

PROCEEDINGS OF THE 2nd ANNUAL SCIENTIFIC SYMPOSIUM August 13-14 2013

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Research Briefing Papers provide a means for researchers, students and professionals to share thoughts and findings on a wide range of topics relating to agriculture, nutrition and health. They contain preliminary material and are circulated prior to a formal peer review in order to stimulate discussion and critical comment. Some working papers will eventually be published and their content may be revised based on feedback received. The views presented in these papers do not represent official views of the institutions. The series of papers is available online at www.nutritioncrsp.org

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ABOUT NUTRITION INNOVATION LAB

Funded by USAID, the Feed the Future Innovation Lab for Collaborative Research on Nutrition, also known as the 'Nutrition Innovation Lab' (formerly the Nutrition Collaboration Research Program – NRSP), is a joint effort of US and local partner academic institutions working towards how program and policy interventions may achieve accelerated gains in maternal and child undernutrition. The Nutrition Innovation Lab specifically focuses on the role of multi-sectoral policy and programing in improving health and nutrition outcomes through the conduct of original research with local partners. The initiative also supports human and institutional capacity building for research and policy analysis in host countries through graduate level training (MS and PhD) and support for short courses and conferences. The program launched in 2010, is managed by the Friedman School of Nutrition Science and Policy at Tufts University, in partnership with the Schools of Public Health at Johns Hopkins University and Harvard, the College of Agriculture at Purdue University, the College of Agricultural, Environmental, and Natural Sciences at Tuskegee University, Development Alternatives Inc., the USAID Bureau for Food Security and USAID missions in Feed the Future focus countries.

ACKNOWLEDGEMENTS

We gratefully acknowledge the organizations and individuals who made the symposium a success including the Nepali co-hosting groups, National Agricultural Research Council (NARC) and the Department of Community Medicine and Public Health, Institute of Medicine (IOM) at Tribhuvan University and their representatives, Dr. Sharad Onta and Dr. Rajendra Wagle(IOM) and Dr. Devendra Gauchan (NARC); the Nepali Technical Assistance Group (NTAG) for logistic support; Dev Raj Gautam, Preeti Subba and Priya Shrestha for photographic coverage of the event; Ms. Shabnam Shivakoti, Drs. Ramesh Adhikari and Devendra Gauchan as session moderators; Diplav Sapkota and Prajula Mulmi as session documenters; Dr. Raman Shrestha and Sun- Eun Lee as symposium rapporteurs; Drs. Patrick Webb (Tufts), Shibani Ghosh (Tufts), Rolf Klemm (Johns Hopkins), Keith West (Johns Hopkins) as members of the Nutrition Innovation Lab team; Abhigyna Bhattarai and Swetha Manohar as lead symposium organizers. Last but not the least, we want to extend our thanks to the oral and poster presenters who provided the technical substance for the symposium; and to USAID/Washington for providing funding support.

EXECUTIVE SUMMARY

The Nutrition Innovation Lab's 2nd annual scientific symposium held in Kathmandu, Nepal on August 13-14, 2013 under the theme "Science and Policy for Health, Agriculture and Economic Growth" facilitated the sharing of new research findings along the agriculture to nutrition pathway. Featuring 15 oral and 11 poster presentations, the two day meeting was attended by approximately 250 participants who represented researchers, field practitioners, government policymakers, donors (including the USAID mission) and 40 students from various Nepali institutions of higher education.

The symposium included two keynote addresses discussing the 2013 Lancet Series on Nutrition and the role of Aflatoxin in growth suppression, a session on multi-sectoral nutrition research and implementation, three sessions addressing research findings on different components of the agriculture to nutrition pathway (agriculture to market, market to home and home to nutrition outcomes), a presentation on the analysis of the large scale survey – the National Living Standards Survey (NLSS); the use of proteomics to assess micronutrient status; a poster presentation session; and high-level policy discussions.

