), and ecology. In particular, food composition data for indigenous crop species are limited due to inadequate research.



**Figure 1:** Top two panels: Drumstick (*Moringa oleifera*) plant-flowers and -pods; bottom two panels: Qinoa (*Chenopodium quinoa*) plants.

**Thirdly**, map where to produce these prioritized food items and integrate them into farming systems to optimize the utility of limited resources. Optimal mapping analysis of these priority crops in diversified agro-ecological zones should be conducted using geospatial information systems (GIS) and ground measurements<sup>20</sup>. Such GIS analyses integrating parameters of specific crops, agro-ecological zoning, climate, water, soil, seasons, and

markets offer evidence-based projections on where to produce specific crops for decision-making. This is a critical step for policymakers to reorient the agricultural production structure to close the nutrition gap at the national level based on scientific findings.

**Lastly**, adopt an integrated value chain approach on how to produce, process, market, and consume these food items. Identifying optimal fields for integrating prioritized food items should enable the elaboration of systematic interventions integrating nutrition-sensitive and climate-smart approaches and interventions into food systems at production, post-harvest, processing, marketing, and consumption stages<sup>19</sup>. Governments should play a leading role in creating an enabling environment to promote agricultural diversification with sustainable intensification in food-system transformation.

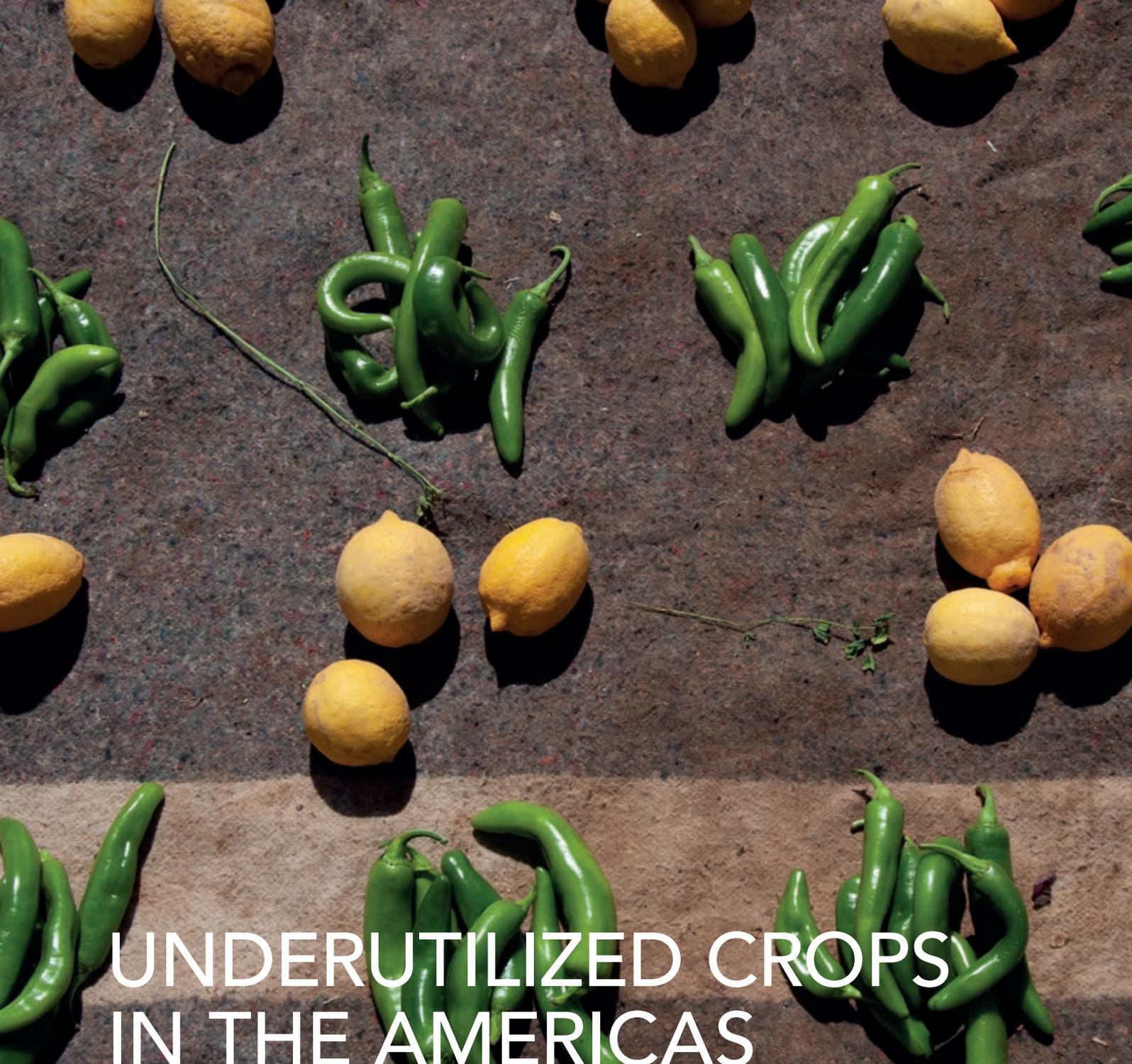
The views expressed in this publication are those of the author(s) and do not necessarily reflect the views or policies of the Food and Agriculture Organization of the United Nations.

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# UNDERUTILIZED CROPS IN THE AMERICAS

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## **NEGLECTED AND UNDERUTILIZED WILD OR CULTIVATED PLANTS IN CENTRAL AND SOUTH AMERICA**

### **Background**

The COVID-19 pandemic has been a global phenomenon that has negatively impacted society (1), with infections currently (November 2021) reaching 250 million people with 5.1 million deaths (2). This situation has impacted on almost all human activities, one such activity being food production, which has been affected by the implementation of sanitary measures (e.g., social distancing, confinement, mobility restrictions) leading to a slowdown of food systems at local and regional level (3). According to FAO et al. (4) global hunger

increased in 2020 in the shadow of the COVID-19 pandemic. After five years of little change, the prevalence of undernourishment grew in just one year from 8.4% to nearly 10%.

More than half of the world's undernourished population is concentrated in Asia and Africa, affecting 700 million people. Compared to 2019, in 2020 this figure will increase by 100 million more people for both continents (4). In Latin America, agriculture and food systems tend to be resilient due to the attributes of their territories; the complexity of socio-ecological systems has been a resilience factor in the face of the pandemic. However, problems that predate the pandemic and that still persist in the territories of the region in the midst of the health crisis (e.g., climate change, lack of financing, poor infrastructure, deforestation or lack of public policies) generate scenarios of food uncertainty. According to FAO (5), in 2020, despite policies to support income and access to food, it is estimated that the incidence of moderate or severe food insecurity reached 40% of the population, i.e., 44 million more people in Latin America and the Caribbean. The prevalence of undernourishment for Central and South America in the last decade can be seen in Figure 1.

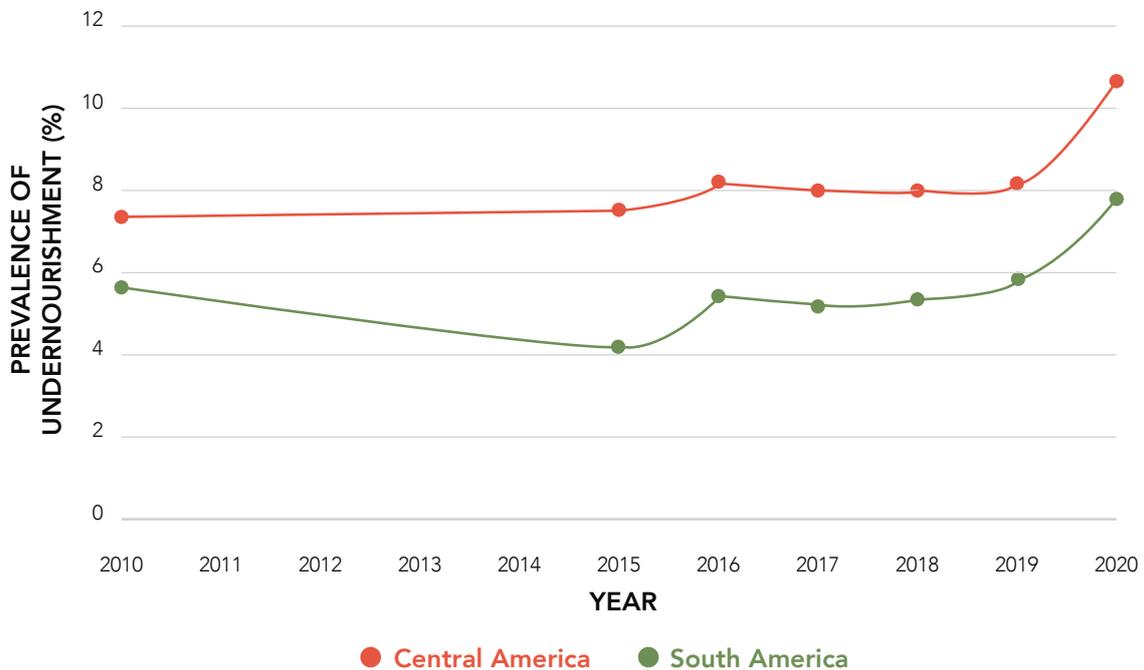


Figure 1: Prevalence of undernourishment in Latin America 2010-2020 (4).

In terms of prevalence, the populations of Central and South American countries are located in phases 2 and 3 of the Integrated Food Security Phase Classification provided by FSIN and Global Network Against Food Crises (6), which indicates the need to implement actions to reduce disaster risk and protect livelihoods.

According to the FSIN and Global Network Against Food Crises (6) report, the COVID-19 pandemic and associated containment measures are expected to continue to exacerbate economic crises and acute food insecurity, especially in the fragile economies of parts of Latin America (e.g., El Salvador, Guatemala, Honduras, Paraguay, Haiti among others) (Figure 2). Even if COVID-19 can be contained in some parts of the world, slow implementation of vaccines in countries with weak health systems could prolong constraints (7), dimming prospects for rapid economic recovery.



**Figure 2:** Undernourished countries in Central and South America 2021 (8).

## Building a resilient food system in Central and South America

The landscape described above is not encouraging, even after the COVID-19 pandemic is over, the consequences of the pandemic will be present for some time to come. The opportunity to look towards resilient food systems is likely in a post-pandemic scenario. A resilient food system implies identifying adaptive, learning and persistence aspects in the components of the system. In rural Latin America, local food systems comply with these premises; however, the precarious conditions of social actors and the lack of public policies are elements that sometimes impede their development.

