



innmana

Innovative Methods & Metrics for Agriculture and Nutrition Actions

Phase 1 outputs and impact
(2014 - 2019)



Introduction

Since its inception in 2015 – with the promise to accelerate the development of a robust scientific evidence base, needed to guide changes in global agriculture-food systems to feed the world's population in a way that is both healthy and sustainable – the Innovative Methods and Metrics for Agriculture and Nutrition Actions (IMMANA) programme has awarded 15 cutting-edge research projects through two competitive funding calls; supported and mentored 21 early-career researchers through its Fellowships programme; and convened – through the Agriculture, Nutrition & Health (ANH) Academy – the global community of researchers, practitioners and policymakers, providing platforms and opportunities for learning, sharing and interaction.

During the past five years, it has been a privilege to lead IMMANA, which has now reached the end of the first chapter. This ambitious series of interlocking and mutually strengthening workstreams has catalysed interdisciplinary collaboration and generated impact, continuing now to evolve in ways that go beyond what we thought possible. The life that this programme has taken on for itself is testament to the hard work and imagination of so many people and institutions who collectively make IMMANA's whole that much greater than the sum of its parts.

As well as our core partners, donors, grantees, Fellows and ANH Academy members who form this wonderfully energised and inspiring

community, I would like to pay special thanks to IMMANA's Steering Committee for the invaluable guidance throughout the programme; to the Independent Panel of Experts, and peer reviewers for their crucial role in impartially selecting Grants and Fellowships; as well as the huge number of partners and collaborators who – over the years – have supported the programme through serving on ANH Academy Week Committees, volunteering at events, or taking part in technical working groups, webinars and blogs.

This short report seeks to highlight briefly the impact that IMMANA has had in its relatively short life to date, providing an overview of some of the stand-out accomplishments from across the programme. We invite you to browse through this record of IMMANA's legacy and very much encourage you to stay in touch as we continue to drive this agenda forward in an exciting and expanded Phase 2.

With warm regards,

Suneetha Kadiyala

IMMANA Principal Investigator, Chair of the Management Committee

Associate Professor in Nutrition-sensitive development, London School of Hygiene & Tropical Medicine (LSHTM); LCIRAH Management Committee member

IMMANA Phase 1 Panels/Committees

INDEPENDENT PANEL OF EXPERTS

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IMMANA STEERING COMMITTEE

Sally Abbott, Acting Nutrition Division Chief, Bureau for Food Security at United States Agency for International Development (USAID)

Laura Birx, Deputy Director of Strategy, Planning and Management, Bill & Melinda Gates Foundation

Margaret Gill, Professor of Integrated Land Use, School of Biological Science, University of Aberdeen, UK (former Senior Research Fellow, UK Department for International Development (DFID))

John McDermott, Director, CGIAR Research Program on Agriculture for Nutrition and Health (A4NH)

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IMMANA MANAGEMENT COMMITTEE

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Who we are

Innovative Methods and Metrics for Agriculture and Nutrition Actions (IMMANA) is a research initiative funded by UKaid from the UK Government Department for International Development. IMMANA aims to accelerate the development of a robust scientific evidence base needed to guide changes in global agriculture and food systems to feed the world's population in a way that is both healthy and sustainable.

IMMANA consists of three interrelated workstreams:

- Competitive Research Grants to Develop Innovative Methods and Metrics for Agriculture and Nutrition Actions (Grants)
- Post-doctoral Fellowships for Emerging Leaders in Agriculture, Nutrition and Health Research (Fellowships)
- Agriculture, Nutrition & Health Academy: a global agriculture and food systems research network for improved nutrition and health.

For more information, please visit our website:
<http://immana.lcirah.ac.uk/>

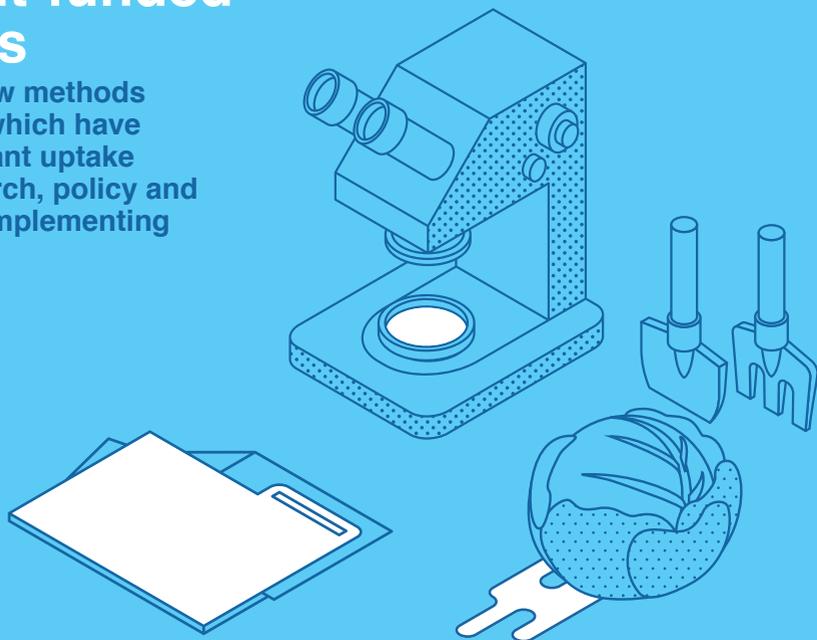


The London Centre for Integrative Research on Agriculture & Health



15 grant-funded projects

generated new methods and metrics which have seen significant uptake among research, policy and programme implementing communities



GRANTS

KEY:



Metrics



Methods



Tools



His and Hers, time and income: How intra-household dynamics impact nutrition in agricultural households

PRINCIPAL INVESTIGATORS

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INSTITUTION

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TOPICS

Food choice, Intra-Household dynamics

DISCIPLINES

Economics, Nutrition

OUTPUT

Choice experiment methods

SIGNIFICANCE

While nutrition knowledge, household dynamics, and agricultural and care practices are all known to influence food choices, how households manage these factors individually or jointly is not well understood. Often research is limited by relying on observational data to explain recalls of food consumption. Efforts to test and refine experimental approaches can help identify factors that influence nutrition and food choices, which are generally difficult to observe and should be prioritized to strengthen methods addressing this key research area.

METHOD OR METRIC

Traditional choice experiments use hypothetical scenarios to understand an individual's preferences. This project adapts this method by asking couples, in addition to individuals, to provide insights on how joint decisions are made. Another important adaptation was the use of incentives to ground the experiments in reality: participants were given a coupon to make food purchases at a local store, their purchases were recorded and can be compared to the experimental food choices and the survey data on food availability in the households (24-hour HDDS).

This project also developed a method to combine choice experiment data with traditional survey data to achieve a primary research objective: to understand how nutritional knowledge, different levels of income and time use impact joint decision-making around food consumption.

IMPACT

Many of the pathways linking agriculture to nutrition are impacted by decision-making processes. By combining observational and experimental methods, new insights can be drawn on how household dynamics influence food choices and nutrition outcomes. From a series of info-notes, presentations, audio-visual materials and workshops hosted by the CGIAR, the team has contributed research on:

- Nutritional outcomes associated with agricultural Guatemalan households.
- Implementing food security and nutrition indicators within the project.
- Using women's empowerment indicators for the Guatemalan context.

KEY RESOURCES

- Twyman, J., Useche, P., Gonzalez, C., Talsma, E., & Lopera, D. (2018). *Intra-household dynamics regarding nutritional decisions in rural Guatemala*. Cali, Colombia: International Center for Tropical Agriculture (CIAT) (3 pages).
- Muriel, J., Twyman, J., Lopera, D.C., Useche, P., Gonzalez, C., Talsma, E.F., & Cosenza, E.L. (2019). *His and Hers, time and income: How intra-household dynamics impact nutrition in agricultural households. Methods guide: Designing and implementation of data collection tools*. Cali, Colombia: International Center for Tropical Agriculture (CIAT) (52 pages).
- Muriel, J., Twyman, J., Useche, P., Lopera, D.C., Gonzalez, C., & Talsma, E.F. (2019). The Abbreviated Women's Empowerment in Agriculture Index (A-WEIA). *Project results for "His and Hers, time and income: How intra-household dynamics impact nutrition in agricultural households"*. Cali, Colombia: International Center for Tropical Agriculture (CIAT) (5 pages).
- Cosenza, E.L., Arora, D., Twyman, J., Useche, P., Gonzalez, C., Lopera, D.C., & Talsma, E. (2019). *Nutritional status of adults and children under 5 years of age in two areas of Guatemala: Project results for "His and Hers, time and income: How intra-household dynamics impact nutrition in agricultural households"*. Cali, Colombia: International Center for Tropical Agriculture (CIAT) (5 pages).
- Lopera, D.C., Gonzalez, C., Twyman, J., Useche, P. & Talsma, E.F. (2019). *Household Food Security: Project results for "His and Hers, time and income: How intra-household dynamics impact nutrition in agricultural households"*. Cali, Colombia: International Center for Tropical Agriculture (CIAT) (7 pages).
- Estrada, Gabriela; Lopera, Diana Carolina; Twyman, Jennifer; Useche, Pilar; Gonzalez, Carolina & Talsma, Elise F. (2018). *Recomendaciones para una alimentación saludable usando la olla familia - Guatemala*. [Video file]. Cali, Colombian: International Center for Tropical Agriculture (CIAT).

DEVELOPMENT OR UPTAKE STATUS

Governmental and non-governmental organizations in Guatemala and several CGIAR research programmes have expressed interest in using the adapted choice experiment method for their ongoing and future projects.



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Leveraging value chains to improve nutrition

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TOPICS

Food systems, Nutrition

DISCIPLINES

Economics, Epidemiology

OUTPUT

Value chain framework,
Mixed methods

SIGNIFICANCE

Food value chains are directly tied to food supply, consumer demand and nutritional quality; thus, they are important targets for nutritional interventions in low- and middle-income countries. However, previous work on value chains has largely ignored nutrition, instead focusing on increasing production or improving process efficiency. Future research and policies that leverage value chains for nutrition require a common framework comprised of validated methods and metrics that are applicable across a variety of contexts.

METHOD OR METRIC

Value chains for nutrition (VCN) are frameworks that describe factors influencing the supply and demand for nutritious foods. They cover both the public and private sectors and can be used to understand gaps or design potential interventions to achieve nutrition targets. VCNs seek to improve overall diet quality by considering processes related to a diversity of foods, their interlinked relationships, and trade-offs from multidisciplinary perspectives.

IMPACT

Through this project, a multidisciplinary framework for linking value chains to nutrition was refined and applied to World Food Programme interventions in Malawi. By integrating evaluation methods and metrics from a variety of disciplines, the team provided a comprehensive blueprint for future efforts in parallel settings.

For the Malawi context, the research uncovered valuable insights on the capacity of local food systems to provide diverse, nutritious foods. In one area, highly perishable but nutrient-rich foods, such as fruits and fish, were susceptible to price fluctuations or low availability. In response, households receiving food assistance relied on the government support to meet their nutritional needs. These findings, along with others gleaned from the project, were presented to stakeholders in the Government of Malawi.

KEY RESOURCES

- Gelli, A., Aberman, N.-L., Margolies, A., Santacroce, M., Baulch, B., & Chirwa, E. (2017). Lean-Season Food Transfers Affect Children's Diets and Household Food Security: Evidence from a Quasi-Experiment in Malawi. *The Journal of Nutrition*, 47(5): 869-878. DOI:10.3945/jn.116.246652.
- de la Peña, I., Garrett, J., & Gelli, A. (2018). *Nutrition-sensitive value chains from a smallholder perspective*. IFAD Research Series 30. International Fund for Agricultural Development, Rome, Italy.

DEVELOPMENT OR UPTAKE STATUS

The developed VCN framework has been endorsed and taken up by the Global Forum on Food Security and Nutrition. Stakeholder engagement with UN agencies (Food and Agriculture Organization, International Fund for Agricultural Development, and the World Food Programme) has resulted in concerted focus on nutrition-sensitive value chains.

With funding from The Bill & Melinda Gates Foundation, the IFPRI-based team will apply the diagnostics and evaluation methods of the framework to poultry value chains in Burkina Faso and further research in Malawi.



