Roads to interdisciplinarity – Working at the nexus between food systems, nutrition and health.

1st Annual Agriculture, Nutrition and Health (ANH) Academy Week
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INTRODUCTION

The development agenda over the next 15 years will be framed by the Sustainable Development Goals (SDGs), of which more than half relate either directly or indirectly to the agricultural sector, highlighting its importance in economic growth and development of low- and middle-income countries (LMICs) (FAO 2015). It is therefore imperative that agricultural systems are better understood, so that they may be strengthened and optimised to deliver outcomes in line with the SDGs. The interface between agriculture, nutrition and health is particularly multifaceted and complex, and the development of successful strategies will require an integrated and multi-sectoral approach (Dorward and Dangour 2012; Jones and Ejeta 2015).

'Agri-health' is an evolving paradigm seeking to unify research approaches and methodologies between agriculture and health. Research within the field encapsulates a broad range of disciplines, locations and actors, and aligns these into a common research agenda. In doing so, agri-health aims to transcend barriers imposed by the longstanding institutional and disciplinary silos. Much progress has been made in recent years in this regard (Harris et al. 2013; Kanter et al. 2014; Picchioni et al. 2015). However, more coordinated efforts are required to generate consensus and target strategic priorities amongst the many existing information gaps (Webb and Kennedy 2014). Understanding the

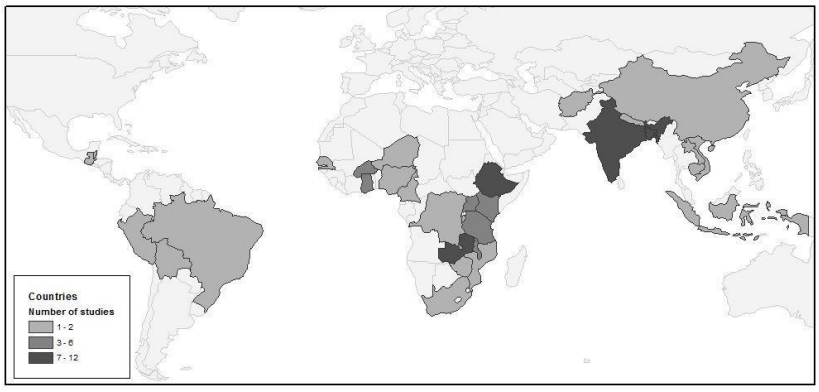
linkages between complex issues such as globalisation, climate change, food systems, and evolving burdens of malnutrition is central to agri-health research.

The Leverhulme Centre for Integrative Research on Agriculture and Health (LCIRAH) was created in 2010 with a key focus on agri-health interdisciplinary research. LCIRAH includes experts from across the member colleges of the University of London: the London School of Hygiene and Tropical Medicine (LSHTM), the School of Oriental and African Studies (SOAS), and the Royal Veterinary College (RVC).

The Agriculture, Nutrition and Health Academy (ANH Academy), was established in 2015 as a platform to facilitate learning, knowledge sharing, capacity building and collaborative partnerships among the growing global community of researchers, practitioners and policy makers working within agri-health. It was developed with support from the Innovative Metrics and Methods for Agriculture and Nutrition Actions (IMMANA)[1] research programme, led by LCIRAH and Tufts University, in partnership with the CGIAR Programme on Agriculture for Nutrition and Health (A4NH).Within this scope, the ANH Academy hosts an annual ANH Academy Week, building on the legacy of five agri-health research conferences organised by LCIRAH; as well as events and activities coordinated under the CGIAR A4NH.

The inaugural ANH Academy Week took place in Addis Ababa, Ethiopia, in June 2016. The Academy Week included two days of interactive 'learning labs' (training sessions on skills and methods across a broad range of disciplines in agri-health), followed by a three-day research conference. The conference included a mix of abstract-driven sessions, round table discussions, and keynote speeches from across the spectrum of agriculture, nutrition and health disciplines, and a wide range of countries (Figure 1).