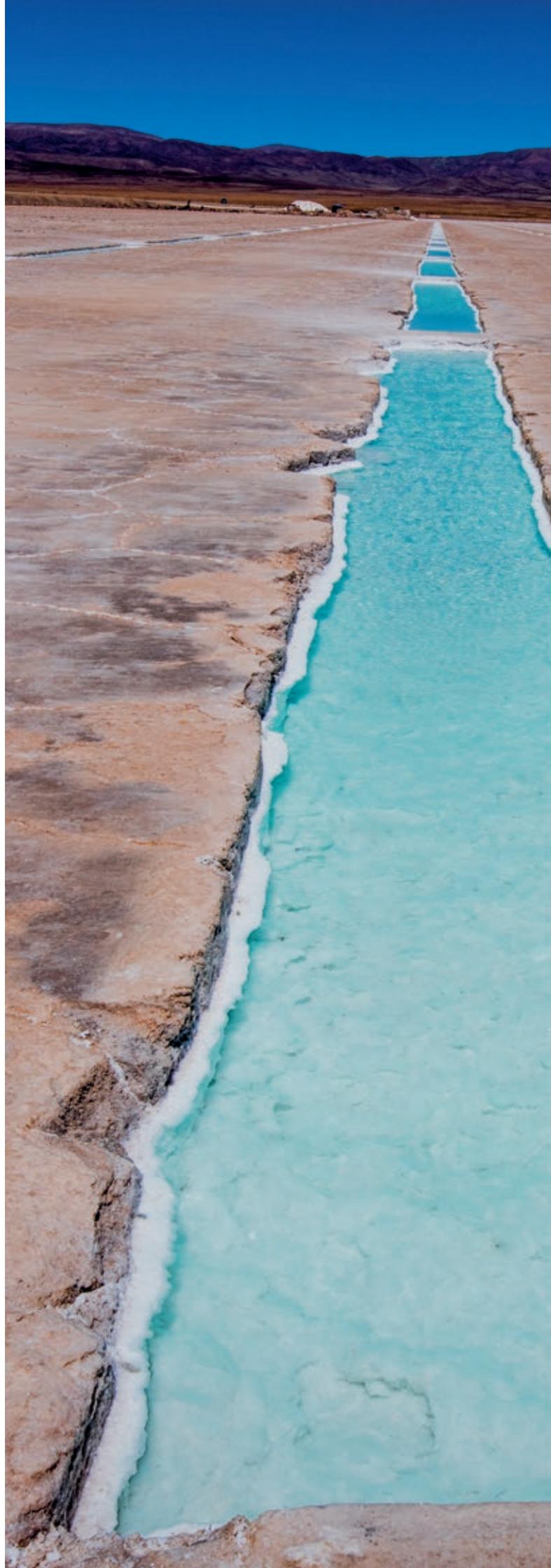
According to Tendall et al. (9), the food system resilience action cycle consists not only of reactive actions (absorb, react, restore, learn), but also of preventive actions (build resilience). Preventive actions can also address stressors, which affect the reactive capacities of the food system in response to a perturbation.

For Tendall et al. (9), the precarious conditions in the territory and the absence of public policies, far from being disturbances, can represent a scenario of opportunity to boost the establishment of resilient food systems. If we look at the rural landscape in Central and South America, more than 80% are small family farms (16 million) that bring together a population of 60 million people (10), which represents a high potential for transforming local food systems.

In the context of globalisation, the FAO highlights the need to develop an institutional framework that promotes access to public goods (e.g., technologies, irrigation infrastructure, roads, transport, etc.), sources of financing and productive resources. This is compounded by the effects of the macroeconomic policies implemented in most of the region's countries (10).

The territorial approach provides a physical space that makes it possible to understand the productive and social reality of family farmers, thus making it possible to design development strategies adapted to the natural resources, infrastructure and socio-economic characteristics of the sector to be intervened. The territory, therefore, recognises the heterogeneity of family farmers, allowing the design of differentiated policies according to the diversity of situations of each segment of farmers (10).

At the same time, indigenous food systems must be considered; these systems are associated with the biodiversity of the territories in Latin America. Central and South America are home to significant indigenous populations, in addition to the fact that the region possesses 60% of the world's biodiversity



and is home to a third of the planet's freshwater (11). These attributes of the region represent an opportunity to learn from indigenous food systems from a sustainability perspective, to explore their adaptability to the heterogeneous reality of Latin American territories and to provide support in a public policy context are the first steps we need to take.

### **Indigenous food systems, challenges and foresight**

Food security in indigenous territories is associated with their biodiversity and systems of beliefs, values and traditions. Indigenous food systems by definition are resilient, they have persisted historically and their custodians, the indigenous groups, safeguard the ancestral knowledge that has enabled their permanence since ancient times. One example is the response strategies to the COVID-19 pandemic by some indigenous groups in Central and South America (Table 1).



**Table 1:** Ethnic groups in Central and South America and the use of some wild and cultivated edible plants

| Country    | Ethnic group (example) | Indigenous strategy for COVID-19                         | Forgotten and recovered plants (Ethnic or common and scientific name) | Underutilized plants (Ethnic or common and scientific name) |
|------------|------------------------|--|---|---|
| Argentina  | Wichí                  | Food system and System of beliefs, values and traditions | Fwalhawuk (Morrenia adorata)  | Fwa'ay (Prosopis alba)                                      |
| Belize     | Mopan                  | Food system  | Sweet potato (Ipomoea batatas)  |   |
| Bolivia    | Weenhayek              | Food system and knowledge of ancestral medicine          |   | Fwa'ay (Prosopis alba)                                      |
| Brazil     | Yanomami               | Food system  | Naönaö amo (Lentnula raphanica)                                       |   |
| Chile      | Mapuche                | System of beliefs, values and traditions                 | Pisku (Pinus pinea)   |   |
| Colombia   | Putumayo               | Food system and knowledge of ancestral medicine          | Tacacho (Musa paradisiaca)  |   |
| Costa Rica | Maleku                 | Knowledge of ancestral medicine                          |   | Pejibaye (Bactris gasipaes)                                 |
| Ecuador    | Shuar                  | Food system  |   | Worm: chontacuro* (Rhynchophorus palmarum)                  |
| Guatemala  | Garifuna               | System of beliefs, values and traditions                 | Malanga (Colocasia esculenta)   |   |
| Honduras   | Lenca                  | Food system  |   | Guamo (Inga feuillei)                                       |
| Nicaragua  | Miskitu                | System of beliefs, values and traditions                 |   | Malanga (Colocasia esculenta)                               |
| Panama     | Naso                   | System of beliefs, values and traditions                 |   | Otoe (Colocasia esculenta)                                  |
| Paraguay   | Mbya-Guarani           | Knowledge of ancestral medicine                          |   | Kambara (Buddleja madagascariensis)                         |
| Peru       | Quechua                | Knowledge of ancestral medicine                          |   | Ayrampu (Opuntia apurimacensis)                             |
| Uruguay    | Charrua                | Knowledge of ancestral medicine                          | Ceibo flower bud (Erythrina cristagalli)                              |   |
| Venezuela  | Hoti                   | Food system and knowledge of ancestral medicine          |   | Asai (Euterpe precatoria)                                   |

Source: Based on data from Lugo-Morin (12). Note: \* Worm of importance to the ethnic group for its nutritional value, collected during a specific period of the year.

Indigenous peoples have mediated relationships with nature through their belief systems, values and traditions, resulting in a knowledge of agricultural practices and management that has endured through the ages (13). This continuous accumulation of indigenous local knowledge is what we can call “biocultural food heritage”.

This biocultural food heritage may be the key to the transformation and adoption of new food systems, but the threat of modernity has always been lurking, indigenous peoples and their food systems in order not to perish in most cases have adopted external cultural elements that allow their survival. According to Argumedo et al. (14) indigenous peoples have been affected by economic and agricultural development and related policies, including industrialisation of production, combined with trade agreements that undermine local competitiveness.

Local and global initiatives, such as the one launched by the International Network of Indigenous Mountain Peoples (<https://inmip.net/>), have confronted these adverse scenarios as a collective. This collective brings together communities and organisations from China, Ethiopia, Guatemala, India, Kenya, Mexico, Papua New Guinea, Peru, Kyrgyzstan, Philippines, Thailand, Taiwan, and Tajikistan. This network offers opportunities for substantive positive change in key regions of diversity by providing a focus for initial integrated efforts to conserve and use biocultural food heritage.