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Agrifood: Development and validation of a rapid assessment tool to identify nutrient gaps in local food systems and help design nutrition-sensitive interventions for agriculture projects

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TOPICS

Food systems, Rapid assessment

DISCIPLINES

Economics, Nutrition, Agronomy

OUTPUT

Decision-support tool, Data validation

SIGNIFICANCE

Food systems in low- and middle-income countries are often inadequate in supporting quality diets for women and children. Despite this, there is a considerable lack of user-friendly tools that rapidly assess food systems and generate recommendations for appropriate nutrition-sensitive agricultural interventions. Efforts to address this need – that consider limited data, private and public sector demands and local environments – are critical for improving nutrition through agriculture.

METHOD OR METRIC

Agrifood is a software tool that supports decision-makers in selecting foods to promote production and/or consumption in the context of nutrition-sensitive agriculture. Agrifood uses Multi-Criteria Decision Analysis (MCDA) to examine agriculture, nutrition, gender and environment trade-offs, and provide a series of ranked options for food combinations. Users can choose up to 10 criteria relevant to their programme decisions (examples are crop yield, nutrient adequacy, water needs and food safety) and compare the results when considering the way different stakeholders may value these criteria.

Recognizing the lack of availability of dietary data, the Agrifood models use estimated food portions and consumption frequency to determine the nutrition criteria and model complete diets. Data, for non-nutrition criteria, can be entered using actual values or a relative scale (e.g., scoring from low to high) across food options.

IMPACT

Along with its predecessor, Optifood, Agrifood underscores the usefulness of modelling for multidisciplinary decision-support tools.

Agrifood
Edit Analysis

Jump to: [Select Foods](#)

Select Foods [Snapshot](#) [Results](#) [Calculate](#)

[Add Non-Staple Food](#) [Add Staple Food](#)

Press 'Calculate' to view the results.

Food	Include in all combinations	Short name	Portions per week	Portion size (g)	Cost per 100g	
Non-Staple Foods						
Fava beans (broadbeans),mature/dried,raw	<input type="checkbox"/>	Broadbeans	4	35	4.42	Delete
Cowpeas,mature/dried,raw	<input type="checkbox"/>	Cowpeas	4	35	6.2	Delete
Cowpeas leaves,dried,raw	<input type="checkbox"/>	Cowpeas_leaf	7	50	5.01	Delete
Pumpkin leaves,fresh,raw	<input type="checkbox"/>	Pumpkin_leaf	7	80	4.32	Delete
Cassava leaves,fresh,raw	<input type="checkbox"/>	Cassava_leaf	2	60	1.29	Delete
Okra,fresh,raw	<input type="checkbox"/>	Okra	7	38	9.14	Delete
Pumpkin,fresh,raw	<input type="checkbox"/>	Pumpkin_fresh	7	50	5.3	Delete
Fish,carp,fresh,boiled,drained	<input type="checkbox"/>	Carp_fresh	3	40	12.26	Delete
Fish,cod,Atlantic,dried & salted	<input type="checkbox"/>	Cod_dried	3	20	19.85	Delete
Goat meat,fresh,raw	<input type="checkbox"/>	Goat_meat	2	40	35	Delete
Sweet potato,orange,fresh,boiled,drained (Mozamb...)	<input type="checkbox"/>	OPSP	7	70	1.9	Delete
Staple Foods						
Cassava,four,raw (West Africa)	<input type="checkbox"/>	Cassava_flour	21	55	2.39	
1.H - Breast Milk						
Use estimate based on Bricart 1971, Dewey YG & Allen LH (1998) <input type="checkbox"/>						
g per day (assuming 1.66 kg/day)						



With agriculture and nutrition policymakers and practitioners consulted across its development process, and by being available online for free, Agrifood is poised to improve food systems by facilitating careful nutrition-sensitive agricultural planning.

KEY RESOURCES

- Knight, F. (2016). *Using Optifood to make agriculture more nutrition sensitive*. IMMANA, London School of Hygiene & Tropical Medicine (UK). Available from: <https://anh-academy.org/blog/2016/05/06/using-optifood-make-agriculture-more-nutrition-sensitive>

Above. A screenshot of Agrifood
Inset. Mozambique Agrifood training (pics: F. Knight)

DEVELOPMENT OR UPTAKE STATUS

This project will continue to test and refine the beta version of Agrifood through additional funding and use by parallel programmes. The Global Challenges Research Fund has funded research projects in Senegal, India and Indonesia, in which Agrifood will be used in food value chain research through its Action Against Stunting Hub; and The Medical Research Council and Newton Fund will fund a project, in which Agrifood will be used for agriculture and nutrition research in Peru. The International Potato Center has agreed to disseminate Agrifood and supporting materials through its network.



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ENRICH: Enriching vegetable consumption by using reliable, cheap and fast consumer-generated data: a proof of principle study for real-time and in-situ method and metrics to assess vegetables intake by targeted consumers in Nairobi, Kenya

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TOPICS

Fruits and vegetables, Food choice motives

DISCIPLINES

Economics, Nutrition, Psychology

OUTPUT

Data collection tool

SIGNIFICANCE

Fruits and vegetables are important contributors to urban diets, nutrition and health. However, current methods to assess fruit and vegetable consumption are costly, burdensome to respondents and biased by recall. Furthermore, they do not account for individual preferences or environmental factors that might influence intake. Thus, more timely and comprehensive data on food intake and choice behaviour are needed for designing effective programmes that address present nutrition challenges.

METHOD OR METRIC

ENRICH Bot is a mobile phone application that facilitates real-time data collection on fruit and vegetable consumption and food choice motives. When linked to a mobile phone, the ENRICH Bot will send a message on stratified random moments throughout the day to prompt the user to enter data on their fruit and vegetable consumption in the last four hours and their food choice motives. Preliminary analysis indicates food choice motives data collected through ENRICH Bot are comparable to the standard self-administered paper-based questionnaires. However, the results should be carefully interpreted.

IMPACT

Development and testing of the ENRICH Bot application yielded important findings for similar work. Recommendations are formulated on three topics: (1) technical quality, (2) recruitment and (3) responses. The study found using traditional diet recalls in urban settings may not be appropriate: in the Nairobi context, prospective respondents did not



Above. The ENRICH project team in Nairobi at the second project meeting

have the time to sit for an hour-long interview. Furthermore, designing data collection tools to resemble the user interfaces of well-known applications, such as WhatsApp, could improve user experience and increase uptake.

Another aim was to check whether it would be possible to see if the collected data of a smaller study sample (ENRICH study sample) could be extrapolated to a larger urban area. The results of the extrapolation show that the results of the traditionally collected ENRICH data are comparable, in the sense that it is possible to re-compare the participants after restructuring the data from the Kenya Integrated Household Budget Survey and ENRICH.

KEY RESOURCES

- ENRICH Project (2017). *Development of a mobile phone application to monitor fruit and vegetable consumption and choice motivation in Nairobi*. Wageningen Economic Research (The Netherlands). Available from: https://www.wur.nl/upload_mm/d/0/7/b09da23d-3649-41b8-a940-9379cf7ecf0f_Development%20of%20a%20mobile%20phone%20application%20to%20monitor%20fruit%20and%20vegetable%20consumption%20and%20choice%20motivation%20in%20Nairobi.pdf
- ENRICH Project (2019). *Designing a Smartphone Application*. Learning lab at the Agriculture, Nutrition & Health Academy Week 2019, Hyderabad, India. Available at: <https://www.anh-academy.org/sites/default/files/Desinging%20a%20smartphone%20app.pdf>
- Raaijmakers, I., van den Puttelaar, J., Linderhof, V., Habumugisha, T., Odhiambo, F., Melse-Boonstra, A., Borgonjen, K., Mueni, I., McMullin, S., Roothaert, R., Kassam, Z., Wanjiru, M., de Vries, J.H.M., & Ruben, R. (2019). *Development and validation of a smartphone app to measure Food Choice Motives of Urban Kenyan consumers—Results of the ENRICH study*. Poster sessions presented at the Agriculture, Nutrition & Health Academy Week 2019, Hyderabad, India.

DEVELOPMENT OR UPTAKE STATUS

In addition to traditional dietary data collection, the project used skin colour measurements to estimate fruit and vegetable intake. Future research will analyse these data to further test the validity of the ENRICH Bot against this method.



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Measuring the livelihoods of smallholder farmers and critical linkages from farmer livelihoods

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TOPICS

Smallholder farming,
Randomized controlled trial

DISCIPLINES

Nutrition, Economics

OUTPUT

Survey design

SIGNIFICANCE

Smallholder farming is an important source of income and livelihoods for millions of people, but our understanding of its impact on food and nutrition remains limited. Given emerging shifts in market access, migration and urbanization, and diet patterns, improving our research toolkit to study these dynamic linkages, such as through better survey design, is critical.

METHOD OR METRIC

The first objective of the project was to develop different typologies of smallholder farmers' livelihoods that are relevant for nutrition. Using data from the 2014 Burkina Faso Continuous Multisectoral Survey, the team identified different combinations of production factors, for example, levels of crop diversity, household income attributed to farm or non-farm activities, and women's decision-making, and estimated their associations with household dietary diversity.

The second objective of the project was to study agricultural survey bias and its impact on measuring nutrition. Following a randomized controlled trial design, surveys of varying length and detail were administered to heads of households or plot managers to assess how these differences affect variation in responses. The trial was carried out across three agroecological zones of Burkina Faso.

IMPACT

This research generated key findings on the significance of agricultural production, farmer livelihoods and survey design on effective measurement and improvement of child nutrition. Several agricultural factors were found to be closely associated with household dietary diversity: seasonality impacted consumption of nutrient-dense foods, such as green leafy vegetables and dairy, and production of higher value crops and greater food spending were tied to more diverse food consumption.



For their randomized trial on agricultural survey design, the results showed that shorter surveys administered to heads of household either depressed or distorted how crop diversity was reported.

Above. Community members with donkeys during survey field work in Burkina Faso (pic: Jerome Some)

KEY RESOURCES

- Dillon, A., Jones, A.D., & Mensah, E. (2018). Proxy biases in agricultural statistics. IFPRI, AMD Seminar Series. Available from: https://amdseminarseries.files.wordpress.com/2018/05/effects-of-survey-design-methods-on-agricultural-outcomes_4_29_2018.pdf
- Somé, J.W., & Jones, A.D. (2018). The influence of crop production and socioeconomic factors on seasonal household dietary diversity in Burkina Faso. *PLoS One*, 13(5): e0195685. Available from: <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0195685>

DEVELOPMENT OR UPTAKE STATUS

The methods and findings from the randomized trial were summarized into technical guidance and distributed to key stakeholder groups, as well as peer-reviewed literature.



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Indicators of Affordability of Nutritious Diets in Africa (IANDA)

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TOPICS

Food environments, Africa

DISCIPLINES

Economics, Nutrition

OUTPUT

Statistical indicators, National policy uptake

SIGNIFICANCE

The lack of affordability of key foods, such as fruits, vegetables and animal source foods, persists as a barrier to adequate nutrition, especially in Africa. While agriculture and statistics organizations track the prices of some foods, they typically select commodities and calculate indicators based on economic importance. Using these data to monitor nutrition affordability can provide a novel approach to understanding food environments in flux.

METHOD OR METRIC

The IANDA Project developed four indicators to measure the affordability of adequate nutrition or diet quality. These indicators use market-level food price data, such as from national agricultural or statistics organizations.

- **Cost of Diet Diversity:** to measure the cost of meeting a minimum of five food groups, as defined by the Minimum Diet Diversity for Women (MDD-W) score
- **Cost of Nutrient Adequacy:** to measure the minimum cost of achieving adequate intake of energy and a set of essential nutrients
- **Cost of a Recommended Diet:** to measure the minimum cost of meeting food-based dietary recommendations, as defined for a specific population
- **Nutritious Food Price Index:** to measure the cost of a basket of foods weighted individually by nutritional value

IMPACT

The Ghana Ministry of Food and Agriculture (MoFA) integrated IANDA's indicators with their food price monitoring. Work with the Tanzania national government continued through discussion to improve food price monitoring between ministries and regional organizations.