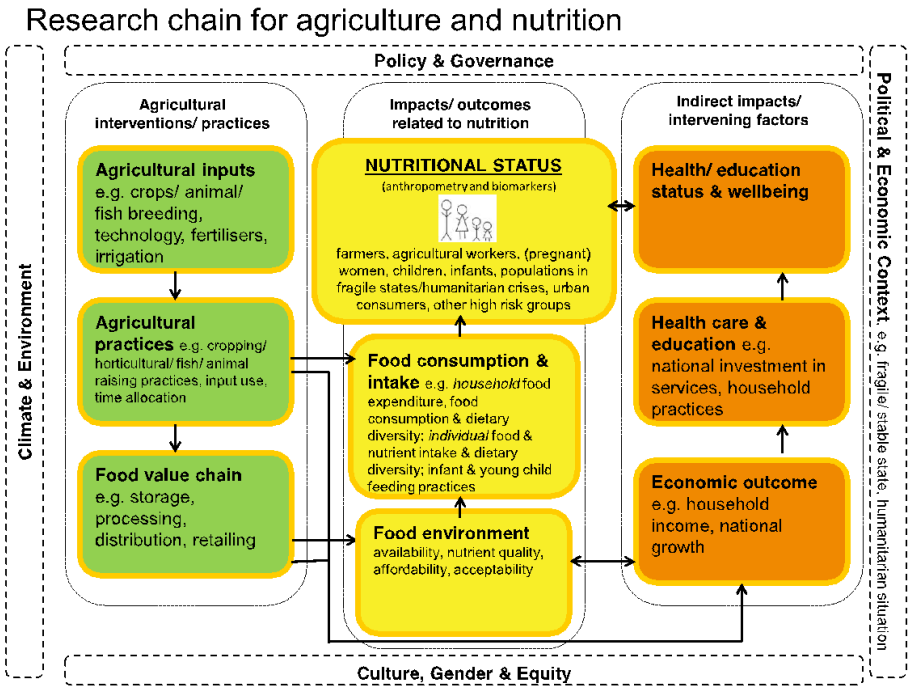
Figure 1. Countries represented within ANH Academy Week abstracts



Hawkes et al. (2012) developed a conceptual framework (Figure 2, hereafter referred to as the Framework), outlining the key pathways through which agriculture may affect nutritional status in LMICs, as well as broader drivers of these pathways. Drawing on this Framework, this paper aims to provide an analytical synthesis of the ANH Academy week by mapping the research and debates presented during the conference.

[1] IMMANA provides a number of grants and fellowships. Grants aim to accelerate the development of innovative interdisciplinary methods, metrics, and tools to fill key knowledge gaps in agriculture-food systems and nutrition research. Fellowships aim to build a cadre of early career researchers in agriculture and food systems, nutrition, and health research. During the ANH Academy Week IMMANA grantees and fellows presented their research. For a detailed list of researchers and projects visit IMMANA website

Figure 2. Conceptual Framework of pathways between agriculture and nutrition



Source: Hawkes et al. 2012.