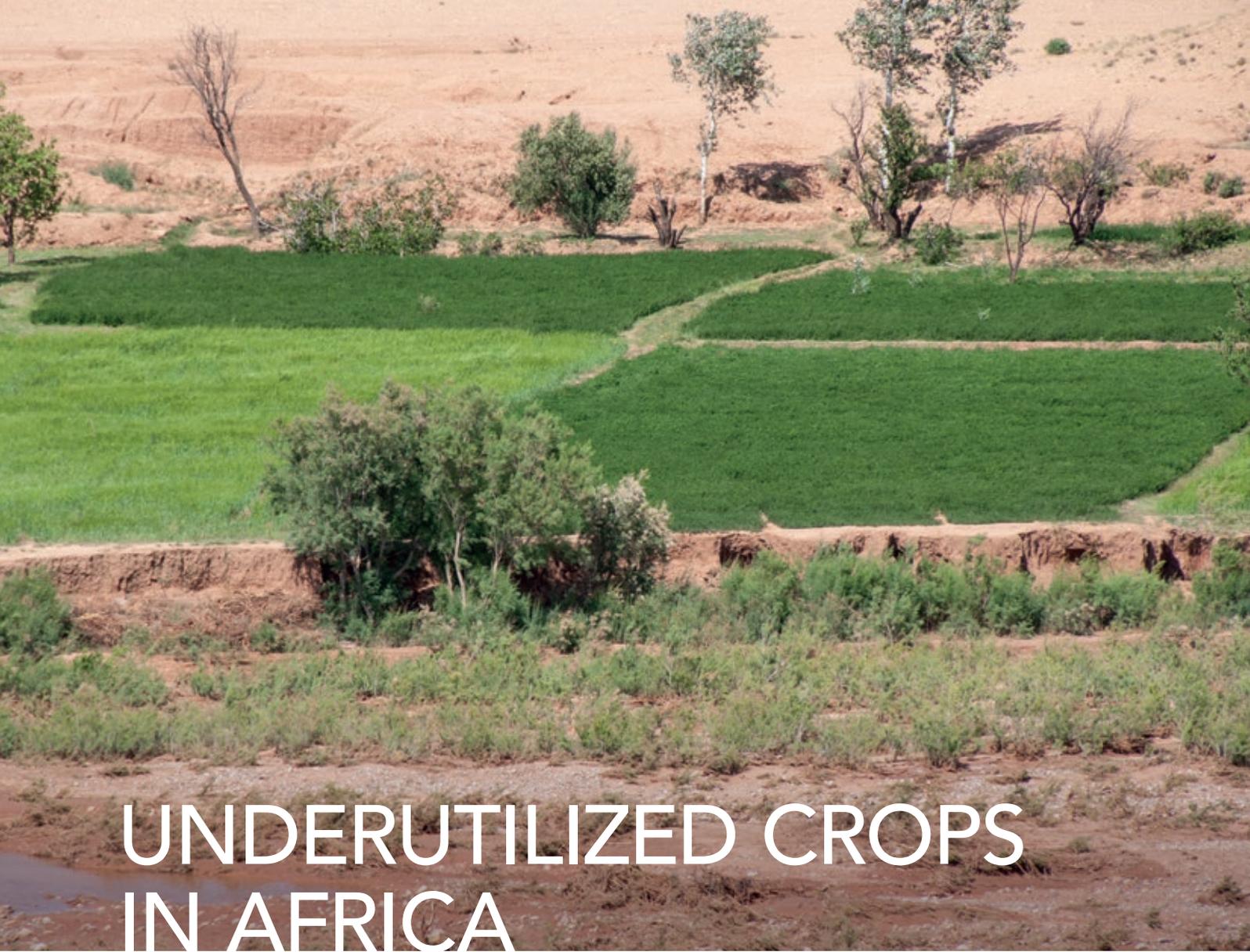
Traditional foods derived from indigenous peoples in Latin America come from food systems that are based on a diversity of edible plants of wild or cultivated origin. Promotion and learning based on these food systems should consider the construction of diverse food landscapes. Forests would be the primary sources of such landscapes, the biodiversity contained therein is sufficient to drive this strategy. On the other hand, support for the design and implementation of public policies is fundamental. These policies would primarily guide the adaptive management of local communities in learning and acquiring new food systems. Secondly, local funding must be secured for community initiatives, including policies for road infrastructure improvements and local impact marketing models.

This adaptive process-based institutionality is not new, at the global level Queiroz et al. (15) have proposed a similar initiative for food systems transformation, the theoretical framework of this proposal is important, but resolving the “how do it” at the local level is also fundamental and is a task to be accomplished.

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# UNDERUTILIZED CROPS IN AFRICA

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## **AN AFRICAN PERSPECTIVE ON FOOD SECURITY AND SAFETY**

Since antiquity our society has faced housing, food, social, political and financial instability as well as unfavourable environmental conditions, all of which influence human culture and attitudinal changes towards agriculture<sup>1</sup>. Nevertheless, the global campaign for sustainable healthy living needs to be intensified, especially in Africa, where many individuals lack the basic necessities of life. In light of predictions that Africa's population might double by 2050 compared to the current population<sup>2</sup>, the need to increase crop productivity is important. In recent years, diverse opinions have been debated on how to rescue the African continent from food insecurity to enable food availability for all<sup>3</sup>. For a meaningful agricultural project to be sustained in Africa, interlinking food security and human capacity-building remains fundamental, and relies on the practical understanding of complex nature and human involvement in improving crop productivity.

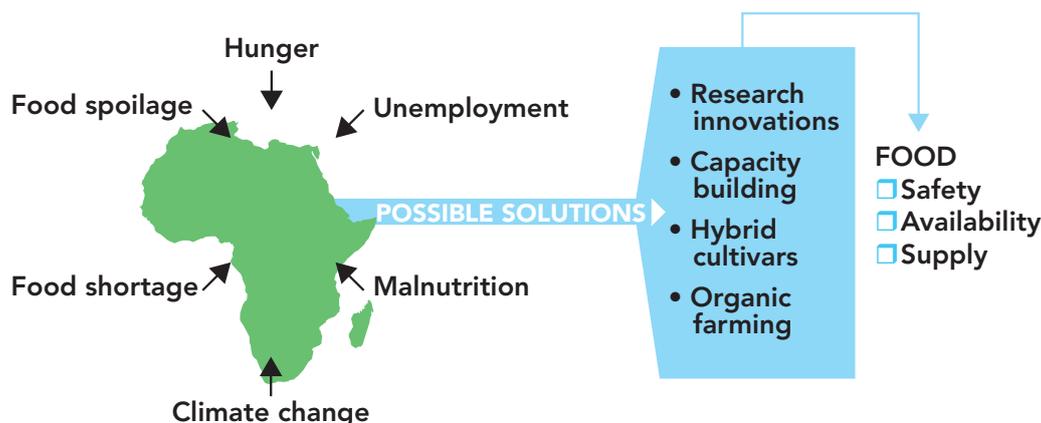
The active involvement of women and youth in agriculture through capacity building can add

to the stability or increase food production in Africa<sup>4</sup>. Providing farm inputs to empower subsistence farmers can immensely encourage local food production from small-scale to larger-scale. Furthermore, through government initiative programs and inclusive policies, agriculture can be made attractive to the teeming youth, which may propel youth engagement in strengthening food safety and control in Africa. Possibilities to create a suitable avenue to discuss diverse issues affecting the agricultural sector in Africa are compelling as part of the goal to circumvent the disadvantageous economy in the future<sup>4</sup>.

Globally, food security has been the core discussion in developing countries with a high undernourished populace, especially in African countries<sup>5,6</sup>. Findings estimate that half of the African population suffers from hunger<sup>7,8</sup>, as opposed to the expectation of meeting the Sustainable Development Goal, which demands urgent attention. Therefore, the long-term established agricultural-initiative programs in Africa aim to boost crop production, improve human nutrition, advance food security, and

enhance income generation with the perspective of specific key issues in bridging research gaps<sup>9</sup>.

Good agricultural practices are essential to contribute to the economic stability in African countries such as Nigeria, South Africa and Ghana, in order to address diverse problems (malnutrition, food insecurity, and inefficient human capacity building) affecting humans (Figure 1). Moreover, the consumption of nutritious foods as a key to human survival is vital to facilitate certain decisions that will bring about agricultural transformation in Africa by placing farmers at the centre of any decision-making plans relating to agricultural policies<sup>10</sup>. To achieve this maximally, it is necessary to engage farmers in capacity-building-oriented programs aiming to enhance crop productivity using modern technologies to develop eco-friendly and sustainable agriculture. In addition, the African government should encourage collaborative partnerships between farmers and researchers, industrialists, agricultural institutions, and policy-makers at all levels to further sustain food production<sup>9</sup>.



**Figure 1:** Problems of food insecurity in Africa and possible solutions

The success of modern biotechnological approaches to harness plant- and soil-associated microbes as bioinoculants and the use of other organic amendments by African scientists for plant growth promotion is evident from much research<sup>11-13</sup>, which provides recommendations to ensure agricultural productivity to tame present and future food insecurity. Further collaboration and dissemination of knowledge for scientific discoveries may strengthen agricultural productivity, processing, and formulation.

The African continent remains the home for indigenous food crops<sup>5</sup>, yet some are underutilized,

with limited information regarding their nutritional profiling, which could have contributed to food supply and security in this era. In addition, these crops' sources, processing methods, and health benefits may underline their global acceptability as major composites in food industries. For instance, in Africa, food crops such as cereals (maize, wheat, sorghum, cowpea, etc.), legumes (soybean and groundnut), oilseed crops (sunflower, rapeseed, locust bean, sesame, etc.), and root crops (yam, cassava, potatoes, etc.) form the primary livelihood in many homes, both farmers' and consumers'<sup>14,15</sup>. However, considering their survival rate under nutrient-limiting soils and unstable environmental conditions, these plants are easily affected in quantity and quality.

Various health benefits characterize many indigenous fermented foods in Africa, and their use in both religious and social ceremonies has been applauded in the region<sup>16,17</sup>. Despite this, the science community's information and awareness of African crops is undervalued. At present, the production level of some crops is still minimal in Africa, as only a fraction has been maximally explored. To boost agricultural production in Africa, the current challenges facing crop production need to be addressed with the possible outlook for implementing modern approaches for crop improvement<sup>2</sup>. These challenges include demographical structure, unfavourable environmental factors, poor research funding, and human capacity building<sup>18</sup>.

The problem of food insecurity in Africa is enormous, such that food production and supply are affected<sup>4</sup>. For instance, changes in the demographic pattern of the African population mean that the provision of food for all is a concern, as food production might not be sufficient to meet the basic needs of human nutrition. Rural dwellers account for the highest percentage population in Africa, but this is expected to change in the future with more people living in urban areas, yet the continent lacks basic amenities and human capacity in terms of job creation to actively boost urban dwellers economically<sup>19</sup>. With the current population increase and rate of crop production, feeding the African population might be critical due to the non-correlational gaps between human population increase and food availability. Overpopulation in some African countries like Nigeria, if not managed adequately, may blow out of proportion by resulting in food shortage and scarcity, malnutrition, hunger, unemployment, and infrastructure problems<sup>5</sup>.

The role of agriculture in Africa in ensuring food security has a strong link to foods' agronomic, nutritional, and health benefits<sup>20</sup>. The uniqueness

of some African foods, such as vegetables, legumes and cereals, has contributed to their high consumption rate within the continent as grown in other parts of the world. To achieve an agricultural revolution in Africa, capacity development by providing farm incentives through consultation with the farmers before making decisions is essential. The slow growth in terms of economic diversification and development in Africa has been traced to low turnout of agricultural productivity, contributing to poverty increase and food insecurity over the years<sup>21</sup>.

Food security suggests the reality of increasing agricultural yields to mitigate poverty in Africa<sup>5</sup>—achieving this through scientific integration forms the primary goal of implementing agricultural-friendly policies. Nevertheless, the question is: who will produce or supply food sufficient to cater to all in Africa? The approach to it by stakeholders might be different based on diverse opinions on how to meet global food competitiveness. Furthermore, the strategy of engaging rural farmers in the food-value production chain should take its course to encourage and enforce farmer-friendly policies as a precursor to poverty alleviation programs through professionalism<sup>18</sup>.