The key messages and conclusions from the symposium were:

- The need for more research on factors such as post-harvest storage and loss, indigenous foods and practices, irrigation, composting and intra-household food security and their effect on the pathways linking agriculture to nutrition in Nepal.
- The need for programs and policies to target economically and socially disadvantaged groups to achieve greater nutrition gains – the evidence presented during this symposium from experimental and non-experimental research designs, unanimously called for this type of informed targeting.
- The need for better evidence from rigorous research to evaluate the effects of "nutrition sensitive" interventions (i.e. interventions that address underlying causes of undernutrition, such as agriculture, social safety nets, hygiene, education).
- The need to increase cross-disciplinary discussions to prioritize and frame a research agenda.
- The need for enabling mechanisms to foster multi-sectoral research that uses valid and reliable metrics and appropriate study designs to answer the following questions:
 - Which agriculture interventions, programs and policies accelerate nutritional improvements, and their cost-effectiveness?
 - Which impact pathways are the most important in different contexts and how can they be positively influenced?
 - Which populations are most likely to benefit from nutrition-sensitive agriculture?

SYMPOSIUM SUMMARY

The theme “Science and Policy for Health, Agriculture and Economic Growth“ guided the scientific discourse and program content for the 2nd annual scientific symposium held in Kathmandu, Nepal on August 13-14, 2013. The goal was to facilitate rapid sharing of new research findings that examined the complex and evolving linkages between agriculture, market dynamics and food storage techniques, other nutrition sensitive interventions and household food security, health and nutrition outcomes. Additionally, the symposium aimed to stimulate interdisciplinary discussions about the findings’ program and policy implications. The symposium featured 15 oral and 11 poster presentations during the two day meeting which was attended by 249 participants from various government and academic institutions as well as, local and international non-governmental organizations. Building on the momentum of the inaugural scientific symposium in 2012, this 2nd symposium doubled participation and interaction, and resulted in the largest forum in Nepal dedicated to examine country-relevant evidence about contributory and contextual factors that shape the pathways between agriculture, health and nutrition in the community.

Dr. Patrick Webb’s keynote address, summarizing key points in the 2013 Lancet Series on Nutrition, launched the symposium. He highlighted the magnitude of child stunting, its severity, the 10 interventions¹ if implemented at scale that could avert 20% of stunting and avoid approximately 1 million child deaths and, the need for rigorous research to identify effective “nutrition sensitive” interventions (i.e. interventions that address the underlying causes of under nutrition, such as agriculture, social protection, education and health) to complement existing direct nutrition specific interventions. Research to better understand the complex set of factors for improving child growth, with the goal of improving intervention effectiveness is needed because poverty reduction alone has not sufficiently reduced stunting.

The symposium’s first session focused on multi-sectoral research and interventions to address the complex causes of undernutrition. Nepal’s Multi-Sectoral Nutrition Plan provides a conceptual framework for cross-sectoral, inter-disciplinary, and integrated approaches to reduce malnutrition amongst women and children. The USAID-funded Suaahara project operates within this framework and reported on its implementation challenges with respect to shared visions, program coordination, cross-agency communication and joint planning, and integrated and/or co-located program implementation at each administrative and service delivery level. Suaahara highlighted the need for research exploring practical, feasible and effective approaches to guide future policies and programs. The PoSHAN study, supported by Feed the Future, was offered as an example of research focusing on the process and outcomes of multi-sectoral and integrated approaches. This study consists of two components: (1) PoSHAN Process study, which is examining factors that facilitate and/or constrain the effectiveness of multi-sectoral processes, policies and programs, and (2) the PoSHAN Community studies which tracks household food security, dietary intake and nutritional status of preschool-aged children and

¹ 2013 Lancet Series on Maternal and Child Nutrition. <http://www.thelancet.com/series/maternal-and-child-nutrition> (November 29, 2013).

their mothers, and links them to measures of agricultural diversity, local market food prices and exposure to agricultural and microeconomic extension, nutrition and health programs in Nepal.

The rest of the symposium was organized into three interlinked sessions following a hypothesized pathway linking agriculture to nutrition: Session 1: Agriculture to Market/Home Production, Session 2: Market/Home Production to Household Food Availability, Access and Use, and Session 3: Household Food Availability, Access and Use to Dietary Intake & Nutrition & Health outcomes of Women and Young Children (Figure 1). In addition, special sessions focused on the potential role of aflatoxin exposure on child growth, an analysis of the Nepal Living Standards Survey, an introduction to Nutriproteomics, and an interactive poster session.