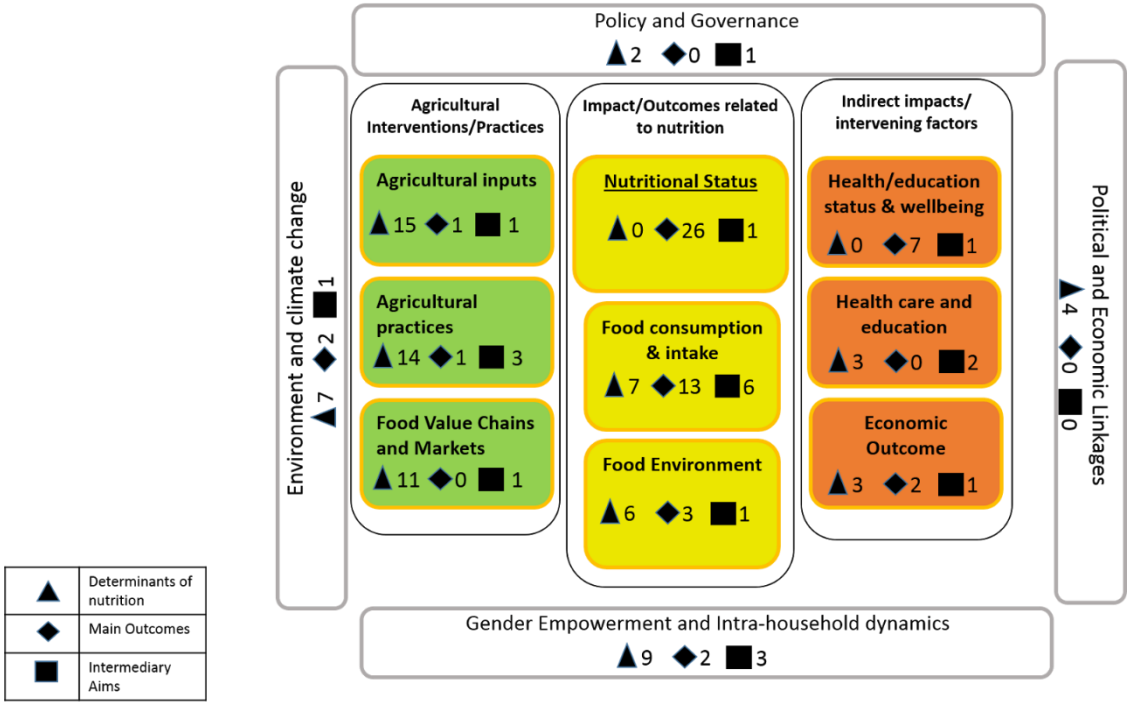
LINKING PATHWAYS BETWEEN AGRICULTURE, NUTRITION AND HEALTH

Identifying pathways between agriculture, nutrition and health, and novel methods and metrics in this area was a common theme connecting the Academy Week learning labs, conference presentations and debates. This section will briefly explain the conceptual Framework used to categorize the conference abstracts, and describe these results. A description of presentations, organised by four thematic areas, then follows.

In the Framework illustrated in Figure 2, nutrition is the key outcome and endpoint of impact pathways stemming from agricultural and food system activities. These pathways from agriculture to nutrition act through modifying food environments and food intake, and alterations of socioeconomic factors such as education, health, and income. Additionally, the Framework shows broad macro-level drivers influencing these pathways to nutrition, namely climate and environment; culture, gender and equity; political and economic context; and policy and governance.

We apply this Framework to assess the research contributions of the conference, using a multi-stage process. We first classified each presentation by its main research scope, broadly represented by the domains in the Framework. The research abstracts were then classified in terms of whether they studied the Framework domains as a determinant of nutrition, as an outcome in itself, or as an intermediary on the pathway to nutrition (Figure 3).

Figure 3. Classification and number of abstracts by research domains and analysis pathways



During the conference, 45 abstracts were presented. Within these, the domains of agricultural inputs, practices, and food value chains were most commonly studied as the determinants of nutrition and health (15, 14 and 11 respectively). Several other domains were also studied as determinants of nutrition in the abstracts, including gender empowerment and intrahousehold dynamics, food consumption, environment and climate change, food environments, and political and economic factors (9, 7, 7, 6, and 4 studies, respectively). This highlights a wide range of intersectoral nutritional determinants that were presented during the conference. In terms of the final outcome domains presented in the abstracts, most focused on nutritional status, particularly and child maternal nutrition. Food intake was also commonly used as a study outcome, often used as proxy for nutritional status. Fewer studies included health, education and wellbeing as the final, measurable outcome of their analysis, emphasising the difficulties in measuring impacts of agricultural interventions on these important domains. In terms of intermediary aims, food consumption was found to be the preferred channel to improve nutritional status (6 studies), followed by gender and equity, and agricultural practices (3 studies for both domains).

We now more comprehensively summarise the presented abstracts, by dividing them according to four thematic spheres which emerged from the conference sessions: 1) Value chain and market approaches in agri-health 2) Pathways between agriculture, food systems, and health; 3) Environmental sustainability of agriculture and food systems; 4) Gender and household dynamics approaches in agri-health.