In addition to its primary objectives, IANDA created opportunities to strengthen other areas of food price data collection and monitoring. Spurred on by inadequate coverage of nutritious foods, the Ghana MoFA collaborated with IANDA and the University of Ghana to revise their food list and develop new data collection protocols to include green leafy vegetables and dairy products. This led the World Food Programme and GIZ to re-publish analyses on the cost of diets in Ghana using the MoFA's expanded food list. After representatives attended an IANDA Learning Lab at the 2017 ANH Academy Week, The World Bank decided to use two of IANDA's indicators to analyse food price data in South Asian countries.

KEY RESOURCES

- Innovative Metrics and Methods for Agriculture and Nutrition Actions. (2016). *Food environments: The missing piece in achieving food security*. London, UK: Anna Herforth. Available from: <http://immana.lcirah.ac.uk/blog/2016/05/13/food-environments-missing-piece-achieving-food-security>
- Masters, W.A., Bai, Y., Herforth, A., Sarpong, D.B., Mishili, F., Kinabo, J., & Coates, J.C.. (2018). Measuring the Cost of Dietary Diversity: Novel Price Indexes to Monitor Access to Nutritious Diets. *American Journal of Agricultural Economics*, 100(5), 1285-1301. Available from: <https://academic.oup.com/ajae/article/100/5/1285/5073250>
- Cost of Nutritious Diets Consortium. (2018). *Indicators and tools for the cost of nutritious diets*. Boston, MA: Tufts University. Available from: http://ianda.nutrition.tufts.edu/sites/default/files/resources/CostOfNutritiousDiets-CollaborativeBrief_31May2018_Final.pdf

DEVELOPMENT OR UPTAKE STATUS

IANDA's work to develop food affordability metrics continues through a follow-up programme, Changing Access to Nutritious Diets in Africa in South Asia (CANDASA), Tufts University, funded by The Bill & Melinda Gates Foundation and UKaid. By adding Ethiopia, Malawi, and India as country partners, CANDASA has fine-tuned the original set of indicators through new analyses and stakeholder feedback.



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Aquatic Food for Health and Nutrition (AQN): A metric for assessing the impacts on nutrition and health of agroecosystems producing farmed seafood

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TOPICS

Fisheries and aquaculture, Maternal and adolescent nutrition

DISCIPLINES

Economics, Nutrition

OUTPUT

Food systems metric

SIGNIFICANCE

Fisheries and aquaculture comprise a dynamic sector that provides food and livelihoods for millions of people in low- and middle-income countries. However, fisheries policies are often disconnected from nutrition and public health. With sea level rise, fisheries decline and growing aquaculture to consider, measures that assess the impact of fisheries on nutrition, especially for vulnerable populations, are critical for monitoring for future decision-making.

METHOD OR METRIC

The Aquatic Food for Health and Nutrition (AQN) index is a metric that can be used to predict the nutrition outcomes for adolescent women in Bangladesh. The metric uses four key inputs – salinity level of the agroecological system, female autonomy, religion and diet diversity – that are associated with an individual's omega-3 index, a measure of polyunsaturated fatty acid blood levels. (Lower scores are associated with worse cardiovascular outcomes). The AQN index was validated with additional data collection in Bangladesh.

IMPACT

The AQN index successfully links factors related to fisheries and aquaculture, agroecology, religion, women's empowerment and nutrition for assessing the health of vulnerable populations. The data generated through this project can be used to further understand the impact of aquatic food systems on nutrition and health.



KEY RESOURCES

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DEVELOPMENT OR UPTAKE STATUS

The AQN index has been presented to nutrition and health stakeholders in Bangladesh, with ongoing work to refine the metric for context-specific research and policy goals.



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Nutritional Postharvest Loss Estimation (NUTRI-P-LOSS)

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TOPICS

Value chains, Nutrition, Post-harvest loss

DISCIPLINES

Agriculture, Economics

OUTPUT

Evaluation methods, Open source tool

SIGNIFICANCE

Considerable food loss occurs across the value chain. While physical and economic losses have been studied over the past 50 years, there is a deficit of research on nutritional losses, especially in low- and middle-income countries. Developing the methods and tools to account for these losses is important for designing food-based nutritional interventions.

METHOD OR METRIC

NUTRI-P-LOSS is a method and tool for predicting nutritional losses during postharvest. The method incorporates quantitative and qualitative nutritional losses and has been tested for three crops – maize, cowpeas and orange-fleshed sweet potato – using a combination of literature, laboratory and field research. The model inputs and calculations can be used in spreadsheet form (Microsoft Excel), but will be formally incorporated into the online open access Post-Harvest Loss tool developed by African Postharvest Losses Information System+ (APHLIS+).

IMPACT

Research conducted under the NUTRI-P-LOSS yielded important insights for measuring postharvest nutritional losses. In a study conducted in Uganda, the researchers found that more highly trained farmers perceived lower postharvest losses, as well as identified specific transportation, processing and storage practices that prevent loss. In a laboratory study with artificial insect infestation, selective feeding behaviour of the different storage insect pest species on different nutrients was observed and this affected the proportional composition of the nutrients in the remaining stored product.



KEY RESOURCES

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- APHLIS+. (2017). *Estimating nutritional postharvest losses – the Nutri-P-Loss project*. Available from: <https://www.aphlis.net/en/news/4/estimating-nutritional-postharvest-losses-the-nutri-p-loss-project/>
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DEVELOPMENT OR UPTAKE STATUS

The project team is currently working to incorporate their nutritional loss models into the APHLIS+ Post-Harvest Loss tool, complementing the existing calculator for dry weight losses.

The University of Zimbabwe research team discuss the findings of storage trials in Mbire with farmers. The data produced from the nutritional analyses of those samples were used in the predictive model.

(Pic: Brighton Mvumi;
Patrick Ngwenyama)



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Household Water Insecurity Experiences (HWISE) Scale

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TOPICS

Water insecurity

DISCIPLINES

Public health,
Anthropology

OUTPUT

Assessment tool,
Methodology

Above. A woman in western Kenya collects water from an open stream - the closest available and accessible water source - for her household's use, including cooking and bathing.

(Pic: Patrick Mbullo)



SIGNIFICANCE

Water insecurity is experienced by billions globally, and dramatically impacts a household's agriculture, nutrition and health. Despite its significance, there is no validated tool to equivalently measure household water insecurity across contexts. As such, there is dire need to develop and disseminate such a tool to ensure that household-level water insecurity is accurately measured and commensurately prioritized in policies and programmes.

METHOD OR METRIC

The HWISE Scale can be used to identify how water insecurity manifests at the household level in low- and middle-income countries. The scale is comprised of 12 easy-to-administer items that query experiences with water insecurity in the past month. This includes worry about not having enough water or changing plans due to problems with water. During interviews, respondents identify the frequency they experience the item's concept during the previous month. (For example, 'changing what was being eaten due to problems with water' for food). During scale development, the scale was piloted in 29 sites across 23 countries. It was found to capture universal experiences of household water insecurity that can be applied to all low- and middle-income countries. The HWISE Scale can be used by researchers, NGOs, policymakers and programme implementers to measure the prevalence of water insecurity, identify vulnerable subpopulations, quantify the impacts of water insecurity on health and economic productivity, and evaluate the effectiveness of interventions.

IMPACT

This project resulted in the first cross-culturally validated scale for equivalently measuring water insecurity at the household level. Under the piloting phase, the first ever comparable water insecurity data were collected and analysed, and summaries of the individual sites are available on the HWISE Research Coordination Network website.

KEY RESOURCES

- Young S.L., Collins, S.M., Boateng, G.O., Neilands, T.B., Jamaludidine, Z., Miller, J.D., Brewis, A.A., Frongillo, E.A., Jepson, W.E., Melgar-Quiñonez, H., Schuster, R.C., Stoler, J.B., & Wutich, A.; HWISE Research Coordination Network. Development and validation protocol for an instrument to measure household water insecurity across cultures and ecologies: the Household Water InSecurity Experiences (HWISE) Scale. *BMJ Open*, 9(1): e023558. DOI:10.1136/bmjopen-2018-023558.
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- Stoler, J.B., Brewis, A.A., Harris, L.M., Wutich, A., Pearson, A.L., Rosinger, A.Y., Schuster, R.C., & Young, S.L. (2019). Household water sharing: a missing link in international health. *International Health*, 11(3): 163-165. DOI:10.1093/inthealth/ihy094
- HWISE Scale: <https://sites.northwestern.edu/hwise/>
- HWISE Research Coordination Network website: <https://hwise-rcn.org/>

DEVELOPMENT OR UPTAKE STATUS

The HWISE Scale has been widely adopted by non-governmental organizations for monitoring and evaluation of their programming: Oxfam, Water for People, Last Mile Health, Action Against Hunger and Water Witness International.

The scale has also been proposed to be added to the Gallup World Poll. If implemented, this would mark the first effort to collect nationally-representative household water insecurity data globally (in 140 countries).

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New keys for old black boxes: Developing methods to improve nutrition assessment by measuring energy expenditure

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TOPICS

Energy expenditure,
Agricultural labor

DISCIPLINES

Economics, Nutrition

OUTPUT

Assessment tool,
Methodology

SIGNIFICANCE

Human energy expenditure due to agricultural labour is an important determinant of an individual's nutritional needs. However, current methods to measure energy expenditure are unreliable in low- and middle-income country contexts. With changing markets, climate and ecology, and gender roles all driving a dynamic agricultural landscape, better, more appropriate methods are needed to understand this vital link between agriculture, nutrition and health.

METHOD OR METRIC

Accelerometers are typically worn as small, watch-like devices, and continuously monitor an individual's movement across three spatial axes. In this project, they are tested as an unobtrusive tool for collecting accurate data that can be converted to energy expenditure.

The study collected accelerometry data from men and women in Ghana, India and Nepal, which were selected as the three country sites to represent diverse agroecologies and agricultural types. By matching these data with reported activities, the team created energy expenditure profiles and analyzed for statistical associations with sociodemographic and food consumption data.

IMPACT

This novel research addressed a key methods gap in linking agricultural labour to nutrition outcomes. The gold standard to measure energy expenditure – doubly-labelled water – is often ill-suited to low- and middle-income country contexts, requiring intrusive data collection and costly laboratory analysis. Using accelerometers was shown to be a feasible, robust alternative to generate energy expenditure data, and the developed guidelines will allow future endeavours to test these methods under different settings.



Above. Survey participant in India wearing an accelerometer while cooking (Pic: © Enumerators team in India/ Ghana)

KEY RESOURCES

- Zanello, G., Srinivasan, C., Picchioni, F., Webb, P., Cherukuri, R., Nkegbe, P., and Neupane, S. (2019). *Physical activity, time use, and food intakes of rural households in Ghana, India, and Nepal 2017-2018*. [Data Collection]. Colchester, Essex: UK Data Service. <https://dx.doi.org/10.5255/UKDA-SN-853777> .
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- Zanello, G., Srinivasan, C.S., & Nkegbe, P. (2017). Piloting the use of accelerometry devices to capture energy expenditure in agricultural and rural livelihoods: Protocols and findings from northern Ghana. *Development Engineering*, 2: 114-131. DOI:10.1016/j.deveng.2017.10.001

DEVELOPMENT OR UPTAKE STATUS

The study protocols were disseminated to country-level stakeholders in Ghana, India and Nepal, with interest from governmental and international organizations, such as the Ministry of Rural Development in India and the International Crop Research Institute for Semi-Arid Tropics (ICRISAT).

As a direct outcome, three new studies using accelerometers are currently being implemented. The Mahatma Gandhi National Rural Employment Scheme (MNREGS), in collaboration with the University of Reading, is conducting accelerometer-based research across 60 sites in India; a Grand Challenges Research Fund project is using accelerometers to understand how different lifestyles impact nutrition in adolescent girls in India and Nepal; and, finally, a project funded by the Donkey Sanctuary Trust is looking at energy expenditure exchange between humans and animals in agricultural activities.



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Probabilistic causal models for nutrition outcomes of agricultural actions

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TOPICS

Agriculture, East Africa

DISCIPLINES

Economics, Epidemiology

OUTPUT

Modelling, Qualitative methods, Decision-support

SIGNIFICANCE

Improving agriculture is a key component of development strategies; however, agriculture's impact on nutrition can yield mixed results. In order to design and implement effective agricultural interventions with complex nutrition outcomes, we need decision-making tools that cross disciplinary boundaries and incorporate a variety of data.