Figure 1. Three interlinked symposium sessions



Sessions 1 to 3 included 10 oral presentations highlighting research on the effect of new and appropriate technologies in agriculture, the impact of the food price crisis on the affordability of a nutritionally adequate diet across socioeconomic groups in Nepal, methods to assess food insecurity, and the results of homestead food production, community development and livestock production and IYCF² interventions. Insights provided by the presentations included (1) the potential increase in crop yield by adoption of intercropping and improved lentil production technologies; (2) the positive changes in nutritional status associated with homestead food production, livestock production and IYCF practices; and (3) how different food insecurity assessment methods capture varying components of household food insecurity. The presentations also highlighted knowledge gaps such as (1) the effect of post-harvest loss on productivity and income; (2) policies and mechanisms affecting food availability and affordability in the market; (3) the magnitude and effect of intra-household food distribution; (4) identifying women-friendly crops and methods to encourage women's involvement and productivity in agriculture.

² Infant and young child feeding

A session on health risks associated with fungal poisons, known as aflatoxins, raised mounting evidence that aflatoxins, in addition to being a known carcinogen, cause or exacerbate impaired growth in children. Studies in other parts of the world have shown the effects of aflatoxin in humans and preliminary studies in Nepal show high levels of aflatoxin in humans particularly the Terai. However, the existing data on aflatoxin exposure in food in Nepal presented during the symposium did not show dangerous levels of contamination in food samples. Quantifying aflatoxin exposure in Nepalese women and children, and identifying sources of exposure, are important research gaps to be filled.

Large, nationally-representative surveys such as the NLSS and DHS can provide snap-shots of household and risk-group food security and nutritional status, and if repeated over time, can provide information on the direction and magnitude of trends if properly analyzed. An analysis of the National Living Standards Survey (NLSS) III 2010/2011 by the World Food Programme showed that despite a national average energy intake greater than the minimum requirement, 20% of the total population still experienced inadequate food consumption. The report highlighted key trends such as improved dietary intake nationally, reduction on the urban rural food expenditure gap, the effect of continued remittance inflow and poverty reduction. Despite recent progress, rates of stunting (46%), wasting (15%), and underweight (35%) in children under 5 years remain high, suggesting the need to address other factors including agriculture and education. There is also a need to target marginalized households with programs tailored to address local determinants of poor nutrition.

There remains a need to develop inexpensive, field-friendly, rapid, reliable, and accurate methods to facilitate the assessment of multiple micronutrient status in low-resource settings. New research is examining how plasma proteins correlate with micronutrient status as a basis for developing new micronutrient assessment tools. A team of researchers at JHSPH examining these correlations found proof of principle (proof that this concept is feasible) of 5 micronutrients: retinol-binding protein 4 for vitamin A, apolipoprotein C-III for vitamin E, vitamin D binding protein for vitamin D, selenoprotein P isoform 1 for selenium, and ceruloplasmin for copper. These findings can form the basis for developing new methods that easily and accurately measure deficiency of many micronutrients. Such new approaches can help inform policies and interventions to tackle the deficiencies and their nutritional consequences.

Eleven posters were presented covering topics ranging from farming practices and aquaculture to food insecurity and micronutrient deficiencies. The poster competition was won by M. R. Maharjan for his poster titled “Innovative Delivery Mechanism for Improving Vitamin A Supplementation Coverage among Children Age 6-11 Months: A Pilot in Three Districts of Nepal, October 2012 – December 2013”.

The symposium also included a panel session for policy makers from government institutions and development partners to reflect on research gaps and ways to promote multi-sectoral research and integrated programs. Speakers highlighted the need for (1) more rigorous research to better inform policies, (2) capacity building at all levels improve implementation, monitoring and evaluation, and (3) mechanisms that facilitate collaboration between different

sectors and disciplines. Participants also recommended that future symposiums include presentations on storage and post-harvest loss, use of chemicals in food production, price control and the factors affecting it, and nutrition in the elderly.

The symposium concluded with a discussion on steps needed to ensure the success of the Multi-Sector Nutrition Plan (MNSP). Processes and interventions supported by the MNSP need to converge at the household level. Such convergence requires that the different actors at each administrative level are given clear roles and responsibilities, have the requisite technical, organizational and coordinating skills, and are accountable for results. Finally, the symposium noted the need to stimulate more research focused on the dynamics between food markets and household food availability, access and use.