Theme 1: Value chain and market approaches in agri-health

In recent years the agri-health community has employed value chain approaches to address global malnutrition. Value chain frameworks examine the actors involved in different stages of food production, distribution, and consumption, as well as their interrelations (Gelli 2015). Key concerns relate to how value chains can be optimised to improve nutrition, including how to minimise inefficiencies and risks. The need to comprehensively account for all stages, and across multiple value chains, was a key message from the discussions.

Multiple value chains combine to shape food availability within food environments, providing both opportunities and constraints for policy levers to tackle malnutrition. However, as *Aisha Twalibu*[2] noted, the vast majority of value chain studies have focused on single chains. Twalibu's project used a multi-chain focus to address the various constraints hindering quality of diets. Her work emphasized the roles of social investment and the public sector in bridging low-income households with access to markets. *Rohit Parasar* compared distribution value chains under the Supplementary Nutrition Programme (SNP) in two Indian states, finding higher state SNP spending is associated with lower levels of undernutrition, and making the case for the programme's inclusion of more beneficiaries. Parasar also emphasized the importance of having differentiated models of preparation and distribution of fortified foods; state intervention, private-public partnerships and cooperatives can play an important role in this sector, while also providing employment opportunities. *Paula Dominguez-Salas,* reported on behalf of *Maud Carron,* on governance structures within poultry value chains in Nairobi, which show nuanced effects on urban food environments. Having only few producer associations, with minimal government oversight, lead to the dominance of informal value-chains and consequent food safety risks. *Geday Elias* found that, in the Ethiopian highlands, whilst there was a negative association between households' participation in milk value-chains and milk consumption, there was a positive association between participation and dietary diversity, energy supply, and farm income.

The importance of improving access to markets that provide affordable and diverse foods throughout the year was a key message from several presentations. The role of markets in dietary diversification has grown more prominent recently within the "agriculture for nutrition" agenda. In a talk presented by Bhavani Shankar, *Giacomo Zanello* examined food availability and accessibility in markets in Afghanistan. He found that household dietary diversity was largely explained by market-purchased foods, especially during seasons when roads to markets are useable. *Mehroosh Tak* found that cross-state dietary diversity in India improves with increased market coverage and female literacy. Likewise, *Kalle Hirvonen's* analysis in remote Ethiopian localities emphasized the centrality of markets in making behavioural change communication strategies effective in improving children's diets. In similar study regions, *Bart Minten* found that the additional costs imposed on farming households from poor roads and market access, translated to worse welfare and food security. *Jérôme Somé's* study, presented by Andrew Jones, showed how degree of seasonal variation in household dietary diversity in Burkina Faso, due to fluctuations in agricultural production, can depend on the households' agricultural and socioeconomic characteristics. This body of research has important policy implications: nutrition-sensitive agricultural interventions have traditionally focussed on prioritizing individual farm-level production, while these studies show the fundamental importance of broad-based market improvements and accessibility.

Theme 2: Pathways between agriculture, food systems, and health

A food systems perspective, of which agricultural production is one component, is crucial to foster health outcomes. Food systems are complex socio-ecological systems, and there is a critical need for specific methods, metrics, and characterisation of the pathways within these systems. A diversity of abstracts on this theme were presented during the conference.

The links between agriculture and nutrition are bidirectional (Hawkes and Ruel 2006), and nutritional intake affects the labour, which is a key input into agricultural production. *Rosemary Isoto* discussed how the intake of macro- and micro-nutrients was positively associated with productivity in Uganda women's productivity in particular more than doubled when nutrition improved. *Maria Garza* reported on the governance of animal health in poultry and aquaculture sectors in Bangladesh, finding a crucial need for more evidence-based

[2] For a thorough list on presenters and learning labs facilitators affiliations, see List of Presenters and Learning Lab facilitators' affiliations and institutions at the end of the document.

approaches in decision-making. *Mieghan Bruce* discussed her research on the effect of animal health interventions on home-consumption and income pathways in rural Tanzanian smallholder households.