METHOD OR METRIC

Bayesian Networks are graphic representations of the causal relationships that make up complex systems. Individual relationships between concepts are described using nodes and arrows. Dependent variables are usually simplified into a ranked scale, such as from low to high, and each level is assigned a probability. These are summarized into what analysts term conditional probability tables.

Both quantitative and qualitative data can be used to build Bayesian Networks. Expert knowledge can be used to supplement available quantitative information collected through a systematic approach. The process is often called expert knowledge elicitation (EKE). The combination of these various data sources allows BNs to be flexible and applicable to a variety of problems and settings.

IMPACT

The project team developed Bayesian Network models to estimate nutrition outcomes for two agricultural development cases: 1.) Fruit trees introduced in small farms in Eastern Kenya; and 2.) The nutrition benefits of the government's agriculture development strategy in Uganda. Workshops convening research and policy actors were conducted to gather expert knowledge, generate two dynamic causal models, and train participants on using these innovative methods.

Recognizing a gap in R's decisionSupport package, the team created new, open access functions that facilitate the transformation of expert knowledge into quantitative data. The team also created new functions for valuing information in AgenaRisk, state-of-the-art software designed



to develop Bayesian Networks through artificial intelligence and statistics. AgenaRisk's creators, Norman Fenton and Martin Neil, both collaborated on this project to provide a notable public-private sector linkage.

KEY RESOURCES

- Whitney, C.W., Lazanova, D., Muchiri, C., Shepherd, K.D., Rosenstock, T.S., Krawinkel, M., Tabuti, J.R.S., & Luedeling, W. (2018). Probabilistic decision tools for determining impacts of agricultural development policy on household nutrition. *Earth's Future*, 6: 359-372. Available from: <https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1002/2017EF000765>
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- Whitney, C.W., Shepherd K.D., Rosenstock T.S., & Luedeling E. (2018). *Decision Analysis to Support Agriculture for Nutrition. ICRAF Policy Brief no 38*. World Agroforestry Centre, Nairobi, Kenya. Available from: <http://www.worldagroforestry.org/downloads/Publications/PDFS/PB18017.pdf>
- Luedeling, E., and Göhring, L. (2016). *decisionSupport: quantitative support of decision making under uncertainty*. R package version 1.101.2. Available from: <http://CRAN.R-project.org/package=decisionSupport>

DEVELOPMENT OR UPTAKE STATUS

Further use of BN approaches to agriculture has been undertaken by project leadership and collaborators, including studies on climate change impacts for farmers in Tunisia and Chile (German Federal Ministry of Education and Research) and for producers of ornamental plants in Germany (Stiftung Zukunft NRW). BNs are also currently being applied for predicting crop yields and for spatial mapping of farming systems in East Africa. The project team is looking to formally integrate the approach into research conducted through the CGIAR's Water, Land and Ecosystems programme.

Above. Participants at the IMMANA workshop 'The Integration of Fruit Trees into Agricultural Landscapes of Kenya to Enhance Nutrition Security', Nairobi.

(Pic: Eike Luedeling, Caroline Muchiri, Cory Whitney, Denis Lanzaova, Geoffrey Malava and Yvonne Tamba.)



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Surveillance of Climate-smart Agriculture for Nutrition (SCAN)

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TOPICS

Nutrition surveillance,
Climate-smart agriculture

DISCIPLINES

Nutrition, Agriculture

OUTPUT

Conceptual framework, Data sharing platform, Mobile phone data collection

SIGNIFICANCE

Effective monitoring of how climate change impacts agriculture and nutrition is imperative. Current approaches to collecting the required data, however, can be expensive, subject to selection bias, and difficult to integrate across individual efforts. Thus, new approaches, such as through mobile phones, offer opportunities to reduce costs, improve coverage and create unified platforms.

METHOD OR METRIC

The primary outcome of SCAN was the construction and testing of a robust agriculture-nutrition surveillance system using mobile phone data collection. This was achieved through four individual components:

1. Co-development of a complex and simplified conceptual framework with research, practice and policy stakeholders to describe the multisectoral and dynamic linkages between climate, agricultural interventions and nutrition.
2. Development a mobile phone-based Rural Household Multi-Indicator Survey (RHoMIS), expanded to include modules on nutrition, water, sanitation and hygiene, and climate change perceptions and adaptations. This tool was tested across 800 households in Kenya and Zambia.
3. Platform for storing and merging data collected through RHoMIS using an ona.io-based system.
4. Multiple research studies on the feasibility and effectiveness of using voice response and voice calls for collecting agriculture and nutrition data in African contexts.

IMPACT

SCAN's efforts provided critical evidence for using mobile phone-based data collection methods in effective nutrition monitoring. In testing voice calls against face-to-face interviews, the team found no changes between women's diet diversity scores, but significant differences between child nutrition measurements. The research also indicated



who mobile phone-based methods might miss: women without phone access were younger and poorer.

The project also sparked policy change for a key, multisectoral research initiative. By collaborating with RHoMIS, the team added new survey modules and implemented a data-sharing platform to facilitate the collection of interoperable climate, agriculture and nutrition data for better nutrition surveillance. These new modules were piloted in Zambia, and results and recommendations were presented to international donors and initiatives as well as the national government.

KEY RESOURCES

- Rosenstock, TS, Lamanna, C, Chesterman, S, Hammond, J, Kadiyala, S, Luedeling, E, Shepherd, K, DeRenzi, B, & van Wijk, MT. (2017). When less is more: innovations for tracking progress toward global targets. *Current Opinion in Environmental Sustainability*, 26-27: 54-61. Available from: <https://www.sciencedirect.com/science/article/pii/S1877343517300398>
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DEVELOPMENT OR UPTAKE STATUS

As a direct result of SCAN's research and partner engagement, the United Nations World Food Programme began integrating voice calls into a nutrition surveillance programme in Kenya, with additional countries in process.



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Using Information Communication Technologies (ICTs) to understand the relationships between labour-saving agricultural innovations, women's time use, and maternal and child nutrition outcomes

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TOPICS

Women's time use, Diet diversity, Data collection technology

DISCIPLINES

Economics, Nutrition

OUTPUT

Methods validation, Tool

SIGNIFICANCE

While enhanced agricultural production can improve maternal and child nutrition, greater workloads can decrease time for child care and leisure. Given the potential for harm, understanding how women allocate time in response to agricultural interventions is a priority. However, current methods to assess women's time use and infant feeding, such as direct observations and recalls, are costly and subject to bias.

METHOD OR METRIC

Information and communications technology (ICT) are valuable tools for collecting and delivering digitized data to unified platforms. This project tested the feasibility and validity of data collected through two ICTs.

- Life-logging GPS-linked cameras are small, lightweight, and can be worn discretely on a participant's clothing. They automatically take photos every minute, which are used to facilitate a participant's recalls of their daily activities.
- Computerized interactive voice response (IVR) diaries are used by participants to provide contemporaneous records of their daily activities via mobile phone.

Wearable cameras and IVR diaries have been used in research to monitor agriculture, nutrition and health behaviours and travel. They both have been used in high-income country contexts; IVR diaries have been used previously in low-income and low-literacy settings.



IMPACT

By comparing wearable cameras and IVR diaries with direct observations and 24-hour recalls, the team was able to test and validate these novel ICT methods for assessing women's time use and maternal dietary practices. Initial data analysis showed that both tools provided similar estimates of women and child diet diversity; further analyses will be conducted to assess validity for maternal time use.

KEY RESOURCES

- Spray, A. (2018). *ICTs for Nutrition, Agriculture, and Time Use: Can we do better than 24-hour recall?* IMMANA, London School of Hygiene & Tropical Medicine (UK). Available from: <https://immana.lcirah.ac.uk/blog/2018/02/08/icts-nutrition-agriculture-and-time-use-can-we-do-better-24-hour-recall>

DEVELOPMENT OR UPTAKE STATUS

This project has received several follow-up awards to continue research on the validity of ICTs for agriculture and nutrition research. The team will develop an analysis framework for ICT data under the Drivers of Food Choice programme, led by the University of South Carolina, and test the tools in Peru with funding from the Medical Research Council and Newton Fund.

Above left. Mother with wearable camera and phone to measure time use and maternal and child dietary practices in Eastern Uganda

Above right. Woman preparing food for her family in Eastern Uganda. Image captured by life-logging wearable camera.

(Pics: Jan Priebe)



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Women's Empowerment in Livestock Index (WELI)

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TOPICS

Gender, Agriculture, Nutrition

DISCIPLINES

Sociology, Epidemiology

OUTPUT

Qualitative methods, Metric

SIGNIFICANCE

Women's empowerment is an important domain for improving maternal and child nutrition. However, research-to-date is limited in describing its role through livestock-focused agriculture: considerations, such as intra-household allocation, cultural norms surrounding livestock ownership, infectious disease exposure, and trade-offs between labour and childcare, have not been studied in concert. Research to develop comprehensive metrics on the full pathway from livestock to nutrition through women's empowerment is needed.

METHOD OR METRIC

The team developed a new metric, the Women's Empowerment in Livestock Index (WELI), through a mixed methods approach. The first iteration of the index was developed by analysing Demographic and Health Survey data for associations between women's empowerment and engagement in livestock-focused agriculture and maternal and child nutrition. This version was refined through data collected through a set of participatory qualitative research methods, and then tested against dietary data collected in Kenya.

IMPACT

This project resulted in the successful development of a new index for describing the role of livestock-focused agriculture in relation to women's empowerment and nutrition. Comparative analysis of the WELI with the Women's Empowerment in Agriculture Index showed considerable differences in the constructs included and scoring distributions, underscoring the need for specialized approaches to understanding livestock.



KEY RESOURCES

- Miedema, S.S., Haardörfer, R., Webb Girard, A., & Yount, K.M. (2018). Measurement invariance of women's empowerment in East Africa. *World Development*, 110: 453-464. DOI:10.1016/j.worlddev.2018.05.031.
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- Galie, A., Korir, L., Teufel, N., Baltenweck, I., Webb Girard, A., & Yount, K. (2018). *The Women's Empowerment in Livestock Index*. Social Indicators Research. DOI:10.1007/s11205-018-1934-z.

DEVELOPMENT OR UPTAKE STATUS

In partnership with Cornell University Tata Institute, additional research is being conducted to adapt the WELI to a South Asian context. Project leadership are working to promote the WELI within the research and policy centres, such as the International Livestock Research Institute.



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Women's Empowerment in Nutrition Index (WENI)

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TOPICS

Gender, Nutrition

DISCIPLINES

Sociology, Economics

OUTPUT

Qualitative methods, Metric

SIGNIFICANCE

Empowering women remains an important focus of development interventions. Previous research indicates complex tradeoffs between agricultural labour and women's time for childcare, as well as maternal and child diet quality. Current approaches to measuring how women's empowerment influences nutrition miss key dimensions. More comprehensive, culturally-sensitive metrics are needed to improve policy and programming encompassing gender, agriculture and nutrition.

METHOD OR METRIC

This project resulted in the development and validation of a novel metric, the Women's Empowerment and Nutrition Index (WENI). The index measures key factors that influence a woman's nutritional empowerment, defined as the capacity to make decisions on, and provide nutrition for, herself and her household. Qualitative research was conducted in Bangladesh and India to refine measurement of nutritional empowerment. The index was validated against anthropometric measures using survey data from two states in India.

The project also yielded support for developing a short-form version of the WENI, that is currently being tested and validated using survey data from three additional sites in India.

IMPACT

Contrary to other measures of women's empowerment, which focus on livelihoods, the WENI focuses on measuring nutrition. This shift enables the WENI to be applicable to all women in malnutrition prevalent areas, instead of being limited to women engaging in specific sectors, such as agriculture. The index also covers factors that are important to nutrition, but have not been previously incorporated into women's empowerment metrics, such as fertility and cultural norms around childcare and social capital.



Furthermore, the team used advanced statistical methods to better quantify how much individual components of the WENI explain changes in nutrition outcomes. By using Shapley-Owen decomposition regression methods, users can account for interdependencies between index components – for example, better food safety can improve gut nutrient absorption – to design more realistic and effective policies and programmes.