The symposium brought together policy makers, academicians, researchers, and development partners from different sectors to share new research findings, discuss their application, and listen to each other's perspectives. Multi-sectoral collaboration depends on forging constructive relationships, building trust, sharing scientific approaches, breaking down institutional barriers, and increasing cross-disciplinary communication. Building on the 1st Scientific Symposium in 2012, this symposium has moved the research, policy and program communities closer to the goals of filling important knowledge gaps, rapidly sharing new research findings, and stimulating multi-sector collaboration. It provides a constructive platform upon which future symposiums can build.

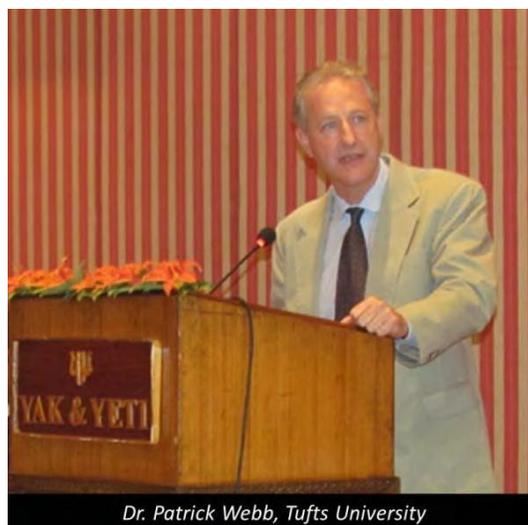
Key Symposium Messages

- ⇒ ***Prioritize research on post-harvest storage and loss, benefits of indigenous foods and practices, irrigation, composting and intra-household food security***
- ⇒ ***Find ways for programs and policies to target economically and socially disadvantaged groups to achieve greater nutrition gains***
- ⇒ ***Increase the design quality and methodological rigor of studies examining linkages between agriculture and improved nutrition.***

DAY 1: KEYNOTE ADDRESS

Dr. Patrick Webb summarized key findings from the ‘2013 Lancet Series on Nutrition’ highlighting the magnitude of child stunting (165 million children stunted worldwide), its severity (undernutrition is an underlying cause of 45% of all child deaths), and the 10 interventions, if implemented at scale, that could avert 20% of stunting and avoid approximately 1 million child deaths. He revealed the low coverage rates for the 10 proven stunting prevention interventions and the dollar figure of USD 9.6 billion annually that would be needed to improve coverage of these interventions to 90%. He also stressed the need for rigorous research to identify effective “nutrition sensitive” interventions (i.e. interventions that address the underlying causes of under nutrition, such as agriculture, social protection, education and health) to complement existing interventions, which by themselves are only estimated to avert ~ 20% of stunting.

Whilst recognizing the progress made by Nepal in reducing childhood stunting prevalence to 41%, Dr. Webb noted that this level corresponds to global levels 20 years ago. And even if Nepal is to meet its goal of reducing stunting levels by 20%, 1.5 million Nepali children would still remain stunted, which puts the country’s child stunting prevalence on par with Haiti and Iraq. Inequities in household wealth put the poorest at the highest risk of stunting and Dr. Webb’s talk underscored the importance of targeting these populations with proven effective interventions to have the largest impact on undernutrition.