Although animal-source foods have many nutritional benefits, food safety issues are still of concern. *Derek Headey* discussed evidence that exposure to chicken faeces had a detrimental effect on child growth but more research was needed to clarify the mechanisms. However, there are potentially detrimental implications associated with food safety regulations; although the presence of aflatoxins in feed for dairy cattle in Kenya contributes to significant costs, *Daniel Senerwa* (in a study on five agro-ecological zones) estimated that if legislation were enforced, the economic losses would be considerable.

School feeding programs are seen as a tool to connect agriculture, nutrition, and development. For example, the Ghana School Feeding Program (GSFP) procures local food from small-holder farmers, and aims to improve both child nutrition and school attendance (Gelli et al. 2016). However, as *Matilda E. Laar* and *Clement Adamba* indicated, challenges exist in evaluating these programmes comprehensively against multiple dimensions, and understanding the obstacles along various stages of the procurement and distribution chain. *Asnake Irenso*'s analysis of food security predictors in Ethiopia highlighted the relevance of secure and stable food production in urban and rural areas.

The food environment is the interface between food systems and consumers, and includes the physical, economic and socio-cultural factors that influence food choices. Consumer-food environment interactions are shaped by the availability, accessibility, affordability, desirability and convenience of diverse food sources and products. Several speakers touched upon these aspects.

Dominic Rowland discussed the important contribution that forest foods provide to dietary quality in 24 tropical countries where communities live within proximity to forests. *Hassan Ishaq Ibrahim* examined the detrimental effects of post-harvest losses in agriculture on household food security of communities in Northern Nigeria.

Anna Herforth discussed the Indicators of Affordability of Nutritious Diets in Africa (IANDA) project and the development of new metrics to track the affordability and availability of nutritious and diverse foods throughout the year. *Fiorella Picchioni* presented the Minimum Calorie Expenditure Share (MCES), an indicator of food prices sensitive to the impacts of price shocks. Drawing on Dorward's (2013) research, the MCES measures the extent of food price increases for food-insecure populations, and compares these against the relative effects of economic and income growth.

Parnali Dhar Chowdhury and *Geofrey Maila* presented on the prevalence of overweight amongst children in Dhaka and the elderly in Zambia, respectively. Both presenters highlighted the need to understand the complex social determinants shaping food consumption patterns within food environments.

Theme 3: Environmental sustainability of food systems

Agriculture is inextricably linked to the environment. Food systems are the leading driver of water and land use globally, and produce about one-quarter of all greenhouse gas emissions (Whitmee et al. 2015; Aleksandrowicz et al. 2016); most of these footprints originate in the primary agricultural production stage (Vermeulen et al. 2006). Agriculture is similarly affected by the environment, with further climatic changes expected to increase pressures on agricultural production capacity. *Stephen Shisanya* presented research on farming households among which 95% were expecting negative future impacts of climate on their crops, and were preparing to undertake adaptive farming practices. Technologies that improve sustainability are necessary for agricultural intensification. *Anteneh Girma* explored the nutrition security impacts of rainwater harvesting technologies, finding that using

rainwater harvesting improved the access and utilization components of a multidimensional food security indicator.

Improving diversity of agricultural production is considered a requirement for food system resilience (FAO 2012). *Andrew Jones* considered the nutritional implications of this, through a systematic review exploring the relationship between agricultural production diversity, market integration and dietary diversity. He found that production diversity was positively associated with dietary diversity in 93% of studies, independent of wealth or market access. *Roseline Remans* assessed the trade-offs between nutritional yields and climate-resilience of cereal crops in India, reporting that sorghum and maize provide high nutritional yields, while small millet is most resilient, and concluded that no single crop was superior for all objectives.

Sustainable diets are considered those with "low environmental impacts, which contribute to food and nutrition security and to healthy life for present and future generations" (FAO 2012). *Edward Joy* presented the Sustainable and Health Diets in India (SAHDI) project which defined typical Indian dietary patterns using latent class analysis, and quantified their health and environmental impacts. This work concluded that dietary changes could be optimised to deliver health and environmental co-benefits.