Evidence has shown that smallholder farmers in rural areas remain the major pivotal stakeholders in agriculture but suffer greatly due to financial constraints, malnutrition, poverty, poor soil, and other related problems<sup>22</sup>. To address these problems in Africa, multifold opportunities should be made available to farmers to broaden human dependence on diverse nutritious staple foods. What farms produce for farmers' income generation might not be sufficient to expand the food supply. This has subjected farmers to seek other sources of income and access to nutritious diets.

The post-harvest loss due to poor storage facilities and high moisture content of some major crops, such as yam, cassava, and potatoes, has threatened the food supply in Africa<sup>23</sup>. Also, the growth of some microorganisms on food products has rendered them unsafe for human consumption, due to reduced food quality. It is noteworthy that most African farmers prefer to sell their high-quality farm produce for economic purposes and feed on spoilage foods, which exposes them to various diseases. For instance, due to poor storage facilities, reports have shown aflatoxin contamination in many kinds of cereal crops with potential risks to food safety and human health<sup>24</sup>. According to the World Health Organization (WHO) report on ensuring a healthy diet without contamination, the processes of food sorting, handling, processing, packaging, and storing need to be adequately monitored to

control foodborne illness (WHO 2021). Therefore, farmers need to be aware of the imbalances between what they eat and the resulting health implications, which could also signal a shift to a consumer preference for quality diets.

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# RESEARCH CAPACITY IN AFRICA

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## **BUILDING NUTRITION CAPACITY IN AFRICA TO ACHIEVE THE GLOBAL NUTRITION GOALS**

The world produces enough food to feed the global population. However, about 800 million people lack enough food to eat<sup>1</sup>. Food systems—meaning the way food is produced, processed, distributed, and consumed—have contributed to our global challenges of food insecurity, malnutrition, climate change and poverty. Inequities exist within the food systems: for example, smallholder farmers and women who are major contributors in the food systems do not receive fair wages for their efforts. Furthermore, our current food systems produce about 30% of the global greenhouse gas emissions, contributing to climate-related concerns (global warming, rising sea levels and climate-related disasters) and thus making them unsustainable. Practices within the food systems are driving agro-biodiversity loss (loss of indigenous and traditional foods) and the degradation of natural resources (land, water, soils, etc.)<sup>2</sup>. Moreover, deficiencies within the current food systems do not deliver on healthy diets but are driving the global nutrition situation of increasing food insecurity,

undernutrition (stunting, wasting, micronutrient deficiencies) and overweight and obesity.

### **Nutrition situation in Africa**

Africa carries a disproportionately high burden of malnutrition. Compared to the global prevalence of 9.9%, Africa leads in the prevalence of undernourishment (the lack of enough food to meet energy requirements), which increased from 18.0% in 2019 to 21.0% in 2020 due to the impact of COVID-19<sup>1</sup>. There has been a gradual reduction in stunting prevalence in Africa over the past decade, from 45.5% in 2000 to 30.7% in 2021. However, in terms of actual numbers affected in 2020, Africa had 61.4 million stunted children compared to 54.5 million in 2000 because of population growth. Africa is the only region where the number of stunted children increased in 10 years. Wasting, an acute form of malnutrition, stands at 27% (12.1 million) in Africa compared to 6.7% (45 million) globally.

Overweight and obesity are increasing in all regions of the world, including Africa, where adult prevalence increased from 11.5% in 2012 to 12.8% in 2016<sup>1</sup>, reflecting a double burden of malnutrition.

The COVID-19 pandemic has highlighted the gaps in the food systems and the wide disparities in global and nutrition food security, preparedness and resilience. Its impacts were felt through disruptions to livelihoods, essential nutrition services and access to healthy diets. Within a year of its emergence, the number of food insecure persons globally increased by an additional 370 million in 2020 alone, of which about 90 million were in Africa. Using modeling to assess the overall impact of COVID-19 on nutrition in 2020, the Standing Together for Nutrition Consortium reported an additional 13.6 million wasted children and 3.6 million stunted children and an increase in maternal anemia by 4.8 million globally<sup>3</sup>. Of the three billion people globally who could not afford a healthy diet in 2020, over 80% (1 billion) of them were in Africa<sup>1</sup>.

### **Global opportunities for nutrition**

In the last decade, nutrition has attracted wider visibility on the global agenda. The UN Sustainable Development Goals (SDGs) in 2015 came with a clear goal for nutrition in Goal Number<sup>2</sup>—to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture. It became evident that without addressing the nutrition challenge, several other SDGs would be impossible to achieve by 2030<sup>4</sup>. The Decade of Action on Nutrition (2016-2025) was declared by the UN General Assembly in 2016, putting nutrition on the agenda of the highest decision-making body of the UN. This declaration provides a ten-year window to achieve progress towards the SDG and the World Health Assembly nutrition-related targets.

Global efforts for food systems' transformation to address their current shortcomings culminated in the UN Secretary General's call for a Food Systems Summit in September 2021, dubbed a "solutions summit", which brought together a wide range of food-systems stakeholders to re-think the way food is produced, processed and consumed, and to deliver on health for people and our planet. Governments made commitments on food-systems changes for better access to quality food and to maintain good nutrition amongst the citizenry. The African Union presented a common position to game-changing solutions that would transform Africa's food systems to contribute to the achievement of the SDGs (2030), the AU's Agenda 2063, and its Comprehensive Africa Agriculture Development Programme (CAADP) goals<sup>5</sup>. The commitments include "to enhance institutional and human capacities to accelerate food systems transformation".

The Nutrition-for-Growth Summit in Tokyo in December 2021 was another pivotal moment which brought together multi-lateral organizations, governments, businesses, civil society groups, UN organizations, donors and academia to address current global nutrition challenges. As a pledging summit, financial, policy and programmatic commitments for nutrition were made to end all forms of malnutrition. Several African governments made policy and programmatic commitments to end childhood malnutrition, especially stunting and wasting. Donors, governments and multilateral institutions and foundations pledged an unprecedented USD 27 billion in financial commitments for malnutrition. To maintain the momentum for nutrition, the African Union has declared 2022 the African Union Year of Nutrition Action.

### **Building capacity for nutrition research for food systems transformation in Africa**

Since Africa still carries a high burden of malnutrition, the continent is expected to be the focus for nutrition actions and commitments in the coming years. These have major implications for strategic planning, implementation, monitoring and evaluation of the impacts of interventions and their sustainability. Developing Africa's Science, Technology and Innovation programmes is critical for the transformation of Africa's food systems<sup>6</sup>. Equally important is the need to build research and institutional capacities to support evidence-based policies for implementation and scaling up interventions, without which the numerous commitments are unlikely to succeed.

A recognition of the need for building up the human capital for nutrition has long been a subject of discussion and actions among academics,

policy makers, Africa’s regional blocks and the African Union. For example, in 2009 an ECOWAS health ministers’ resolution called for “a major initiative to strengthen, expand and coordinate existing academic programmes in human nutrition and related applied programme-linked research activities”. The West African Nutrition Capacity Development Initiative (WANCDI) supported by the West Africa Health Organization (WAHO) and the European Union’s (EU’s) African Nutrition Strategic Partnership was established in 2013 following the ECOWAS health ministers’ resolution.

### Current nutrition capacity gaps, challenges and opportunities

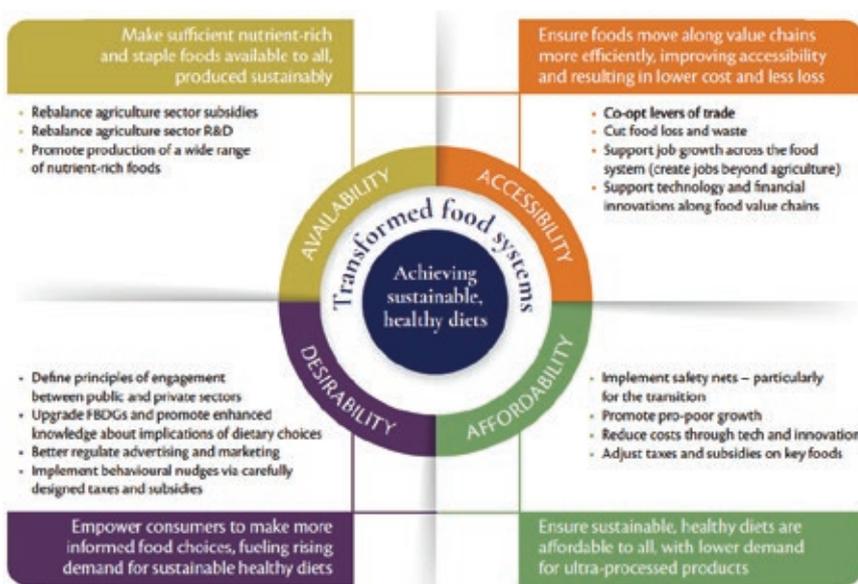
Some recent surveys and workshops have assessed Africa’s institutional and workforce capacities and identified that serious gaps exist<sup>7-9</sup>. Other reports have explored capacity building for public-health nutrition<sup>10</sup>, capacity building for agriculture, nutrition and health research<sup>11</sup> and examples of country-level capacity building programmes to meet national priorities<sup>12</sup>.

With respect to pre-service training, curricula are not comprehensive enough, especially considering the need to address all forms of malnutrition from a food-systems perspective<sup>7</sup>. The Figure shows the various dimensions food systems and its association with nutrition<sup>13</sup>.

In their paper on “capacity building for a strong public health nutrition workforce in low resource countries”<sup>10</sup>, concluded that “both food system changes, at the level of production, processing and distribution, and behaviour change communication are needed to re-orient the nutrition transition, and nutritionists have a major role to play in this regard”. Their recommendations included the training of more nutritionists at the undergraduate level (to carry out the bulk of interventions), and developing a core of specialized nutritionists at the master’s level (to work at district and national levels).

There is a shortage of skilled nutrition professionals to deliver interventions called for at the country level<sup>9</sup>. There is shortage of nutritionists at the district level and a sense that not much attention is paid to nutrition and that there is a lack of commitment to nutrition activities in countries across Africa. Following the earlier work done by WAHO<sup>8</sup>, a capacity-building and skills in nutrition and food security in West Africa (PRENFOS) initiative was launched at a workshop in Ouagadougou, Burkina Faso, jointly organized by the West African Health Organization (WAHO), UNICEF and the African Development Bank (AfDB). The AfDB committed USD 525,000 to fund the capacity-building programme for nutrition in the ECOWAS region through the Korean-Africa Economic Co-operation Trust Fund to be implemented by the WAHO.