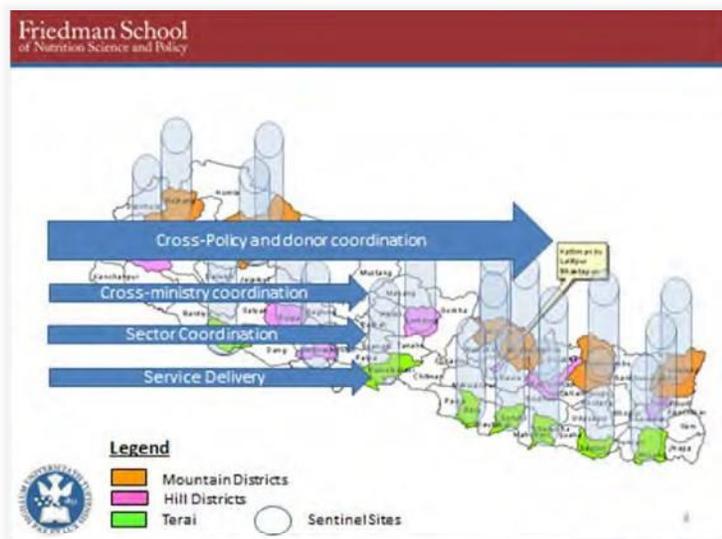
Dr. Patrick Webb, Tufts University

Dr. Webb discussed the following updated recommendations in the 2013 Lancet Series: (1) multiple micronutrients be given to all pregnant women, (2) calcium supplementation be provided to at-risk women and women whose calcium intakes are low, and (3) treating and managing severely and moderately wasted children. Take home points from Dr. Webb’s keynote include: (1) there is sufficient evidence to act now and take proven interventions to scale, (2) there is a need to conduct studies on the impact of “nutrition sensitive” interventions to inform policies and programs, (3) it is important to identify the most effective, feasible and cost-effective interventions for specific contexts and local conditions and (4) it is important to develop nutrition interventions that cut across multiple sectors rather than designing interventions that are limited to just one sector.

PLENARY SESSION

Multi-sectoral approaches are conceptually more effective than single-sector approaches to understand and address the many underlying causes of undernutrition, but there is a lack of evidence on the appropriate mix, effectiveness and cost of these approaches. Also, common perceptions about the challenges of multi-sectoral approaches, such as paradigm differences, institutional barriers, capacity constraints, limited communication across sectors, competing priorities and the lack of incentives to collaborate, can impede multi-sectoral action.

These issues were highlighted in a session showcasing progress made in multi-sectoral



GHOSH: *PoSHAN Policy: Understanding processes that support nutrition program impacts.*

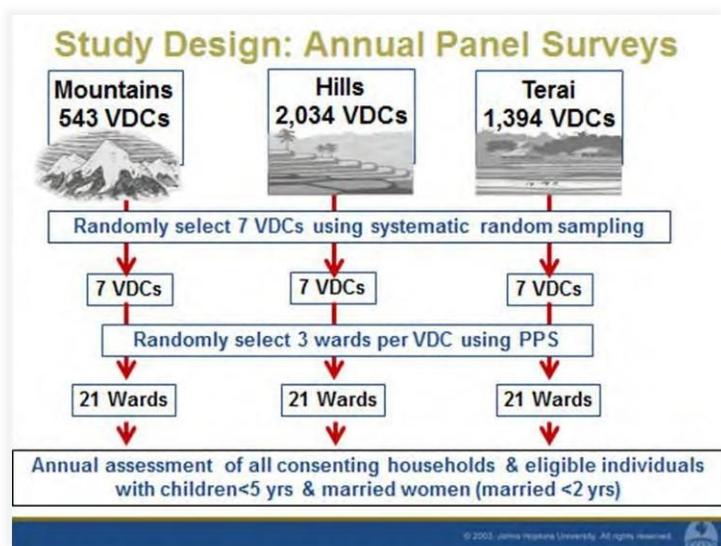
research and implementation in Nepal since 2012. Informed by recommendations from the 2011 Scientific Symposium, the Nutrition Innovation Lab designed and has begun implementation of a two-component study called “PoSHAN”, meaning the “Policy and Science for Health, Agriculture and Nutrition” Study. The PoSHAN Process Study aims to understand the policy and program process around multi-sectoral and integrated approaches to improve nutrition. And, the complementary component, the PoSHAN Community Studies research, aims

to explore relationships of household food security, dietary intake and nutritional status of preschool aged children and their mothers with measures of agricultural diversity, local market food prices and exposure to agricultural and microeconomic extension, nutrition and health programs in Nepal.

The PoSHAN Process research, guided by Tufts University and implemented by Valley Research Group, uses a mix-methods approach to understand multi-sector planning and implementation processes, identifying factors that promote or constrain the processes and examine the vertical and horizontal “coherence” at different administrative levels on an annual basis. Dr. Shibani Gosh described the study methods as consisting of annual surveys among ~700 key informants at the national, regional, district, Ilaka, VDC and ward levels using structured open-ended questions. Data collected will assess individual (i.e. skills, knowledge, training, experience, attitudes to multi-sector actions, nutrition goals, priority problems), institutional (i.e. perceived constraints to multi-sector collaboration, resource use efficiency) and system (disincentives to collaboration, innovation, venues for dialogue, roles and responsibilities) factors to inform our understanding on whether and how integrated service

delivery works, the sectoral coordination processes and their vertical and horizontal coherence. Data collection was carried out between February and June 2013, with findings expected within the coming months.