KEY RESOURCES

- Lentz, E.C. (2018). Complicating narratives of women's food and nutrition insecurity: domestic violence in rural Bangladesh. *World Development*. 104: 271-280. DOI:10.1016/j.worlddev.2017.11.019
- Narayanan, S., Fontana, M., Lentz, E.C., & Kulkarni, B. (2017). "Rural Women's Empowerment in Nutrition: a proposal for diagnostic linking food, health, and institutions." Prepared for United Nations Women: Expert Group Meeting on 'Challenges and opportunities in achieving gender equality and the empowerment of rural women and girls.' Available from: <http://www.unwomen.org/-/media/headquarters/attachments/sections/csw/62/egm/rural%20womens%20empowerment%20in%20nutritionnarayanan%20fontana%20lentz%20and%20kulkarnifinal.pdf?la=en&vs=2753>
- Narayanan, S., Rathore, U., & Sharma, M. (2019). *Women's nutritional empowerment and their well-being Identifying key drivers in India and Bangladesh*. Indira Gandhi Institute of Development Research, Mumbai Working Papers 2019-004, Indira Gandhi Institute of Development Research, Mumbai, India. Available from: <https://ideas.repec.org/p/ind/igiwpp/2019-004.html>
- Lentz, E.C., Narayanan, S., & De, A. (2019). Last and least: Findings on intrahousehold undernutrition from participatory research in South Asia. *Social Science & Medicine*. 232: 316-323. DOI:10.1016/j.socscimed.2019.05.024

DEVELOPMENT OR UPTAKE STATUS

Organisations in India, such as the Members of the Public Health Resource Network, the Pratiche Trust and the MS Swaminathan Research Foundation, have implemented a short version of the WENI as part of their work and plan to incorporate it in their research or surveillance toolkits.

Above left. At a community researcher training in Orissa (Pic: Ankita Mondal)

Above right. Drying rice in Bangladesh (Pic: Krushna Ranaware)



FOR ADDITIONAL INFORMATION, PLEASE CONTACT:

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21 early career Fellows supported

for research leadership
across agriculture, nutrition
and health



FELLOWSHIPS

Zeweter Abebe Sime



PROJECT TITLE

Impact of home gardening on breastmilk vitamin A composition and child vitamin A intake

SIGNIFICANCE

Disorders stemming from vitamin A deficiency during infancy impair health throughout the life course. Breastmilk is a critical source of vitamin A for infants but relies on mothers consuming a vitamin A-rich diet. Agricultural and food-based interventions may increase the amount of vitamin A in breastmilk, but current research characterizing this pathway is lacking.

METHOD OR METRIC

During her fellowship, Zeweter Abebe Sime developed a suite of statistical models to describe the impact of home gardens on vitamin A levels in breastmilk. These models incorporate household agricultural practices, mother's diet, and sociodemographic information, and were used to set a cut-off for minimum dietary vitamin A intake needed to deliver adequate vitamin A to infants through breastfeeding.

IMPACT

Zeweter's research on quantifying the relationship between home gardens, maternal diets and vitamin A in breastmilk represents an important step forward for harnessing agriculture to improve child nutrition and health. Her study also compared vitamin A measurements taken with a low-cost, portable device to the expensive standard: high performance liquid chromatography. The portable device had not yet been tested for use on low vitamin A levels, and Zeweter's research provides new data for evaluating its use.

WHERE IS THE FELLOW NOW?

Zeweter is currently an Assistant Professor at Ambo University. Her research has been published in *Appetite*, the *Food and Nutrition Bulletin*, and the *European Journal of Clinical Nutrition*.

LOCATION

Ethiopia

TOPICS

Breastfeeding, Vitamin A

DISCIPLINES

Nutrition, Agriculture

MENTORS

Home: Kaleab Baye, Addis Ababa University

Host: Marjorie Haskell, University of California, Davis

LEARN MORE

Abebe, Z., Haki, G.D., Schweigert, F.J., Henkel, I.M., & Baye, K. (2018). Low breastmilk vitamin A concentration is prevalent in rural Ethiopia. *European Journal of Clinical Nutrition*. DOI:10.1038/s41430-018-0334-4

Kafui Adjaye-Gbewonyo

PROJECT TITLE

Agricultural Trade Policy and Nutritional Disparities in African Countries

SIGNIFICANCE

Have agricultural policies in postcolonial Africa improved child nutrition and health? Evaluating the effects of an array of interventions, spanning markets and trade, technology adoption, and reconceptualized food systems, on child nutrition has eluded researchers and policymakers.

METHOD OR METRIC

The nominal rate of assistance (NRA) to tradeable agriculture is an indicator calculated annually by The World Bank. Defined as the percentage of gross returns to farmers attributable to government intervention, this indicator can be used to capture the effects of agricultural trade policy.

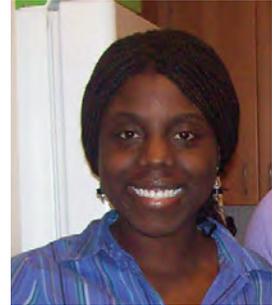
During Round 2 of IMMANA Fellowships, Kafui Adjaye-Gbewonyo conducted research to examine the effects of agricultural structural adjustment programmes on child nutrition in Africa. She developed statistical models integrating the NRA to tradeable agriculture with Demographic and Health Survey data to estimate average changes in stunting and wasting. Since the NRA to tradeable agriculture is available from 1955 to 2011 and DHS data are collected for multiple years, Kafui could address longer-term effects and variation over time in her study.

IMPACT

Kafui published a research article on the methodology and findings in *BMC Globalization and Health*. She found that increases in government assistance to tradeable agriculture was associated with small improvements in child nutrition, but with varying effects depending on whether the household participated in agriculture and the types of commodities they produced. This research fills a key gap in evaluating how structural adjustment policies during Africa's postcolonial period impacted nutrition and health.

WHERE IS THE FELLOW NOW?

After her Fellowship, Kafui joined the Institute of Advanced Studies, University College London, as a Research Associate, working on projects examining non-communicable diseases and the epidemiologic transition in Sub-Saharan Africa. Her research has been published in *Social Science & Medicine*, the *International Journal for Equity in Health*, and *BMC Globalization and Health*.



LOCATION

Sub-Saharan Africa

TOPICS

Agricultural policy, Child nutrition

DISCIPLINES

Economics, Nutrition

MENTORS

Home Mentor: S.V. Subramanian, Harvard University

Host Mentor: Samuel Codjoe, University of Ghana

LEARN MORE

Adjaye-Gbewonyo, K., Vollmer, S., Avendano, M., & Harttgen, K. (2019) Agricultural trade policies and child nutrition in low- and middle-income countries: a cross-national analysis. *BMC Globalization and Health*, 15(21). DOI:10.1186/s12992-019-0463-0

Semira Mohammed **Beyan**



PROJECT TITLE

Soil nutrients, dietary intake, and nutritional status of children and women in southern Ethiopia

SIGNIFICANCE

Low diversity diets in rural Ethiopia are mostly comprised of cereal-based foods. Thus, agricultural factors, such as soil nutrient levels, could significantly impact the iron and zinc intake of women and children. Research investigating these associations is imperative to improving nutrition in agricultural settings.

METHOD OR METRIC

To build a detailed case study on how soil health might affect the nutritional status of women and children, Semira Beyan described agriculture, nutrition and health components in one district in southern Ethiopia. She measured relevant physical and chemical characteristics for soil samples from her study site, including soil pH, nitrogen and phosphorus, and iron and zinc levels. To assess the women's and children's diets, she used weighed food records and analysed the nutrient composition of locally grown, commonly consumed foods. Finally, she assessed stunting and wasting and anaemia status by blood haemoglobin.

IMPACT

Through her research, Semira was able to propose an approach for understanding the linkages between soil health and maternal and child nutrition. In her case study, Semira found while soil health was strong – iron and zinc levels were generally high, and the soil pH was acidic enough to promote uptake in plants – the micronutrient content of produced foods was low. One explanation for this is fertilizer use, which could affect how available these micronutrients are to plants. This is especially important considering the sample's diets comprised mostly of cereal goods, and anaemia was high.

WHERE IS THE FELLOW NOW?

Semira is a Lecturer in Soil Sciences, with the School of Plant and Horticulture Science at Hawassa University. Her research has been published in *Biology and Fertility of Soils*, the *South African Journal of Botany*, and *Symbiosis*.

LOCATION

Ethiopia

TOPICS

Smallholder agriculture, child nutrition

DISCIPLINES

Plant science, Nutrition

MENTORS

Home Mentor: Sheleme Beyene, Hawassa University

Host Mentor: Felix Dakora, Tshwane University of Technology

Mieghan Bruce

PROJECT TITLE

Food system dynamics, animal disease and human nutrition in Tanzania

SIGNIFICANCE

Animal source foods provide key nutrients for women and children. Livestock provide livelihoods and wealth for rural households. However, livestock can bring infectious disease and degrade land. Considering these conflicting pathways is imperative in designing livestock interventions for improved nutrition outcomes.

METHOD OR METRIC

System dynamics is a scientific approach that uses quantitative and qualitative data to describe interrelated causal pathways for research and policy decision-support. This approach entails examining a system and mapping interactions, visually representing the system to engage stakeholders, incorporating feedback loops, and using the model in practice to evaluate interventions.

During her Fellowship, Mieghan Bruce used system dynamics to model the nutrition impacts of a randomized controlled trial on vaccinating livestock in Tanzania (Nkuku4U, University of Sydney). She interviewed participating households to design her conceptual model, encompassing livestock production, the food chain, household dynamics, and child nutrition, and tested the model using trial data and information from previous literature.

IMPACT

Mieghan's research provided a proof-of-concept for using system dynamics to model the impacts of livestock health on child diets and nutrition. A key finding from her work is that vaccinating chickens increased the number of eggs available to children, but not egg consumption. Future research could adapt this approach to other contexts for complex agriculture and nutrition interventions.

WHERE IS THE FELLOW NOW?

Mieghan is a Lecturer in Veterinary Epidemiology at Murdoch University in Australia. She continues to use her interdisciplinary IMMANA training to conduct food systems research rooted in One Health. Her work has been published in *Food Security*, *Parasitology*, and *Frontiers in Veterinary Science*.



LOCATION

Tanzania

TOPICS

Animal-source foods, Food systems

DISCIPLINES

Veterinary science, Epidemiology

MENTORS

Home mentor: Jonathan Rushton, Royal Veterinary College

Host mentor: Furaha Mramba, Tanzania Veterinary Laboratory

Project mentor: Robyn Alders, University of Sydney

LEARN MORE

Rushton, J., & Bruce, M. (2017). Using a One Health approach to assess the impact of parasitic disease in livestock: How does it add value? *Parasitology*, 144(1), 15-25. doi:10.1017/S0031182016000196

Christopher Conz



PROJECT TITLE

(Un)Cultivating the Disease of Maize: a history of pellagra in Lesotho, southern Africa, as a metric for rethinking agricultural policy

SIGNIFICANCE

Agricultural policies can have unintended effects on nutrition, such as through interconnected factors specific to a historical context. During the 1960s, Lesotho experienced a dramatic increase in pellagra, a disease caused by niacin deficiency. Understanding how agricultural intensification, low diet quality, and environmental change contributed to this increase can help us understand present day nutrition challenges.

METHOD OR METRIC

Christopher Conz used historical analysis to develop a narrative of the agriculture, environment, and policy forces that shaped nutrition during the 1960s in Lesotho. During his fellowship, Christopher interviewed farmers and nurses with first-hand experiences with agriculture and nutrition during this time period, and corroborated oral histories with newspapers and government reports. He also collected data from archives in Lesotho, South Africa and the UK.

IMPACT

Through his research, Christopher described the contextual factors that manifested to produce pellagra in Lesotho. He found that a drought during the 1930s devastated crops and livestock in southern Africa and drove labour migration from Lesotho to South Africa, which diminished agricultural incomes and increased reliance on niacin-deficient maize. Furthermore, government focus on wool exports shifted mutton production to rearing of merino sheep, subsequently depriving agricultural households of niacin-rich meat. Policymakers today can use this narrative as a historical analogue to understand agriculture's impacts on nutrition.

LOCATION

Lesotho

TOPICS

Pellagra, Agricultural history

DISCIPLINES

History, Agriculture

MENTORS

Home Mentor: James McCann, Boston University

Host Mentor: Stephen Gill, Morija Museum & Archives

WHERE IS THE FELLOW NOW?