Theme 4. Gender and household dynamics approaches in agri-health

Research investigating the relationship between women's empowerment and nutrition is expanding, with gender empowerment increasingly being a core component of development interventions (van den Bold 2013). However, these complex pathways still remain to be understood. There is growing acknowledgement to widen nutritional analysis to a broader range of household members (particularly adolescents), and to incorporate qualitative research to understand the linkages between gender, intrahousehold dynamics, and child nutrition.

Women farmers are often custodians of knowledge on the climate resilience and nutrition of local crops. *Florence Mtambanengwe* described her project using elderly women's know-how on production of resilient cereals and legumes for household nutrition security among smallholder farmers in Zimbabwe. *Hilde Bras* reflected on whether women's empowerment can improve the current inequalities in nutritional status between siblings in Ethiopia, due to birth order and/or gender. Bras connects much of this effect to women's time burdens, and suggests investment in infrastructure and cultural change around gender norms could reduce these disparities. Similarly, *Elisabetta Aurino* identified similar patterns in India among longitudinal cohort data of young and adolescent children, which showed higher dietary diversity among boys, and higher allocation of nutritious food groups. Such gender imbalances appeared to be linked with parent's educational aspiration towards boys (Aurino 2016).

Erin Milner described the negative impact of household food insecurity on early child development, and *Jessica Heckert* suggested that empowerment and increased resource availability from integrated agriculture and nutrition programmes can help women implement optimal nutrition and health practices. The development of a new agri-health indicator of women's empowerment in livestock-focused agriculture was discussed by *Amy Webb Girard*.

Cynthia Matare described her project on women's time use, cultural norms, and agriculture in Zambia. Additionally, *Nitya Mittal* and *Sudha Narayanan*, discussed their use of mixed methods to identify the pathways and mediating factors between gender, agriculture and nutritional outcomes.

METHODS

Agri-health research employs a broad range of methods, metrics, and multidisciplinary approaches in addressing the complexities of nutritional and health challenges. Various debates on agri-health data collection, harmonization and measurement were presented during the Academy Week's conference and learning labs. The following two sections describe the main debates and methodological approaches discussed.

New tools and infrastructure for collecting, analysing and disseminating data

There is a need to both collect new data on many agri-health research gaps, as well as openly utilise and integrate the great amount of data that already exists. *Todd Rosenstock* presented the Surveillance of Climate-Smart Agriculture for Nutrition (SCAN) project which aims to increase the spatial and temporal resolution of data. A new project presented by *Andrew Jones* seeks to redefine livelihood typologies in smallholder farming households, while the suitability of conventional dietary intake measurements in pastoral contexts was explored by *Bekele Megersa*.

On the constraints of collecting and using data relevant for agri-health research, *Lidan Du* discussed the impact of timing, particularly of seasonality harvest frequency, on the value of reported food consumption. *Perrine Geniez* described the practical challenges of setting up the National Information Platforms for Nutrition, largely related to the accessibility, quality, and standardisation of data. Accurate dietary intake data is important for many policy outcomes, particularly for countries undergoing nutrition transitions, such as India. However, as *Lukasz Aleksandrowicz* pointed out, there is a lack of national, gold standard data, and his comparison of seven Indian datasets showed contrasting results in intake of important food groups.

Perrine Geniez identified scientific approaches such as probabilistic causal models hold promise to overcome the challenges associated with poor data accessibility and quality. A Bayesian network model being developed for an IMMANA grant was presented by *Eike Luedeling*, which demonstrated the value of a holistic decision analysis approach that integrates even uncertain or missing data, to quantify nutrition pathways of agricultural interventions.

Learning Labs - multidisciplinary trainings and workshops

A number of well-attended Learning Labs provided attendees with opportunities to learn and apply broad range of skills required for researchers and practitioners in agri-health. The lab on Core Disciplines in Agriculture-Nutrition-Health (ANH-101), organised by the LCIRAH research team, provided the basics of the main disciplines of agri-health (nutrition, health and agricultural economics, and anthropology). Additional learning labs focused on important components of the research process, including systematic reviews, data visualisation, working across disciplines in agri-health, and publishing research.