## Food system transformation: Priority policy actions



The transition steps can be distilled into four distinct policy objectives:

1. Sufficient nutrient-rich and staple foods are **available** to all, and sustainably produced

Those foods are readily:

2. **Accessible**;
3. **Affordable**; and
4. **Desirable** for everyone

Source: Global Panel on Agriculture and Food Systems for Nutrition. 2020. Future Food Systems: For people, our planet, and prosperity. London, UK. (with permission)

A major expected outcome of the workshop was an “agreement on the preliminary content of the training curriculum for nutrition trainees” with a focus on health and agriculture to be validated. The project also sought to examine strengths and weaknesses of an accreditation system for nutrition training and to evaluate the harmonization experiences of nutrition curricula in the region.

Over a decade ago, when surveys of nutrition capacity building were conducted and reported on across Africa<sup>9</sup>, the majority of training programmes (e.g. 78% in the ECOWAS region) were by government-supported (public) higher education and research institutions and financial constraints were the norm across countries. This has a knock-on effect on the type and scope of research that can be reasonably expected unless these are supported by external research grants. However, like a chicken-and-egg situation, the ability to attract highly competitive research grants remains a challenge where the human capital for research leadership is lacking; infrastructure and the tools needed for doing research are limited; and the environment is not conducive for nurturing, mentoring and generating high-quality research outputs. More recently, there is a proliferation of private universities in Africa, with some offering nutrition programmes. However, the lack of effective national regulatory frameworks and a regional body to harmonize nutrition curricula and training vis-à-vis benchmarks for quality assurance and effective workforce development remain a major concern. In a survey of sixteen West African countries,<sup>8</sup> the most important needs put forth by African researchers were lack of teaching material, equipment, funding, and access to resources such as publications. Nutrition research informing decision making is another critical gap<sup>7</sup>. Research does not necessarily address national priorities to enable incorporation into policy decisions. Research is mostly donor-driven; findings are often published in low-impact journals which are difficult to access.

In 2011, the International Malnutrition Task Force (IMTF) in collaboration with the African Nutrition Society and the African Graduate Students in Nutrition Network (AGSNET) held a workshop on building systemic capacity for nutrition. This was held in collaboration with the African Nutrition Society, the African Graduate Students in Nutrition Network (AGSNet) and supported by the Nutrition Society and the Federation of African Nutrition Societies (FANUS). Stakeholders included participants from 25 academic institutions in Sub-Saharan Africa and five non-academic institutions. The outcomes of the workshop and subsequent follow-up activities in South Africa and Ghana in 2012 and 2014 respectively culminated in a paper<sup>14</sup>,

whose recommendations included the creation of centres of excellence demonstrating developed nutrition training, innovations and best practice in teaching, learning and assessment as well as research.

#### Questions arising on nutrition capacity building

- What is the level and quality of staffing and resources (library, laboratories, teaching materials and tools, technological resources) and funding available for nutrition training and research?
- Where no nutrition programmes exist, have individuals and the countries made use of programmes elsewhere in Africa to build their capacity for nutrition?
- What is the level of in-country recognition of degrees obtained from other countries and what are the employment opportunities for graduates to apply new knowledge and expertise to strengthen their national nutrition programmes?
- Have the issues of equivalence, standardization and harmonization of pre-service training and postgraduate training and research been resolved to enable expansion of the capabilities for workforce development?
- To what extent have South-south and intra-Africa institutional collaborations been fostered to strengthen nutrition training and research, including the principle of ‘nurturing and mentoring’ institutions? How have such collaborations been aligned to national and regional nutrition priorities and the UN’s Sustainable Development Goals (SDGs, 2030) and the Africa Agenda 2063 ambitions?
- Have Centres of Excellence for nutrition training and research been identified across Africa which are well-financed and equipped with the necessary tools and infrastructure to support capacity building for the continent?
- To what extent has the call for a regional strategy to strengthen capacity for nutrition been carried forward and operationalized?
- At the country level, what are the registration issues and how well are nutrition research graduates integrated into nutrition leadership, training and programme management at district, national and policy levels to support food-systems and nutrition investments and interventions?
- Is there a database of a ‘community of African experts’ in nutrition research, academic and institutional leadership as a reference source of human capital for consultancy?

Chiwona-Karlton et al.<sup>11</sup> reported on a study involving seven African countries (Ethiopia, Ghana, Kenya, Nigeria, Tanzania, Uganda and Zambia) whose objectives were to provide an overview of the individual and institutional nutrition expertise available in Africa; describe current nutrition research; identify gaps linking agriculture research with nutrition and health outcomes; and delineate activities within African partners for a future research agenda on agriculture, nutrition and health (ANH) outcomes. They found a paucity of research connecting health outcomes with household income. Among their recommendations were to promote interventions which focus on building an enabling environment for conducting ANH research in Africa.

Based on the current nutrition situation in Africa, we make the following recommendations for improving nutrition capacity:

- At the pre-service stage, the content of graduate nutrition programmes must be broadened to enable graduates to appreciate the complex range of factors that affect nutrition: climate change, poverty, conflicts, economic downturns and many others. Additionally, this would prepare nutrition researchers to collaborate with other sectors to address all forms of malnutrition.
- There is a need for African higher-education institutions (HEIs) to review their curricula and undertake gap analysis. HEIs need to design their learning objectives based on professional functions of nutritionists and within the context of national and regional nutrition priorities and develop networks and institutional collaboration.
- It is important to harmonize nutrition graduate programs. This can be done through national or regional authoritative sources for graduate programmes<sup>15</sup>.
- There is the need to re-orient nutrition research agenda to align with national priorities. For example, there are efforts to promote traditional and indigenous foods in Africa. Urgent research is needed on the content of these foods and how they can be promoted as part of healthy diets from the region.
- Governments must commit funds for local research. Lack of funds is part of the reason for the poor quality of research. Although several tertiary institutions are increasing doctoral-level programmes, due to the lack of funding, students are compelled to self-fund their own research. Offices of Research could help students by identifying local and external funding sources for doctoral-level research.

- It will be important to set up mentorship programs for early-career nutrition researchers to have support and guidance on how to prepare award-winning grant proposals. An example is the African Women in Agriculture Research and Development Initiative (AWARD) that offers fellowships towards mentorship, career development and scientific research skills development for women agricultural scientists in Sub-Saharan Africa<sup>16</sup>. More such initiatives are needed.
- Post-service training for nutrition researchers is urgently needed. The COVID-19 pandemic has facilitated the opening of virtual programmes—virtual/hybrid conferences, webinars and on-line training courses. These have substantially reduced costs for such professional development activities. However, to fully access these facilities, internet infrastructure should be well developed.

In conclusion, building nutrition research capacity is key to generating the evidence for policy making and scaling up the needed interventions to achieve the global nutrition goals. Centers of Excellence for nutrition research and capacity building should be identified and collaborative efforts and networks strengthened across Africa. A database of African nutrition experts and research leaders should be established. There is a critical mass of world-renowned African academics and researchers with recognized global leadership in nutrition and food-systems research. Such a major human capital resource should be tapped into to help develop national and regional capacity for training, research and institutional capacity development for nutrition.

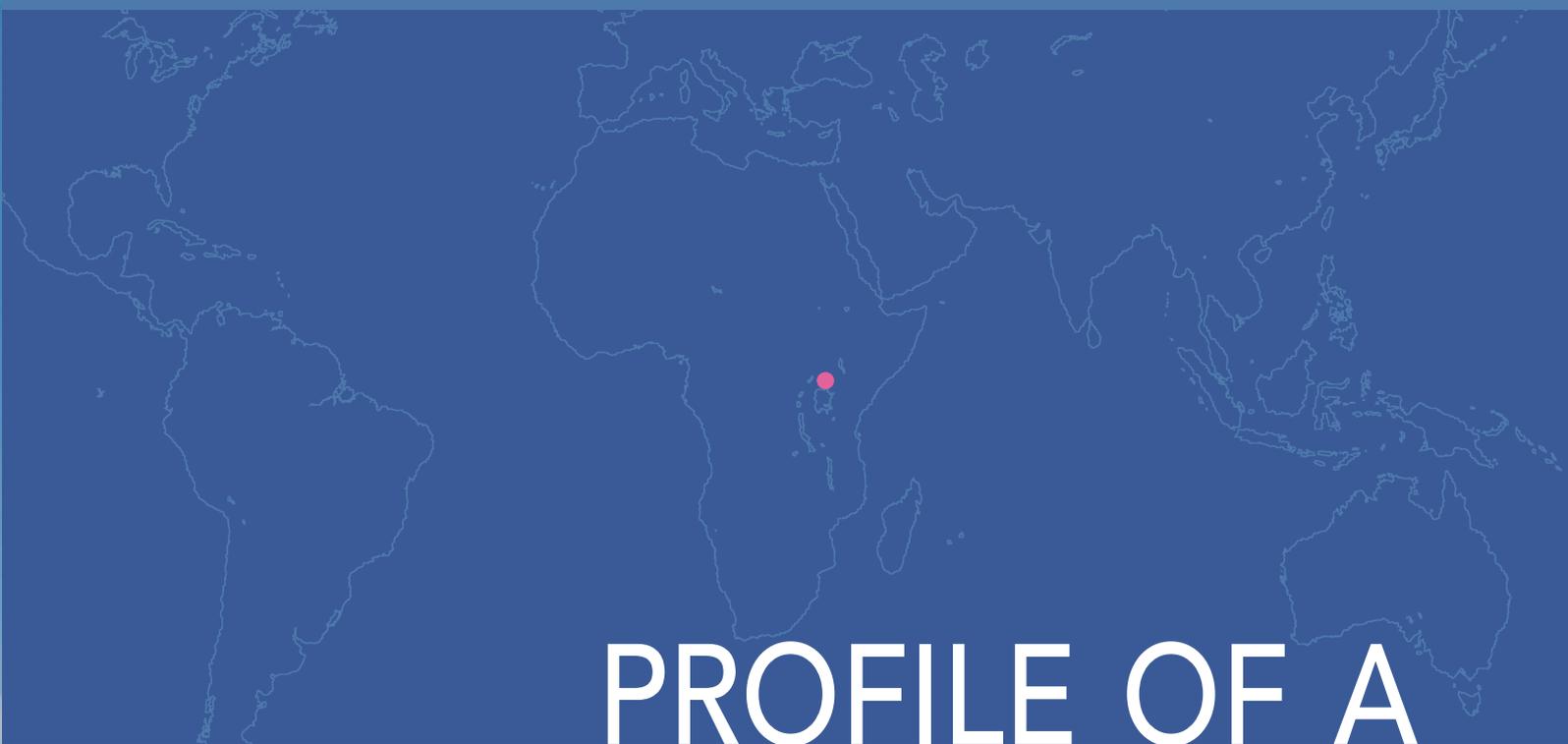
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15. Shrimpton R, du Plessis LM, Delisle H, et al. Public health nutrition capacity: The quality of workforce for scaling up nutrition programmes. *Public Health Nutrition* 2016;19:2090-100.
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# PROFILE OF A NUTRITION INSTITUTE



# MAKERERE UNIVERSITY

**Archileo Kaaya, PhD**  
**Robert Fungo, PhD**  
**Ivan Muzira Mukisa, PhD, Head of the Department**

Department of Food Technology and Nutrition  
School of Food Technology, Nutrition and Bio-  
Engineering  
Makerere University  
Main Campus  
Kampala, Uganda

## **Background**

The Department of Food Technology and Nutrition (DFTN) is the former Department of Food Science and Technology, and is part of the School of Food Technology, Nutrition and Bio-Engineering, College of Agricultural and Environmental Sciences, Makerere University. The DFTN is Uganda's leading centre for training and research in food sciences, food technology and human nutrition. For over thirty years, the department has been at the forefront of training and research for the nascent food sector in Uganda's economy. Our research programs focus on addressing current development challenges and issues of strategic importance to Uganda's food industry while putting special emphasis on the dynamic and global nature of the food and nutrition subsector. A number of technologies including nutrition packages and food products have been developed and are ready for uptake.