Following his fellowship, Christopher joined Tufts University as a Lecturer in African History. His research has been published in *Agricultural History*, *Environment & History*, and the *Journal of Southern African Studies*.

Julia de Bruyn

PROJECT TITLE

Developing pictorial methods to document seasonal variation in dietary diversity and available food resources in Tanzania

SIGNIFICANCE

Repeated dietary assessments are essential for observing variations in food security and identifying food consumption trends. These data, however, are often costly to collect, as they require highly-trained interviewers working off a pre-formed list. In low-literacy settings, picture-based records kept by participants could offer a viable alternative to standard methods.

METHOD OR METRIC

Round 4 Fellow Julia de Bruyn adapted and tested a picture-based method for collecting dietary data in rural Tanzania. Participants were given charts with images reflecting commonly consumed foods and instructed to mark the images corresponding to household food consumption over one day. The charts were filled out by the household member responsible for food preparation and compared against 24-hour recall.

IMPACT

Preliminary results from Julia's research indicates that dietary data collected using the picture-based methods differed significantly than those collected through standard methods. The next phase of this fellowship project will use qualitative methods to explore factors influencing the accuracy of picture-based methods and research and policy stakeholder perspectives.

WHERE IS THE FELLOW NOW?

Julia is currently a Lecturer and Researcher with the Natural Resources Institute at the University of Greenwich. Julia's research has been published in *Nutrients*, *Maternal & Children* and *Global Food Security*.



LOCATION

Tanzania

TOPICS

Dietary assessment, Animal source foods

DISCIPLINES

Epidemiology, Nutrition

MENTORS

Home: Elaine Ferguson,
London School of Hygiene &
Tropical Medicine

Host: John Msuya, Sokoine
University of Agriculture

Laura Hackl



PROJECT TITLE

Determining iron transition from Indian mothers to their infants via breast milk using stable iron isotopes in the context of a sustainable food-based intervention

SIGNIFICANCE

Iron deficiency is the most common micronutrient deficiency worldwide, severely impacting the health and development of infants, young children and women. While iron supplementation comes with health risks and fails to address the root causes of iron deficiency, biofortification of key foods may be a sustainable approach. The extent to which iron from biofortified grains are transferred from maternal intake to infants through breastmilk is unknown and research quantifying this pathway is needed.

METHOD OR METRIC

During this fellowship, Round 4 Laura Hackl is developing a statistical model to describe the dietary transition of iron from biofortified pearl millet to infant via breastmilk. The project combines a set of clinical nutrition, anthropometric and dietary assessment methods – iron isotopes, test meals made with biofortified pearl millet, doubly-labelled water and blood biomarkers – to fully account for breastmilk ejection in mothers and actual consumption by infants, infection and other dietary sources of iron.

IMPACT

Full research operations for Laura's project are underway. When completed, this study will be the first of its kind to characterize iron status among breastfeeding infants and their inflammatory status, allowing the statistical model for dietary iron transition to control for these important factors influencing iron absorption and uptake.

LOCATION

India

TOPICS

Iron biofortification,
Breastfeeding

DISCIPLINES

Nutrition, Epidemiology

MENTORS

Home Mentor: Saurabh
Mehta, Cornell University

Host Mentor: Anura Kurpad,
St. John's Research Institute

WHERE IS THE FELLOW NOW?

Laura is currently a Post-doctoral Fellow with IMMANA at Tufts University. Her research has been published in the *Journal of Nutrition*, the *American Journal of Clinical Nutrition* and *Science Advances*.

Mohammed Husein

PROJECT TITLE

Cognitive development and long-term effects of ENAM in Ghana

SIGNIFICANCE

The Enhancing Child Nutrition through Animal Source Food Management (ENAM) Study, conducted in Ghana during the mid-2000s, improved child nutrition through increased consumption of animal source foods. Assessing the long-term cognitive development of participating children is one way to evaluate the long-term effects of nutritional interventions.

METHOD OR METRIC

One foundational tool for measuring cognitive functioning is the Wechsler Abbreviated Scale of Intelligence (WASI). Designed to measure verbal comprehension and reasoning, the WASI is administered individually, takes between 30 to 45 minutes to complete, and is comprised of four subtests: block design, vocabulary, matrix reasoning and similarities.

During his fellowship, Mohammed Husein (R2 Fellow) conducted new research to adapt the WASI for use in rural Ghana. During the first phase of the project, the WASI tool was translated into two local languages and the block design, vocabulary and similarities subtests were modified for cultural appropriateness. The adapted tool was pretested, checked for consistency and reliability, and used in a study testing the long-term cognitive development of former participants enrolled in the ENAM Study.

IMPACT

The adaptation of the WASI to the Ghanaian context and its application to a successful multisectoral intervention programme expands our research toolkit for evaluating agriculture's impact on nutrition. In his study, Mohammed found that adolescents who had participated in the ENAM Study did not have higher cognitive functioning or improved diet and nutrition. This suggests the initial gains in child nutrition did not last into later life stages.

WHERE IS THE FELLOW NOW?

Mohammed joined the University of Ghana as a Lecturer in the Department of Nutrition and Food Science. His research has been featured in *Maternal & Child Nutrition*, the *Ghana Medical Journal* and *BMC Nutrition*.



LOCATION

Ghana

TOPICS

Animal source foods,
Cognitive development

DISCIPLINES

Nutrition, Psychology

MENTORS

Home Mentor: Frances
Aboud, McGill University
Host Mentor: Gloria Otoo,
University of Ghana

LEARN MORE

Mohammed, H., & Aboud, F. (2019). Adaptation of a mental development assessment tool for the evaluation of the long-term effect of a successful nutrition intervention in Ghana. *Maternal & Child Nutrition*, e12829. DOI:10.1111/mcn.12829.

Abu Hayat Md. Saiful Islam



PROJECT TITLE

Farm diversification and food and nutrition security in Bangladesh

SIGNIFICANCE

Recent literature suggests that as farms diversify the number of crops they produce, the diversity of their household diets will increase commensurately. However, this relationship has predominately been explored in Sub-Saharan Africa, and more studies that focus on South Asian contexts, describe individual and women's diets, and test different agriculture to nutrition pathways are needed.

METHOD OR METRIC

During his IMMANA Fellowship, Abu Hayat Md. Saiful Islam (R2 Fellow) used panel data from the Bangladesh Integrated Household Survey to understand how increases in farm diversity might increase the diversity of household and women's diets. Saiful developed several statistical models to estimate the effect of adding crops to diet diversity, and controlled for factors such as access to markets, commercialisation and sociodemographic factors. He also tested for consistency between various metrics: farm diversity including food, non-food, and nutritious crops and biodiversity indicators; diet diversity was represented at the household-level, in women, and by the variety of foods purchased or consumed.

IMPACT

The results of Saiful's research provided new insights into the proposed relationship between farm diversity and diet diversity. While all the statistical models developed for this study indicated a positive relationship, the effect size was very small: for example, producing one additional vegetable or fruit crop yielded only a 1.9% increase in household diet diversity score. This effect size was even smaller for women. Furthermore, adding crops when farm diversity is already high diminished diet diversity, potentially due to the opportunity cost of specialisation.

WHERE IS THE FELLOW NOW?

Saiful is currently an Associate Professor in the Department of Agricultural Economics at the Bangladesh Agricultural University. His research has been published in *Food Security*, *Aquaculture* and *Progressive Agriculture*.

LOCATION

Bangladesh

TOPICS

Smallholder agriculture, Diet diversity

DISCIPLINES

Economics, Nutrition

MENTORS

Home Mentor: Joachim von Braun, University of Bonn

Host Mentor: Andrew Thorne-Lyman, Johns Hopkins University

LEARN MORE

Islam, A.H.M.S., et al. (2018). Farm diversification and food and nutrition security in Bangladesh: empirical evidence from nationally representative household panel data. *Food Security*, 10(3): 701-720. DOI:10.1007/s12571-018-0806-3

Rosemary Isoto

PROJECT TITLE

Nutritional barriers to agricultural productivity in Uganda

SIGNIFICANCE

Nutrition is vital for the active lifestyles required by smallholder farmers. Previous research has focused on the relationship between energy balance and labour productivity, but misses key nutrients, such as protein, iron and vitamin A, and women's agricultural roles and nutrition needs.

METHOD OR METRIC

While studies have observed loss of farm productivity with micronutrient deficiencies, models describing a micronutrient-wage relationship in Sub-Saharan Africa do not exist. Rosemary Isoto, a Round 1 IMMANA Fellow, adapted a standard household agricultural productivity model to include requirements for iron, calcium, vitamin A and vitamin C. She derived intake of these important micronutrients from household food consumption, which she then applied to a labour efficiency function.

Rosemary tested her model using farm output and dietary data from four rounds of the Uganda National Panel Survey. This analysis helped her estimate the minimum iron, calcium, vitamin A and vitamin C intake required for a given amount of agricultural productivity, taking into consideration different nutrient requirements for women.

IMPACT

By combining agricultural economics with nutrition principles, Rosemary's research adds to our understanding of micronutrient deficiencies, smallholder farm labour and gender. A key finding from her research – that the effect of increased nutrient intake on labour productivity was nearly double for women than in men – underscores the importance nutrition policies targeting women have on improving agricultural development.

WHERE IS THE FELLOW NOW?

Following her Fellowship, Rosemary was promoted to Lecturer in the Department of Agribusiness & Natural Resource Economics at Makerere University. Her research has been published in *The Journal of Development Studies*, *Food Security* and the *Agricultural Finance Review*.



LOCATION

Uganda

TOPICS

Smallholder agriculture,
Gender

DISCIPLINES

Economics, Nutrition

MENTORS

Home mentor: David Kraybill,
Ohio State University and
Sokoine University of
Agriculture

Host mentor: Bernard
Bashaasha, Makerere
University

Matilda Laar



PROJECT TITLE

Developing a Monitoring and Evaluation Toolkit for the Ghana School Feeding Programme

SIGNIFICANCE

National school feeding programmes are a cornerstone to child nutrition by supporting developmental periods, incentivising school attendance and engaging local agriculture. The Ghana School Feeding Programme (GFSP), implemented through the national government and donor partners, did not have an adequate monitoring and evaluation, and key inputs, outputs and outcomes were missed.

METHOD OR METRIC

As the Ghana School Feeding Programme shifts from donor partners to national ownership, effective M&E is critical in achieving the programme's objectives. However, an independent review of the GFSP revealed a lack of adequate measures to capture changes in child nutrition and local food production.

To address this gap, Matilda Laar conducted research on strengthening the GFSP's M&E toolkit. Matilda interviewed the GFSP leadership to assess priorities and challenges. She reviewed other school feeding programmes to identify missing indicators. Her research led to the addition of new indicators on meal quality and local food production, supporting the GFSP's goal of improving agriculture, nutrition and education in Ghana.

IMPACT

With additional funding from the Partnership for Child Development, Matilda conducted a feasibility test of the new M&E toolkit in beneficiary schools over one academic term. Matilda used a 'train the trainer' approach to introduce the toolkit to GFSP training staff. The study results were presented to GFSP leadership to inform full implementation.

WHERE IS THE FELLOW NOW?

Matilda's work to enhance agriculture and nutrition in Ghana led to her current position as a Lecturer in the Department of Family and Consumer Sciences, University of Ghana. Her research has been published in *BMC Public Health* and she gave a keynote speech on Ghana's food environments for maternal and child nutrition at the 2018 Agriculture, Nutrition & Health Academy Week in Accra.

LOCATION

Ghana

TOPICS

School feeding programmes,
Monitoring and evaluation

DISCIPLINES

Nutrition, Agriculture

MENTORS

Home: Grace Marquis, McGill
University

Host: Esi Colecraft,
University of Ghana

Cynthia Matare

PROJECT TITLE

Women's time use, agriculture and nutrition in Zambia

SIGNIFICANCE

When women are engaged in agriculture, their workloads compete with other important uses of time, such as caregiving and leisure. Currently, there are no standard ways to measure women's time use in low-income agricultural settings, and the current methods, 24-hour recalls and observations, are time and cost burdensome on enumerators and respondents.