The PoSHAN Community Studies component, designed and managed by Johns Hopkins University in collaboration with New ERA, uses an annual population-based national, panel survey in 21 randomly selected wards across the major ecological zones of Nepal (mountains, hills and terai), and seasonal follow-up data collection in a subset of VDCs, to explore relationships between household food security, dietary intake and nutritional status of preschool aged children and their mothers and measures of agricultural diversity, local market food prices and exposure to agricultural and microeconomic extension, nutrition and health programs. Dr. Klemm described the data collection methods (i.e. community, market, household and individual interviews), sampling strategy (i.e. stratified systematic random sampling by agro-ecological zone), timeline and analytic plans for the study.



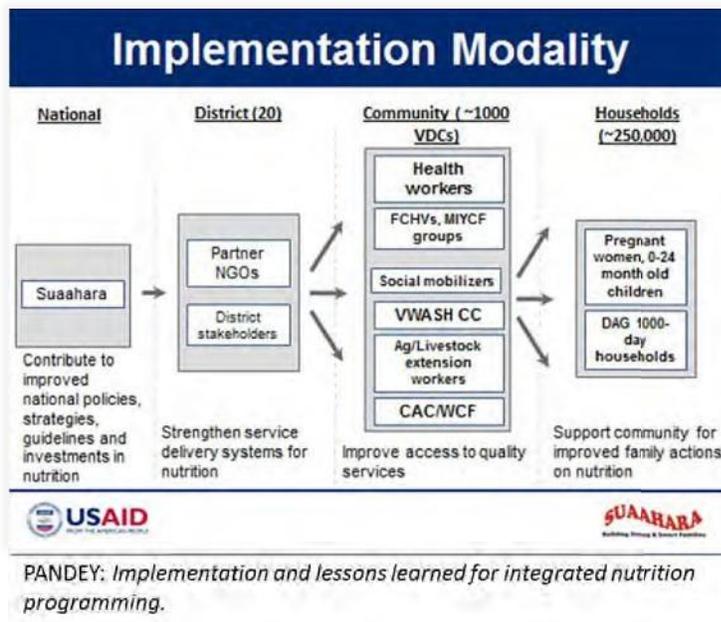
KLEMM: *PoSHAN Community Studies: Finding pathways to accelerate nutritional impacts.*

lessons learned from Suaahara, a multi-sector approach for implementing integrated nutrition programs across 20 districts in the country. She stressed the importance of on-the-ground oversight, the need to strengthen district and VDC management capacity to foster cohesion, leadership, and effective coordination, and the need to position nutrition to resonate with the priorities of the agriculture, education and other sectors.

The first panel survey, completed from May-July 2013 yielded a total of 4,288 households, 4,509 married reproductive age women, and 5,401 children <5 years of age based on the study's design. Data analyses, currently underway, will include characterizing nutritional status; dietary intake; indices of household food insecurity; agricultural productivity; income and expenditures; and participation in agricultural, health and nutrition interventions by agro-ecological zone.

Ms. Pooja Pandey shared early lessons learned from Suaahara, a multi-sector approach for implementing integrated nutrition programs across 20 districts in the country. She stressed the importance of on-the-ground oversight, the need to strengthen district and VDC management capacity to foster cohesion, leadership, and effective coordination, and the need to position nutrition to resonate with the priorities of the agriculture, education and other sectors.

Reflecting on the two years of the program planning and roll out, Ms. Pandey mentioned that the biggest challenge was determining how to package both health and non-health interventions that can be effectively delivered to beneficiaries. This involves trying to determine how different sectors can collaborate effectively and requires a convergence at the institutional and programmatic levels from all involved sectors (health, agriculture, water and sanitation etc.). A necessity to clearly delineate the roles and responsibilities of the different sectors at the local level in order to ensure efficient collaboration and minimize missed opportunities was highlighted. Another challenge mentioned was the attempt to move the focus from the national to the district and VDC levels, encouraging them to prioritize nutrition interventions along with



building the technical and administrative capacity of their grass-root level workers (such as FCHVs, agricultural extension workers etc.).