The skills-focused Labs above were accompanied by ones focusing on the uptake of methods, such as: i) Optifood, ii) mixed methods in process evaluation, iii) evidence-informed decision-making, and iv) IFSTAL's food systems approach. These were complemented by a set of labs on the use of targeted and novel indicators. This session instructed researchers and policy analysts on the Food Security and Information Network's (FSIN) compiled food security and nutrition indicators. A specialist team from the International Food Research Policy Institute (IFPRI) led participants on the use of the Women's Empowerment in Agriculture Index (WEAI).

A final group of Learning Labs focused on integrative approaches in agri-health. A session on mainstreaming nutrition in national agriculture investment plans, led by A4NH/IFPRI, FAO and NEPAD, introduced the CAADP Results Framework. A multi-institutional research team

lead by University of Sydney [3] presented an EcoHealth approach to review options for achieving optimal diets in resource-limited settings. Finally, a specialist team from FAO led participants through mapping food security and nutrition policies for policy coherence in food systems.

The Learning Labs were well-attended and participants represented diverse sectors, levels and regions. In alignment with the goals of the ANH Academy Week, the Labs focused on linking agriculture and nutrition, and emphasised cross-cutting themes such as culture, gender, and climate change. These sessions targeted junior researchers from LMICs and their participatory nature enabled participants at all levels and sectors to engage and learn from one another.

CONCLUSION

As reflected in *Shawn Baker's* keynote, considerable progress has been made in expanding the agri-health research evidence base and uptake in policy. A research landscape once typified by few and relatively small groups has now evolved towards an increasingly large, well-funded, interdisciplinary, and global array of researchers. This research space, which naturally supports the SDGs agenda, is actively filling critical gaps in agriculture and health, developing innovative methods and metrics, and already informing interventions and cross-sectoral policy. The very existence of an ANH Academy and similar initiatives, as well as political commitment to initiatives such as Scaling Up Nutrition (SUN), is evidence of this progress and validation of the robust body of evidence being produced.

The necessarily wide scope of the agri-health agenda has been helpful for pursuing research on food system perspectives, as well as measuring impacts across multiple dimensions. Emphasis on innovative tools has been accompanied by shifts towards more qualitative and mixed-methods research to provide deeper context around agri-health pathways.

Yet, considerable challenges still exist. Beyond the high global number of people undernourished - around 795 million (WFP 2016) - there is a rising prevalence of overnutrition. Indeed, dietary risk factors are now the top contributor to the global burden of disease (Global Panel on Agriculture and Food Systems for Nutrition 2016).

There is also major room for improvement in the equality between high- and middle- or low-income researchers to access to funding opportunities and resources in agr-health. Efforts to make data, tools, and frameworks open, widely available, and useable, such as the *Global Open Data for Agriculture and Nutrition (GODAN)* initiative, are admirable and should be encouraged. Another priority is harmonising the use of methods and metrics, while recognising the strengths and weaknesses of the various tools we are using, to efficiently drive research advances and impact.

Despite its increasing prominence, agri-health is still in its infancy. Frameworks emerging in this multidisciplinary area point towards complex and evolving relationships, and sometimes tensions between global and local scales. This complexity brings both challenges and opportunities, including shifting to novel and flexible ways of working collectively. The increasing pressure on policymakers to deliver co-benefits and efficiency offers great opportunities for agri-health research to find relevance in policy spheres. To capitalise on this requires a concerted effort to present information with coherence both to policy makers and the public alike. As *Haris Gazdar* noted in his keynote 'researchers must be honest translators of their work and respectful interpreters of others [work]'. In this sense it is everyone's responsibility to communicate, share and learn from one another.

[3] University of Sydney, International Livestock Research Institute, London School of Hygiene & Tropical Medicine and the Royal Veterinary College

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