## **Graduate Training**

As far as training is concerned, the DFTN is the leading Department training undergraduates and graduate students in the areas of Food Science and Technology, Food Safety and Quality Management, and Human Nutrition. The Department has two undergraduate programmes: BSc. Human Nutrition (three years) and BSc. Food Science and Technology (four years). The DFTN also offers four postgraduate programmes: MSc. Applied Human Nutrition, MSc. Food Science and Technology, and MSc. Food Safety and Quality Management, as well as a PhD in Human Nutrition and Food Science. To date, the Msc Applied Human Nutrition and Msc Food Safety and Quality Management are only offered by the DFTN

# UGANDA

## AREA

|                    |                         |
|--------------------|-------------------------|
| Total:             | 241,038 km <sup>2</sup> |
| Agricultural land: | 71%                     |
| Arable land:       | 34%                     |

## POPULATION

|   |  |
|---|--|
| Total (July 2021 est.):   | 48,432,873   |
| Urban population (2018):  | 26%  |
| Under age 15:   | 48%  |
| Median age:   | 15.7 years<br>(Male 14.9 years /<br>Female 16.5 years) |
| Net migration rate<br>(per 1000) (2022 est.):                       | -3.26  |
| Rate of urbanization<br>(annual rate of change,<br>2020-2025 est.): | 5.4%   |

## POPULATION GROWTH RATE

|                                   |                              |
|-----------------------------------|------------------------------|
| Total (2022 est.):                | 3.27%                        |
| Total fertility rate (2022 est.): | 5.36 children born/<br>woman |

## GDP

|                           |           |
|---------------------------|-----------|
| (per capita, PPP) (2020): | USD 2,294 |
|---------------------------|-----------|

## LIFE EXPECTANCY AT BIRTH

|                                       |
|---------------------------------------|
| Total: 68.9 years                     |
| Male: 66.7 years / Female: 71.2 years |

## MORTALITY RATES

|  |                         |
|--|-------------------------|
| Neonatal mortality rate:                         | 19.2/1000 live births   |
| Infant mortality rate<br>(at birth) (2018 est.): | 30.4/1000 live births   |
| Under-five mortality rate:                       | 43/1000 live births     |
| Maternal mortality rate<br>(2017 est.):          | 375/100,000 live births |

## MICRONUTRIENT DEFICIENCIES

|   |     |
|---|-----|
| Households consuming<br>iodized salt (2016, %):     | 91% |
| Vitamin-A supplementation<br>(full coverage, 2018): | 33% |

## OTHER PARAMETERS

|   |            |
|---|------------|
| Population below poverty<br>line (2016 est.):                                       | 21.4%      |
| Mother's mean age<br>at first birth (2016 est.):                                    | 19.4 years |
| Contraceptive prevalence<br>rate (2018):  | 41.8%      |
| Health expenditure<br>(% of GDP, 2019):   | 3.8%       |
| Physician density per<br>1000 population (2017):                                    | 0.17       |
| Hospital bed density<br>(beds per 1000)   | 0.5        |
| Immunization, measles<br>(% of children<br>ages 12-23 months)                       | 87%        |
| Proportion of children<br>< 5 years sleeping under<br>insecticide-treated bed nets: | ~60%       |
| Youth literacy rate<br>(15-24 years):   | 89%        |
| Population using improved<br>sanitation facilities, 2020 est.,<br>total:            | 37.4%      |
| Population using improved<br>sanitation facilities, 2020 est.,<br>urban:            | 67.3%      |
| Population using improved<br>sanitation facilities,<br>2020 est., rural:            | 27.5%      |
| Adult HIV prevalence<br>(2020 est.):  | 5.4%       |
| Obesity (adult prevalence<br>rate 2016):  | 5.3%       |
| Internet users (% of the<br>population, 2019 est.)                                  | 23.7%      |
| Early initiation of<br>breastfeeding (%):   | 66%        |
| Exclusive breastfeeding<br>(5 months, %)  | 66%        |

in the entire country. Our graduates are leaders in managing the food industry and all nutrition-related programmes both in government and the private sector. In addition, the Department conducts non-formal skills-development courses (short courses) which mainly target small-scale entrepreneurs like women groups and the youth. The courses are aimed at equipping participants with hands-on skills in adding value to different products in a business context. The training is run on a short, modular basis.

### Research Activities and Infrastructure

The current research for development activities in the DFTN focus on the use of technological innovations in adding value to the locally available food resources to enhance nutrition and food security in the country. In addition to the wealth of well-trained researchers, the DFTN is proud of the nature of our infrastructure available for research and training in the areas of Food and Nutrition Sciences. The department boasts of four relatively well-equipped laboratories including a nutrition lab, food chemistry lab, microbiology lab and food sensory evaluation lab. These are essential for supporting student training, research and outreach activities. The DFTN also has two pilot processing plants equipped with various state-of-the-art food processing equipment which give the students hands-on experience in processing a range of products from meats, fruits and vegetables, cereals, roots and tubers, among others. The DFTN labs and pilot plants are also utilised by other universities in supporting their training programmes. The pilot plants are part of the Food Technology and Business Incubation Centre (FTBIC) that is the first University-based technology and business incubator in the East and Central African Region. The core business of the FTBIC is technology transfer and nurturing knowledge-based enterprises in the food processing and nutrition fields. Several start-up companies have been incubated in this facility with a number graduating and running their own businesses.

The DFTN has worked with the following development partners to conduct rigorous multidisciplinary research: The Government of Uganda, Nestlé Foundation, FAO, USAID, World Bank, Government of the Royal Kingdom of Norway, USAID, The Rockefeller Foundation, Thrasher Foundation, McKnight Foundation, European Union, DFID, British Council, Dutch Government, Harvest Plus, International Foundation for Science, SIDA-SAREC, East African Community, BIOEARN, Bill Gates Foundation, World Food Program, UNICEF, Association of African Universities, Uganda Manufacturers Association, UNESCO, and the Private Sector Foundation among others. The department has worked with these partners in a transparent manner with all accountabilities done following the University regulations or as have been deemed necessary by the partner.





A few of the many research studies that have been conducted by the staff of the DFTN as PIs or Co-PIs in the area of nutrition in the last five years are:

- Enhancing nutritional benefits and safety of maize to improve the health of Africans. Project conducted in collaboration with University of Maryland and FARM STEW NGO, Uganda; funded by the Nestlé Foundation
- Improving incomes and nutrition security through development and commercialization of consumer-preferred, processed legume-based products in Malawi and Zambia
- Creating an enabling environment and capacity for school food and nutrition
- Enhancing nutrition security and incomes through adding value to indigenous vegetables in East and Central Uganda
- Developing a photographic figure rating scale to reduce malnutrition among infants and young children among low-literate mothers in Buyende district
- Development of vegetable-enriched nutrient-dense products for schoolchildren
- Building the capacity of agricultural extension workers to conduct nutrition education
- A pilot virtual nutrition education and support program to enhance access to health services among individuals with noncommunicable diseases
- FOOD and Local, Agricultural, and Nutritional Diversity
- Promoting community- and home-based appropriate postharvest handling and processing of starchy staples to improve food and nutrition security in Uganda
- Harnessing dietary nutrients of under-utilized fish and fish-based products to combat micronutrient deficiency among vulnerable groups in Uganda (NutriFish)
- Development of high-quality food protein from multi-purpose crops through optimized, sustainable production and processing methods: PROTEIN2FOOD
- INSBIZ: INSEct-based agriBIZiness for sustainable grasshopper and cricket production and processing for food in Kenya and Uganda