METHOD OR METRIC

Round 1 Fellow Cynthia Matare used qualitative methods to develop a new tool for measuring women's time use in agricultural settings. She used focus group discussions to identify productive, reproductive, domestic and social activities and their relative contributions to workloads. These data were used to construct a standardized list, from which enumerators could quickly assess how frequently different activities took place and their time duration. This version was further refined from data generated from cognitive debriefs of respondents to test their comprehension of the questions and how information was recalled.

IMPACT

The research resulted in a new tool for collecting data on women's time use in agricultural settings. The tool uses a culturally-sensitive approach, underscoring the benefit of qualitative methods in fine-tuning quantitative instrument development. The tool also cuts down the time needed for collecting these data: in a sample of 23 women, survey administration took an average of 26 minutes. The final survey instrument was validated using six-hour direct observations.

WHERE IS THE FELLOW NOW?

Cynthia is currently a Nutrition Scientist with Cornell University and IMA World Health in Tanzania. Her research has been published in *Clinical Infectious Diseases*, *PLOS ONE*, *Breastfeeding* and *Current Developments in Nutrition*.



LOCATION

Zambia

TOPICS

Gender, Women's time use

DISCIPLINES

Nutrition, Economics

MENTORS

Home: Rebecca Stoltzfus,
Cornell University

Host: Marja Hinfelaar,
Southern African Institute for
Policy & Research

Bekele Megersa



PROJECT TITLE

Milk consumption, nutrition and health in southern Ethiopia

SIGNIFICANCE

Milk provides key nutrients for pastoral communities. However, whether any level of milk consumption can bridge nutrition needs remains unclear. To address this question, Bekele Megersa conducted new research in Ethiopia to estimate nutrient intake and gaps, however finding that milk alone does not suffice.

METHOD OR METRIC

While rural pastoral Ethiopian communities consume low diversity diets, portending inadequate nutrient intake, the role of milk in fulfilling these nutrition gaps is unclear. Can milk provide enough key nutrients? If yes, how much milk needs to be consumed?

To answer these questions, Bekele was awarded a Round 1 IMMANA Fellowship to conduct research linking diet diversity, milk consumption and child growth outcomes in rural Ethiopia. During the first phase of his project, Bekele collected detailed information on different types of milk and their consumption, dietary data and child anthropometry. These data were then analysed to answer if the milk in low diversity diets could potentially fill gaps in nutrition.

IMPACT

Bekele found that while milk provided nearly half of the nutrition needs of children, it could not cover missing key nutrients, such as iron, folic acid and vitamin C. This is especially important, considering the high prevalence of child stunting despite high concurrent milk consumption observed in the sample. While milk, a culturally important food, is rich in an array of nutrients, it alone cannot bridge the gap between low diversity diets and child nutrition requirements.

WHERE IS THE FELLOW NOW?

Following his IMMANA Fellowship, Bekele was promoted to Professor of Veterinary Medicine at Hawassa University. Bekele's research is highly cited and has been published in *Tropical Animal Health and Production* and *Acta Tropica*.

LOCATION

Ethiopia

TOPICS

Animal source foods, child nutrition

DISCIPLINES

Nutrition, Agriculture

MENTORS

Home: Uriel Kitron, Emory University

Home: Abebe Haile, Hawassa University

PROJECT TITLE

Intra-household allocation and child nutrition in Bihar, India

SIGNIFICANCE

Households may present as food secure, but uneven food allocation among individual household members can result in nutritional deficits. This is especially important for child nutrition in India, for which gender, birth order, and nutrition and health knowledge play determining roles, and deciding which types of data to collect for poverty and nutrition policies and programmes.

METHOD OR METRIC

While the gold standard for estimating dietary intake and quality is 24-hour recall, data collection is time-intensive and costly. In order to develop household-level indicators that predict child diet and nutrition outcomes, Round 1 Fellow Nitya Mittal conducted research linking household factors with calorie sufficiency and diet quality among individual children. Using panel data from Bihar, India, that included a variety of sociodemographic and health behaviour concepts, household consumption and dietary data, Nitya was able to construct variables, such as mother's bargaining power and childcare practices, and test how well they explain child nutrition outcomes.

IMPACT

While nutrition knowledge and other health behaviours were expected to explain child diets and nutrient intake, parental preferences for children was observed to have a more significant role. This finding opens opportunities for continued study on household dynamics and their impact on nutrition. Better understanding of these dynamics could improve nutrition messaging and behaviour change interventions.

WHERE IS THE FELLOW NOW?

Following her year with IMMANA, Nitya took a post-doctoral fellowship at the Centre of Modern Indian Studies at the University of Goettingen. Nitya's research has been published in the *Journal of Development Studies*, the *Journal of Health Economics* and the *National Medical Journal of India*.

**LOCATION**

India

TOPICS

Intra-household allocation,
Child nutrition

DISCIPLINES

Economics, Nutrition

MENTORS

Home: J.V. Meenakshi, Delhi
School of Economics

Host: Pierre-Andre Chiappori,
Columbia University

Molly Muleya



PROJECT TITLE

Mineral bioaccessibility of cereals and legumes as influenced by agronomic management and soil contamination in Zimbabwe and Malawi

SIGNIFICANCE

Many individuals in rural settings rely on cereals and legumes to meet mineral requirements. While significant research has characterized how diet and biology modify the digestion and absorption of minerals, understanding the role of agronomic factors, such as soil health and crop management, is an emerging research area.

METHOD OR METRIC

Bioaccessibility of minerals refers to the proportion of total mineral content released during digestion and absorbed in the gut. The bioaccessibility of minerals from plant sources are generally low, due to tough food matrices stemming mineral release and antinutrients, such as phytates, that inhibit absorption. To understand how agronomic factors impact the bioaccessibility of three key minerals, iron, zinc, and selenium, Round 4 Fellow Molly Muleya is developing a statistical model that incorporates different types of soil, soil contamination of food, and different types of crops, as well as laboratory work using enzymes to simulate digestion.

IMPACT

Work on this fellowship project is ongoing. This research will produce a bioaccessibility model, which can be directly used to create a bioaccessibility index for use in agriculture, public health and nutrition.

LOCATION

Zimbabwe and Malawi

TOPICS

Agricultural management,
Micronutrient deficiency

DISCIPLINES

Nutrition, Agronomy

MENTORS

Home Mentor: Prosper
Chopera, University of
Zimbabwe

Host Mentor: Elizabeth
Bailey, University of
Nottingham

WHERE IS THE FELLOW NOW?

Molly is currently a Post-doctoral Fellow with IMMANA at Tufts University. Her research has been published in *Food Reviews International*, the *Journal of Agricultural and Food Chemistry* and the *Journal of Food Composition and Analysis*.

Aissatou Ouedraogo

PROJECT TITLE

Social networks, production of micronutrient-rich foods, and child health outcomes in Burkina Faso

SIGNIFICANCE

Social networks can impact the effectiveness of behaviour change interventions. Larger social networks could diffuse knowledge more widely; tighter networks might facilitate uptake. Understanding how different social network characteristics influence agriculture and nutrition education can improve the design and delivery of policies and programmes.

METHOD OR METRIC

Social networks encompass the social relationships that connect a person or household to others. For this fellowship project, Aissatou Ouedraogo investigated the roles of three social network characteristics: degree, betweenness and type. Degree, which represents connectivity, is measured by the number of other households in a social network. Betweenness, representing importance or influence, is measured by how short the paths are from studied household to others. Type was determined by conduit of the agriculture and nutrition education intervention: older women leaders or members of a village-level health committee.

IMPACT

Aissatou's research used social network theory to understand who should deliver nutrition education and what aspects of social relationships improve uptake and child nutrition outcomes. Older women leaders were more effective at increasing nutrition knowledge than village health committee members. Households in social networks that collectively ate more nutritious foods were more likely to follow suit. Finally, being connected to networks with more nutrition knowledge was linked to lower stunting and underweight prevalence. These findings indicate that cultural roles may wield more influence than professional ones, and that communities working together to improve nutrition may be more successful.

WHERE IS THE FELLOW NOW?

Aissatou continues to work. Her research has been published in *Area Development and Policy* and featured by the Agricultural & Applied Economics Association.



LOCATION

Burkina Faso

TOPICS

Social networks, Nutrition education

DISCIPLINES

Economics, Nutrition

MENTORS

Home Mentor: Andrew Dillon, Northwestern University

Host Mentor: Eugenie Maïga, Université de Koudougou

LEARN MORE

Ouedraogo, A., Dillon, A., & Maiga, E.W.H. (2018). *Social networks, production of micronutrient-rich foods, and child health outcomes in Burkina Faso*. 2018 Annual Meeting, August 5-7, Washington, D.C. 273883, Agricultural and Applied Economics Association. Available from: <https://ideas.repec.org/p/ags/aaea18/273883.html>

Anjali Ganpule Rao



PROJECT TITLE

Dietary diversity and its determinants among rural adolescents from Pune, India

SIGNIFICANCE

Adequate nutrition is critical during adolescence, a life stage marked by rapid physical and cognitive development. Despite its importance, especially in dynamic country contexts such as India, no measures that rapidly assess adolescent nutrition exist. Diet diversity measures offer one such direction to solve this measurement gap.

METHOD OR METRIC

Round 3 Fellow Anjali Rao used data from the Pune Maternal Nutrition Study to build new measures of diet diversity for adolescents. Using food frequency data, Anjali compared existing diet diversity scores to select important food groups, estimated nutrient intake for individuals, and compared those to blood nutrient levels. She also identified key sociodemographic determinants of adequate diet diversity.

IMPACT

Anjali's research successfully developed an India-specific diet diversity score for adolescents in agricultural settings. Her research validated the score for adequate nutrient intake and blood nutrient levels for males and females, ensuring its significance for clinical nutrition and public health. Future research efforts can use this simple tool to assess adequate nutrition in similar contexts for an oft-overlooked population.

WHERE IS THE FELLOW NOW?

Anjali is currently a Senior Research Associate with the King Edward's Memorial Hospital Research Centre in Pune, India. Anjali's research has been published in the *European Journal of Clinical Nutrition*, the *Asia-Pacific Journal of Endocrinology* and the *American Journal of Human Biology*.

LOCATION

India

TOPICS

Diet quality, Adolescent nutrition

DISCIPLINES

Epidemiology, Nutrition

MENTORS

Home Mentor: Chittaranjan S. Yajnik, King Edward's Memorial Hospital Research Centre

Host Mentor: Elaine Rush, Auckland University of Technology

Sukhwinder Singh

PROJECT TITLE

The effect of farm, crop and livelihood diversity on farmer nutrition in India: A comparative study of Punjab and Gujarat

SIGNIFICANCE

Significant regional differences in food production, food security and nutrition outcomes in India exist. While farmers in some states have increased their livelihood diversity, others have specialized toward staple grains. Research comparing these agricultural trends can help characterize how different sources differentially impact nutrition.

METHOD OR METRIC

In his fellowship, Sukhwinder Singh collected new data to construct various indexes of farm-level production diversity and nutrition indicators in two states of India: Haryana and Gujarat. He used standard statistical tests to establish and estimate associations between livelihood diversity, food consumption, and adult and child nutrition statuses. Results for each state were compared against each other to identify important factors which might influence the examined relationships.

IMPACT

Results from Sukhwinder's research indicate that livelihood diversity might increase the quality of farmer's diets. Within their income sources, having a diverse set of crops was important, but only during the monsoon seasons and in Haryana. Variation between the two study regions, Haryana and Gujarat, shed light on region-specific agricultural determinants of food consumption and nutrition.

WHERE IS THE FELLOW NOW?

Sukhwinder continued post-doctoral research with the School of Environment and Sustainability at the University of Michigan. His research has been published in the *Journal of Crop Improvement*, *Environmental Research Communications* and *Food Security*.



LOCATION

India

TOPICS

Smallholder agriculture,
Farmer nutrition

DISCIPLINES

Economics, Nutrition

MENTORS

Home Mentor: Sukhpal
Singh, Indian Institute of
Management

Host Mentor: Meha Jain,
University of Michigan

Thalia Sparling



PROJECT TITLE

New methods to measure delivery and uptake of nutrition-sensitive agriculture programs

SIGNIFICANCE

While improving the design and evaluation of nutrition-sensitive agriculture research has received considerable attention, efforts to improve programme monitoring lags. Strengthening methods to monitor programmes can help studies identify and fix intervention gaps, or more carefully link inputs, outputs and outcomes. Developing and testing of such methods is critical for delivering higher quality research.