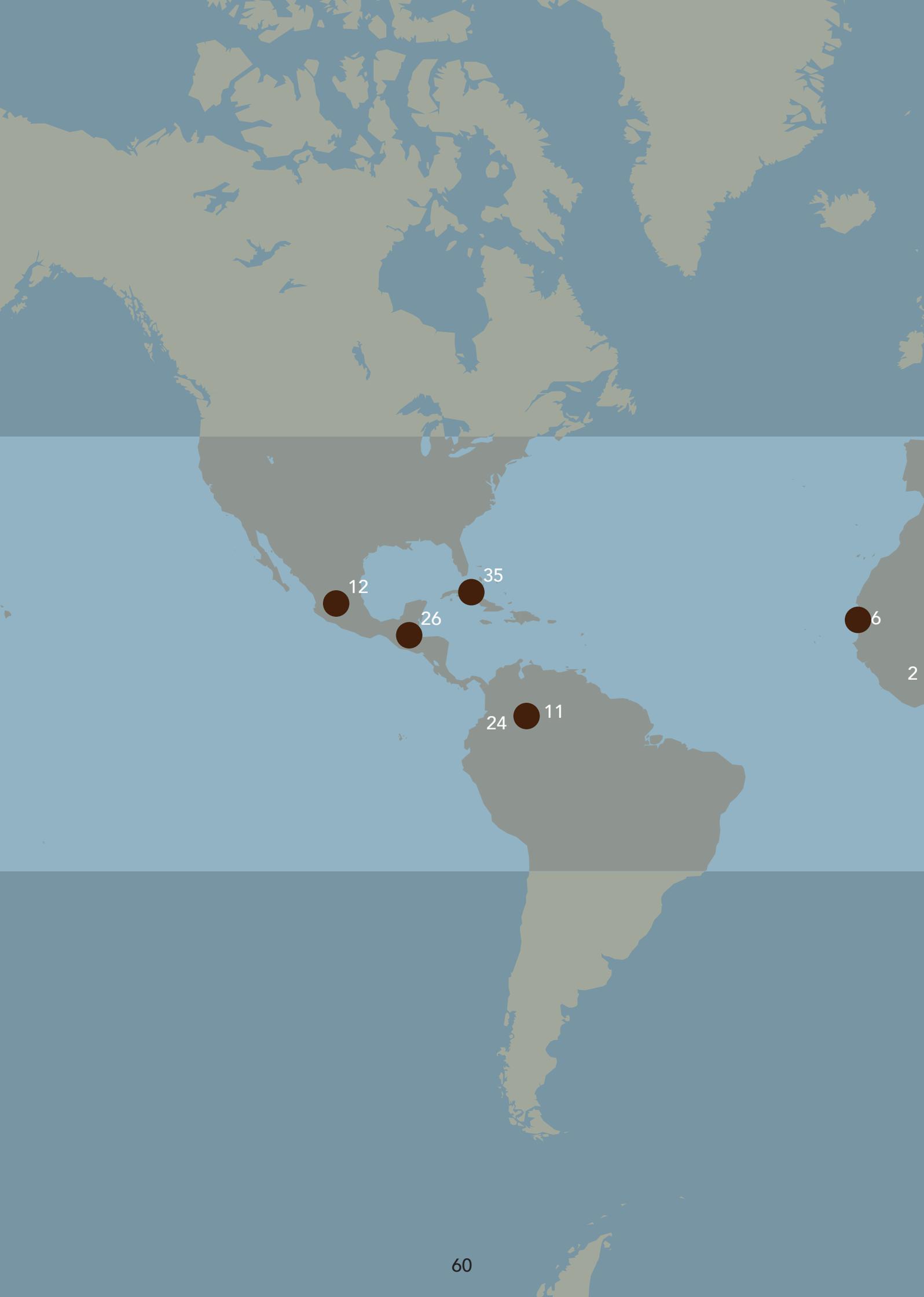
- Developing high-quality silverfish powder for utilization in the preparation of nutrient dense and acceptable complementary flours

The Department is currently hosting the Uganda Nutrition Society (UNS), a forum that unites all Nutrition Professionals in the country. UNS is one of the few active professional bodies in the country.

### Human Resources

Our core human resources include 17 academic staff (16 with PhDs): three Professors, three Associate Professors, five Senior Lecturers, four Lecturers and two Assistant Lecturers. These are experts in specific areas of food science, food technology and human nutrition. This team is supported by four highly trained and experienced technicians. In addition, the Department works in partnership with experts and professionals in areas such as business management and marketing.





12



26



35



11

24



6

2



# ONGOING PROJECTS



TITLE

PRINCIPAL INVESTIGATOR

MICRONUTRIENTS

INFANT AND CHILD NUTRITION

|   |  |  |
|---|--|--|
| 1 | 2018 / Efficacy of micronutrient powder formulation with low-dose iron in Bangladeshi children living in areas of high iron in groundwater                                     | Faruk Ahmed / Griffith University, Public Health, School of Medicine, Health Sciences, Queensland, Australia   |
| 2 | 2018 / Iron-biofortified fast-cooking cowpeas to reduce iron deficiency among children in malaria-endemic areas in Ghana   | Sylvester Addy / CSIR Crops Research Institute, Kumasi, Ghana  |
| 3 | 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   |
| 4 | 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                          |
| 5 | 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  |
| 6 | 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 Niasse, Bureau de Liaison, Dakar, Senegal |
| 7 | 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   |
| 8 | 2020 / Assessing causal relationship between Environmental Enteric Dysfunction (EED) and growth failure in children from Rukwa-Tanzania: A cross talk between EED and stunting | Modern Grantina / Nelson Mandela African Institution of Science and Technology (NM-AIST), Tengeru, Arusha, Tanzania  |
| 9 | 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   |

INFANT AND CHILD  
NUTRITION

10 2020 / Effect of nutrition education of village doctors on health status of children

Li Lei / Xiamen University, Public Health School, Xiamen, PR China

11 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

12 2021 / Vitamin A bioefficacy of high-provitamin-A carotenoid maize in Mexican schoolchildren

Verónica López Teros / Universidad de Sonora, Hermosillo Sonora, México

13 2021 / Study of effectiveness of a complementary food based on the mixture of locally produced food in the malnutrition prevention of children from 6 to 23 months old in Haut Katanga Province of the Democratic Republic of Congo: Randomized controlled trial (RCT) of the MASO31 recipe in Kapolowe Health Zone

Emmanuel Ngoy Bulaya / University of Lubumbashi, School of Public Health, Lubumbashi, Congo Republic

14 2010 / Pre-conceptional vs gestational food supplements and pregnancy outcomes in rural Vietnam

Tu Ngu / National Institute of Nutrition, Department of Applied Nutrition and Nutritional Surveillance at the National Institute of Nutrition, Hanoi, Vietnam

15 2013 / Impact of pre-pregnancy micronutrient supplementation on infant growth and development

Phuong Hong Nguyen / Thai Nguyen Medical School, Thai Nguyen, Vietnam

16 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

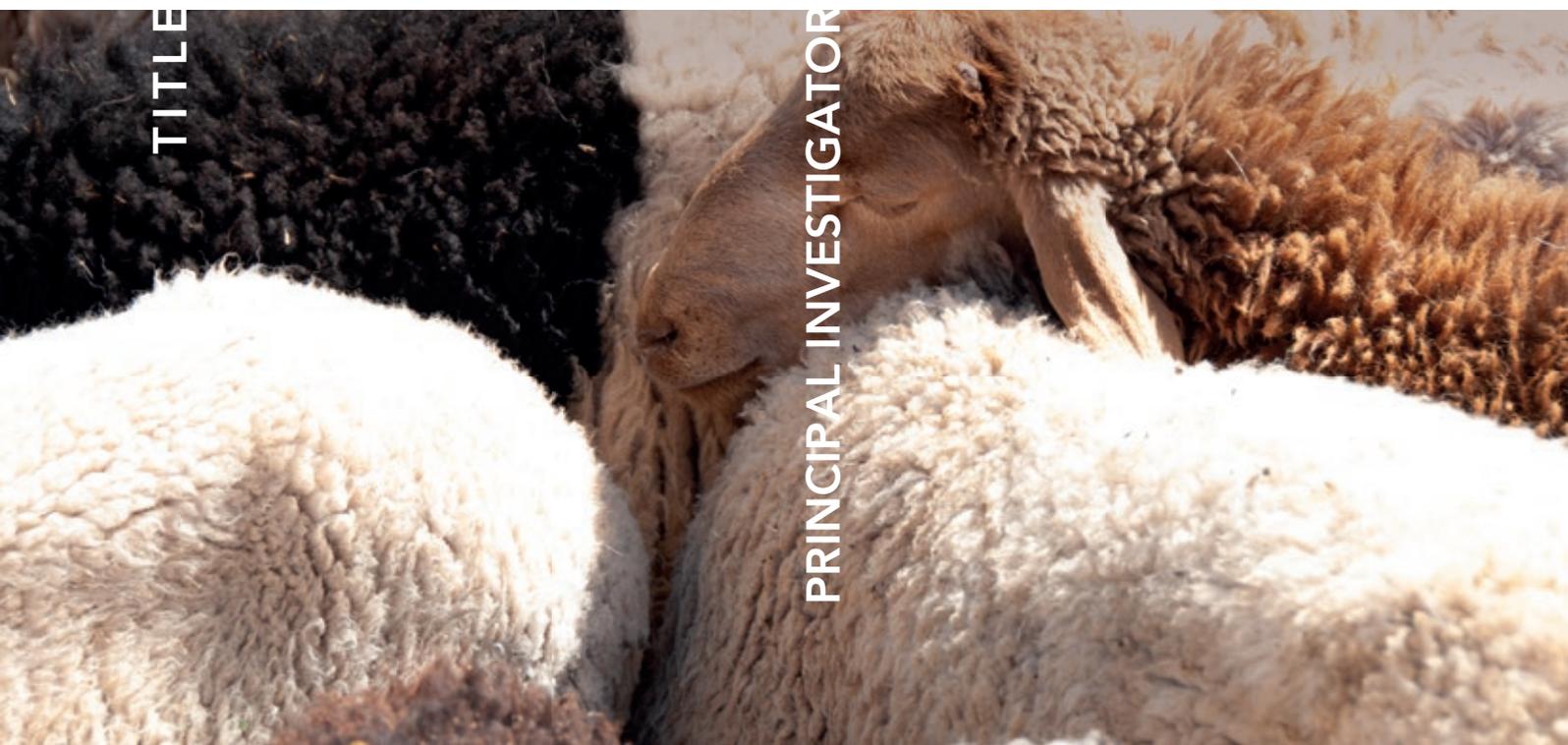
17 2018 / Impact of preconceptual micronutrient supplementation on child growth and development

Phuong Hong Nguyen / Thai Nguyen Medical School, Thai Nguyen, Vietnam

MATERNAL  
NUTRITION

TITLE

PRINCIPAL INVESTIGATOR





TITLE

PRINCIPAL INVESTIGATOR

**MATERNAL  
NUTRITION**

- 18 2020 / Folate and vitamin B12 assessment among women of reproductive age in Eritrea: A population-based study 2020
- 19 2020 / Promotion of exclusive breast feeding and young child feeding practices through m-Health: A randomized controlled trial
- 20 2020 / An urban picture of overweight, gestational weight gain and pregnancy outcomes among slum and non-slum dwellers in Pune, India

- Kidane Amanuel / Xi'an Jiaotong University, Department of Epidemiology and Biostatistics, Xi'an, Shaanxi, PR China
- Rozina Nuruddin / Aga Khan University, Department of Community Health Sciences, Karachi, Pakistan
- Deshpande Swapna / Hirabai Cowasji Jehangir Medical Research Institute, Pune, India

**NUTRITION  
EDUCATION**

- 21 2019 / Designing, administering and evaluation of a nutrition training package for rural women farmers in Tanzania
- 22 2020 / Long-term effects of acute malnutrition on physical function: A 5-year prospective cohort study in Ethiopia

- Hadijah Ally Mbwana / University of Agriculture, Department of Food Technology, Nutrition Sciences, Sokoine, Tanzania
- Tsinuel Girma / Jimma University, Department of Human Nutrition, Jimma, Ethiopia

**FORGOTTEN CROPS /  
AGRICULTURE**

- 23 2020 / A methodological framework to transform monoculture to complex rice system landscape in East Java, Indonesia
- 24 2021 / Exploring the potential of agro-ecology to restore community diet diversity and food security in a vulnerable rural area of Colombia

- Uma Khumairoh / Brawijaya University, Malang, Indonesia
- Clara Nicholls and Miguel Altieri / Centro Latinoamericano de Investigaciones Agroecológicas (CELIA), Berkeley, California, USA

## OTHER RESEARCH AREAS

|    |  |  |
|----|--|--|
| 25 | 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  |
| 26 | 2013 / Behavior change and nutrition associated with integrated maternal/child health, nutrition and agriculture program         | Manolo Mazariegos / Institute of Nutrition of Central America and Panama (INCAP), Guatemala City, Guatemala  |
| 27 | 2013 / Healthy kitchens, healthy children: A school-based cluster randomized controlled trial                                    | Nadine Sahyoun and Hala Ghattas / University of Maryland, Department of Nutrition and Food Science, College Park, Maryland, USA and American University of Beirut, Center for Research on Population and Health, Beirut, Lebanon |
| 28 | 2014 / Nutrition Gap Map: A comprehensive mapping, quality assessment and summary of nutrition-relevant systematic reviews       | Zulfiqar Ahmed Bhutta / Aga Khan University Hospital, Women and Child Health, Karachi, Pakistan  |
| 29 | 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  |
| 30 | 2015 / Maternal folate supplementation and epigenetic changes in the offspring   | Phuong Hong Nguyen / Thai Nguyen Medical School, Thai Nguyen, Vietnam  |
| 31 | 2015 / Effect of vitamin B12 supplementation during pregnancy and 6-month postpartum to improve B12 status and child development | Towfida Jahan Siddiqua / icddr, b, Nutritional Biochemistry Lab, Sciences Division, Dhaka, Bangladesh  |
| 32 | 2016 / Risk factors and associated cost of preventing childhood stunting: A case study of Buhweju district, Uganda               | John Bukusuba / Makerere University, School of Food Technology, Nutrition and Bioengineering, Kampala, Uganda  |
| 33 | 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   |

TITLE

PRINCIPAL INVESTIGATOR





TITLE

PRINCIPAL INVESTIGATOR

OTHER RESEARCH AREAS

- |    |   |   |
|----|---|---|
| 34 | 2017 / Development of bio-control approach for mitigation of aflatoxin in groundnuts using atoxigenic strains of <i>Aspergillus</i> spp in Tanzania   | Juma Mfaume / Naliendele Agricultural Research Institute (NARI), Mtwara, Tanzania   |
| 35 | 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   |
| 36 | 2018 / Towards introduction of “edamame”, vegetable soybean, for more nutritious diets and food availability in Benin   | Eric Etchikinto Agoyi / University of Abomey Calavi, Cotonou, Benin   |
| 37 | 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   |
| 38 | 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                    |
| 39 | 2019 / Optimizing household agricultural production for nutrition: Impacts of nutrition education on Zambian households   | Kelvin Mulungu / Colorado State University, Fort Collins, Colorado, USA   |
| 40 | 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  |
| 41 | 2019 / Dietary patterns of Indonesian elderly diet and their associations with sodium and potassium intakes: A baseline study to develop a nutrition program for non-communicable disease                                   | Dianis Wulan-Sari / The University of Tokyo, Tokyo, Japan   |
| 42 | 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 |

## OTHER RESEARCH AREAS

43 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

44 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

45 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

46 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



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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. The Foundation is independent and self-constituting and is managed by a Council consisting of at least five internationally well-known scientists as Council Members. The Foundation has been financially and operationally independent of the Nestlé Company since its inception due to the endowment received in 1966. 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, basic and applied research in nutrition has been supported by the Foundation 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, priority is given to projects which lead to sustainable developments with strong elements of capacity building, and the implementation of the results of a research project should be immediate and sustainable. 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, and
- (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 are dealing with 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.

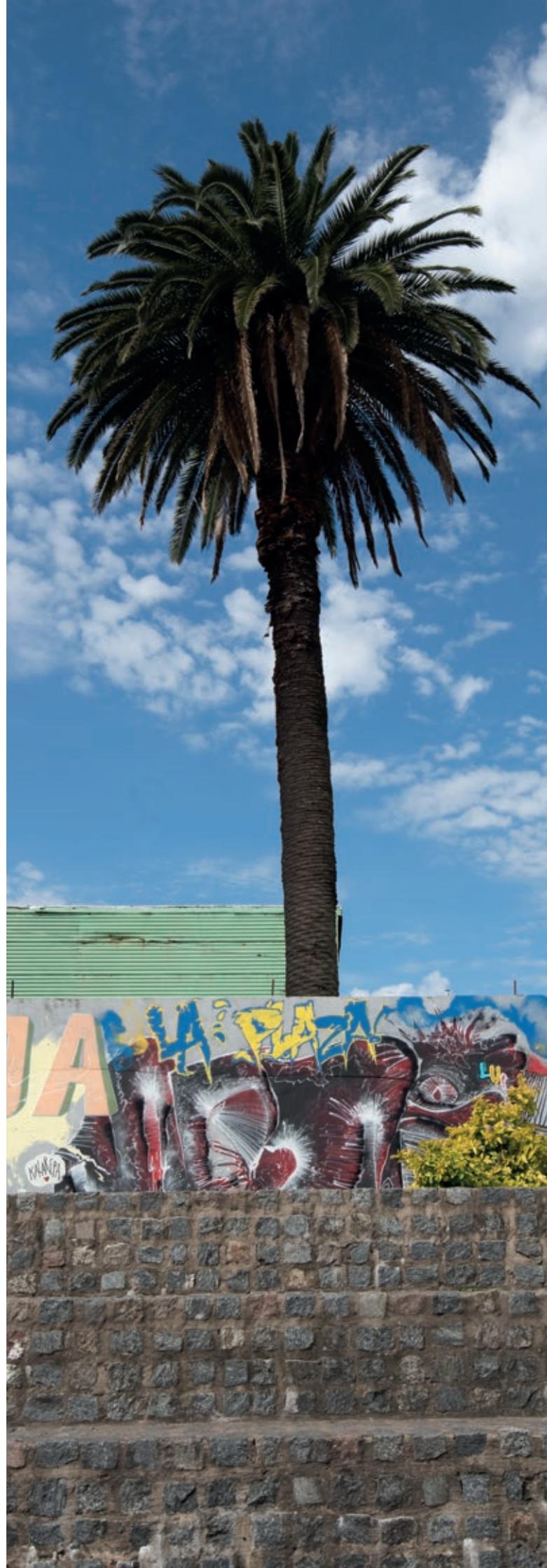
The Foundation does not normally fund:

- (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**

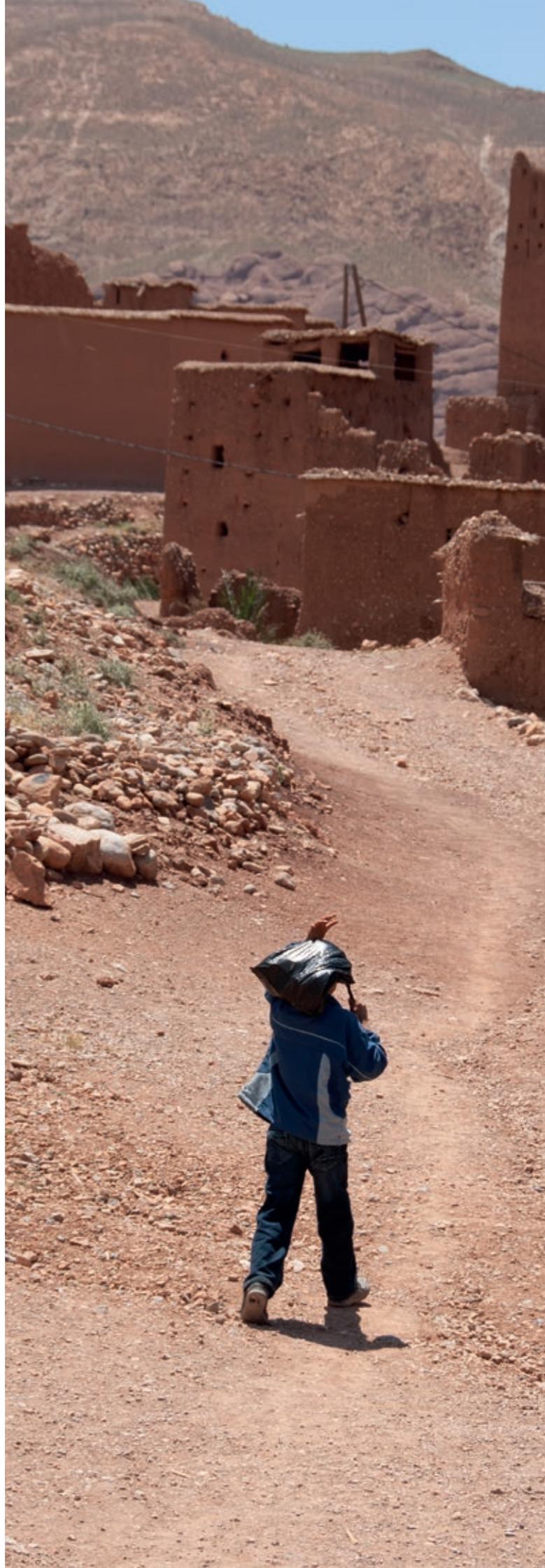
Interested scientists should first submit a letter of intent in which they describe very briefly the kind of project they would like to undertake, including an estimated budget. Instructions for the letter of intent are available on the Foundation website at [www.nestlefoundation.org](http://www.nestlefoundation.org). For a 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 reported. 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.

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.

## THE COUNCIL

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#### **Charlotte Terrier**

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Ernst & Young AG, Bern, Switzerland

From left to right: Ben Caballero, Ann Prentice, Petra S. Hueppi, Dominique Darmaun, Anura Kurpad, Paolo M. Suter.  
Since we only had remote Council Meetings in 2021, Anna Lartey is not on the picture.





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Throughout The Report 2021 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.



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

Mahatma Gandhi

Nestlé Foundation



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