METHOD OR METRIC

This fellowship project by Thalia Sparling sought to develop new methods for tracking the delivery of nutrition-sensitive agriculture research. The project used data from a large-scale homestead food production programme conducted in Bangladesh, as well as qualitative data from staff describing their use of the existing monitoring system. A key aspect of the fellowship research will assess the feasibility of using mobile-based data collection in the programme context.

IMPACT

Thalia's research on testing new methods for monitoring nutrition-sensitive agriculture research is ongoing. The work she has accomplished thus far led to an intersecting project, the development of an interactive evidence and gap map of tools, metrics and methods used to study the linkages between agriculture and nutrition.

WHERE IS THE FELLOW NOW?

Thalia is currently a Research Fellow with the London School of Hygiene & Tropical Medicine. Thalia's work has been published in the *Journal of Nutritional Science*, *Maternal & Child Nutrition* and *BMJ Open*.

LOCATION

Bangladesh

TOPICS

Program evaluation,
Nutrition-sensitive agriculture

DISCIPLINES

Epidemiology, Nutrition

MENTORS

Home: Sabine Gabrysch,
Heidelberg University

Host: Purnima Menon,
International Food Policy
Research Institute

Taddese Alemu Zerfu

PROJECT TITLE

Dietary factors in maternal anaemia and pregnancy outcomes in rural Ethiopia

SIGNIFICANCE

Iron deficiency anaemia is a major public health concern in Ethiopia, especially for pregnant women. Despite the known barriers to consumption of iron-rich foods, there is scant research available describing the role of diet quality on pregnancy outcomes. Identifying dietary factors associated with anaemia and poor outcomes in pregnant women can facilitate development of agricultural, food-based interventions.

METHOD OR METRIC

Taddese Alemu Zerfu used data from a pregnancy cohort study conducted in rural Ethiopia to develop two statistical models for predicting adverse perinatal outcomes. The first model focused on the roles of different food groups in giving birth prematurely, low birth weight and stillbirths; the second model focused on anaemia status, as determined by blood haemoglobin levels.

IMPACT

In his study, Taddese found that low consumption of dairy, fruits and dark green leafy vegetables were all independently and strongly tied to poor pregnancy outcomes, whereas meat and fish had weaker effects. Low consumption of any food group, though, increased risks. In addition to these findings, Taddese's use of a prospective cohort design enriched the body of research investigating the role diet quality plays in maternal anaemia, pregnancy and birth.

WHERE IS THE FELLOW NOW?

Following his IMMANA Fellowship, Taddese joined the African Population and Health Research Centre (APHRC) as a Post-doctoral Research Scientist. His research has been published in *The Lancet*, the *American Journal of Clinical Nutrition*, *Nutrition & Diabetes* and *BMC Nutrition*.



LOCATION

Ethiopia

TOPICS

Iron deficiency anaemia, Pregnancy

DISCIPLINES

Epidemiology, Nutrition

MENTORS

Home Mentor: Kaleab Baye, Addis Ababa University

Host Mentor: Mieke Faber, South African Medical Research Council

LEARN MORE

Zerfu, T.A., Pinto, E., & Baye, K. (2018). Consumption of dairy, fruits and dark green leafy vegetables is associated with lower risk of adverse pregnancy outcomes (APO): a prospective cohort study in rural Ethiopia. *Nutrition & Diabetes*, 8(52). DOI:10.1038/s41387-018-0060-y

three



A vibrant community
of over 1,800 researchers and
users of research globally

ANH
ACADEMY



The London Centre for
Integrative Research
on Agriculture & Health



About us

The Agriculture, Nutrition & Health (ANH) Academy is a global network of researchers and research users dedicated to improving nutrition and health through agriculture and food systems. The ANH Academy is, by definition, inclusive: any individual or organization engaged in agriculture, food systems nutrition and health, whether by research, practice or policy, is invited to participate. Thus, the Academy's opportunities to network, share knowledge, and engage around research are accessible to all levels of expertise and are delivered through a variety of formats.

The ANH Academy is one of the three workstreams of Innovative Methods & Metrics for Agriculture & Nutrition Actions (IMMANA) and was jointly founded in 2015 by IMMANA, LCIRAH and the CGIAR Research Program on Agriculture for Nutrition and Health (A4NH).

Activities

The ANH Academy achieves its mission of fostering a global research community through a set of interlinked objectives, which are to:

1. Share innovative research;
2. Stimulate the development and harmonization of new research;
3. Strengthen the community in conducting intersectoral and interdisciplinary research; and
4. Promote research uptake through policy

To achieve these objectives, the ANH Academy offers in-person and online networking, member-generated blogs, expert webinars and expert technical working groups. Through its flagship event, the ANH Academy Week, it convenes over 350 individuals from 35+ countries each year, to learn, share and generate new ideas and collaborations.





ANH Academy Weeks

Every year, researchers, policymakers, and practitioners come from around the world to attend the five day ANH Academy Week. The event is split into two components: a series of Learning Labs, followed by a Research Conference. Each ANH Academy Week takes place in agriculture, nutrition and health capitals of Africa and South Asia and is co-developed with regional actors and experts to feature relevant and pressing research themes.

The first half of each ANH Academy Week is comprised of over 20 Learning Labs delivered by experts from around the world. These sessions provide training on a range of ANH-relevant tools, methods and metrics, and are taught using experiential learning approaches. While the slate of Learning Labs changes to respond to local needs and recent advancements, some sessions, such as Qualitative Research Methods and Sustainable Diets, are offered each year to meet consistent and growing demand.

The ANH Academy Week Research Conference serves as a platform for early- to senior-career researchers to present their interdisciplinary work, interact and form new ideas and collaborations. Oral presentations are arranged into sessions, such as women's empowerment and gender, sustainability of agri-food systems, and innovative tools and methods. Posters can be viewed throughout the week and their presenters are given one-minute slots to advertise their work. For plenary events, the ANH Academy Week has enjoyed keynote speeches that represent a diversity of ANH perspectives, from personal research journeys, to synthesis of large-scale research programmes, cross-regional capacity building, and using photojournalism to capture food narratives.



Networking and resource hub

Agriculture, nutrition and health researchers, practitioners and policymakers work all over the world, but how do they connect with one another? In 2016, the ANH Academy launched its online platform to provide a dedicated networking space for people in these fields. Through the Academy website, registered users can create digital profiles to describe their interests, background



and ongoing projects, as well as use the search function to connect with other members according to disciplinary or sectoral expertise, geographic location or research interests.

Through its web-platform, the ANH Academy has co-hosted numerous online trainings and webinars with organizations such as the African Nutrition Society and Agriculture-Nutrition Community of Practice (Ag2Nut), as well as showcasing the latest cutting-edge research emerging from the IMMANA Grants and Fellowships programme. Notable topics covered in these trainings and webinars include measuring women's time use in agriculture, developing a household water insecurity scale, and tracking the impact of agriculture on malaria control, as well as sessions covering funding opportunities and masterclasses on improving presentation skills.

Research synthesis

ANH research spans a broad range of disciplines including health sciences, geography, ecology, anthropology and economics. In order to synthesize often disparate but complementary research, the ANH Academy constitutes technical working groups to tackle methodological challenges in key ANH domains. Based on their findings, working groups develop user-friendly resources to enable future research. To date the Academy has formed four active groups:

- **The Food Environments Technical Working Group**, which conducted a systematic literature review, devised a conceptual framework and definition, as well as a short food environments animation of methods and metrics applicable for low-income settings;
- **The Sustainable Diets Technical Working Group**, which created an interactive social game to stimulate dialogue around simulated food systems challenges and responses;
- **The Food Safety Technical Working Group** which wrote a working paper that compares methods and metrics for low-income countries;
- **The Economic Evaluations Technical Working Group**, which produced a technical brief to describe current approaches and challenges in designing economic evaluations of multisectoral interventions for health and nutrition.



Our impact

While the ANH Academy will continue to influence research, policy and practice for years to come, it has already been able to effectively facilitate the sharing and uptake of knowledge into multisectoral policies, catalyzing new dialogue and generating innovative interdisciplinary research.

Promoting Research Advancements

Several efforts to advance ANH research are tied to the Academy's networking and research synthesis activities. In response to voiced demands for a common framework to evaluate the costs and benefits of agriculture and livelihood interventions for nutrition and health, the ANH Academy convened a technical working group to develop a unified evaluation approach. The Economic Evaluations Technical Working Group reviewed 70 studies to assess existing research and proposed a set of concepts and definitions to promote standardisation of future work. These outputs provided the foundation for a popular Learning Lab on Economic Evaluations at the 2019 ANH Academy Week and a widely disseminated technical brief that summarized key findings. The ideas from the working group in part gave birth to an entirely new \$2.5 million research programme: Strengthening Economic Evaluation for Multisectoral Strategies for Nutrition (SEEMS-Nutrition).

As a platform for convening communities of research and practice, the ANH Academy Week has become a key mechanism for forming interdisciplinary collaborations and training. In 2017 the Academy Week was instrumental to the conceptualisation of a new, largescale interdisciplinary initiative which aims to transform research on child stunting, by shifting from individual factors to more holistic approaches. The 'Action against Stunting Hub' is a £19.7 million multi-country, multi-partner research grant funded by the Global Challenges Research Fund (GCRF) implemented by 18 institutions until 2024.

The ANH Academy also served as a conduit for research funders to launch their own awards. Recent joint funding by UK Aid and The Bill & Melinda Gates Foundation was hosted exclusively by the ANH Academy, underscoring the ANH Academy's uniquely interdisciplinary and engaged research community. The research investments under these awards use systems-level approaches to link agriculture, nutrition and health, and cut across impact assessments, food safety and drivers of food choice.

Moving Research to Policy

At the heart of the ANH Academy's mission is the facilitation of research uptake. Whether through strengthening capacity of researchers to effectively communicate science, providing



platforms on which to do so, or stimulating dialogue around key methodological challenges or evidence gaps, it aims to enhance opportunities for ANH evidence to inform policy at different scales.

Tools such as the interactive social game 'Diet Dimensions' - developed by the Sustainable Diets Working Group – have been used to create such discussion at various levels, from country delegates at Scaling Up Nutrition's Global Gathering in 2018, to the UK Department for Environment, Food & Rural Affairs (DEFRA), and among university-level students studying food systems. This innovative methodology designed to stimulate interdisciplinary discussion and decision-making around critical trade-offs such as nutrition goals and environmental sustainability has been adapted in over 10 different settings.

As well as creating physical discussion, the ANH Academy has sought to synthesise and (re) conceptualize thinking around several key topic areas pertinent to agriculture-food systems, nutrition and health, shifting debates onwards in the process. A framework and definition developed by the Food Environment Working Group has been used across global agencies, including the United Nations High Level Panel of Experts Report on Food Systems and Nutrition as well as featuring in key outputs by the Global Panel on Agriculture and Food Systems and the Global Nutrition Report. Recently, FAO and UNICEF adapted these ideas further in their Conceptual Frameworks of Food Systems for Children's

Diets and Nutrition Status. The Working Group's accompanying food environment animation is now embedded into a large Diabetes MOOC signalling how research from agriculture-food systems domains is increasingly being incorporated into public health fora.

The ANH Academy has also provided ripe opportunities for researchers and policymakers to meet. In one example, the 2018 ANH Academy Week in Accra, Ghana, provided space for Changing Access to Nutritious Diets in Africa and South Asia (CANDASA), a follow-up project to the IMMANA-funded Indicators of Affordability of Nutritious Diets in Africa (IANDA) grant, to hold a policy workshop for members of the Ghana national government. This workshop, the culmination of continued policy engagement by the research teams, resulted in formal intent by the Ghana national government to integrate research outputs from IANDA and CANDASA into their standard surveillance toolkit.

Building Practice Communities

By moving between Africa and South Asia, the ANH Academy Week has helped foster new networks of regional practitioners. Since the first event held in Addis Ababa, Ethiopia, the Agriculture-Nutrition Community of Practice (Ag2Nut) has utilized the unique gathering to establish highly active country and regional chapters in Ethiopia, Nepal, Nigeria, South Asia and West Africa.



The London Centre for Integrative Research on Agriculture & Health