Lessons learned to date through the implementation of Suaahara include (1) the need to simplify messages and give practical advice to facilitate comprehension by the lowest cadre of workers, (2) the need to have evidence-based interventions converge, reinforce and complement each other, and target vulnerable households, no matter how they are integrated or co-located at the higher administrative levels. Ms. Pandey

also stressed the need to better understand the factors that affect program pathways that move inputs through processes to generate impact and reiterated Nepal's unique position to contribute to the body of learning on how agriculture and other sector approaches can be leveraged to accelerate improved nutritional outcomes.

OPENING REMARKS BY INAUGURATION PANEL

The inauguration panel for the symposium comprised of honorable guests Dr. Praveen Mishra (Secretary, Ministry of Health and Population [MoHP]), Mr. Uttam Kumar Bhattarai (Joint Secretary, Ministry of Agriculture Development [MoAD]), Mr. Bishnu Nepal (Joint Secretary, National Planning Commission [NPC]) and Ms. Shanda Steimer (Director of Health, USAID).

Each member of the inauguration panel provided brief remarks on their views of research areas and interventions that need to be prioritized in Nepal and what they felt would most effectively and efficiently foster multi-sectoral coordination to successfully tackle malnutrition.



From L-R: Mr. Bishnu Nepal, Dr. Praveen Mishra, Mr. Uttam Bhattarai, Ms. Shanda Steimer, Dr. Patrick Webb and Dr. Sharad Onta.

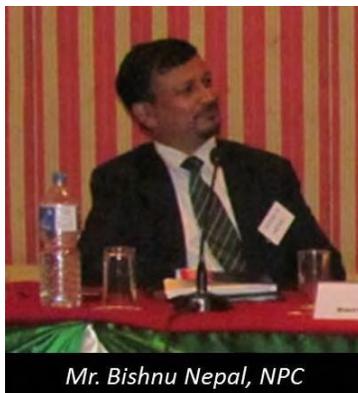
Dr. Mishra, Secretary, MoHP, began the session stating that the determinants of optimal health and nutrition encompass areas beyond the work of the MoHP and thus it is vital to consider health promotion whilst formulating policies in all sectors of the government and this type of effort would ensure successful multi-sectoral coordination. He stressed the need to design interventions so that they target marginalized groups but also acknowledged that delivering the interventions effectively to these groups can be especially difficult and modalities to do so need improvement. Nutrition interventions include changing dietary habits which are influenced by cultural and religious norms and people are often reluctant to change their food habits especially to foreign foods. Thus, finding culturally appropriate and locally adapted alternatives was highlighted by the Secretary and he urged evidence on such approaches to be generated. In her opening remarks, Ms. Shanda Steimer, Director of Health at USAID, underlined the fact that as we gain more knowledge about the causes and consequences of undernutrition, there exists a need for collaboration between multiple sectors. She expressed her pleasure at seeing people from various disciplines coming together to collaborate and share research findings. Ms. Steimer stated that USAID supports the MSNP through Suaahara and the 'Knowledge-based Integrated Sustainable Agriculture and Nutrition' (KISAN) Project. KISAN is a part of the Feed the Future (FTF) Initiative that seeks to sustainably reduce poverty and hunger globally

and in Nepal by achieving inclusive growth in the agriculture sector, increasing income of farm families and improving nutritional status, especially of women and children in over 160,000 households. Ms. Steimer pointed out that Nepal has some of the most compelling evidence based programs and with the increasing investment, she indicated a need to conduct thorough evaluations to understand what works and why.

Next, Mr. Uttam Kumar Bhattarai, Joint Secretary, MoAD, explained that nutrition is crucial for the health and productivity of the nation, pointing out that according to the World Bank, an estimated 3% of the GDP of developing countries is lost due to malnutrition. Despite Nepal having a positive balance of cereals and productivity that is increasing yearly, the level of malnutrition is alarming. Mr. Bhattarai called upon the development community to invest in educating people on a balanced diet with locally available foods and increasing awareness on food processing techniques, food safety and how to maintain the value chain.



Mr. Uttam Kumar Bhattarai, MoAD



Mr. Bishnu Nepal, NPC

Mr. Bishnu Nepal, Joint Secretary, NPC, expressed the need to improve the nutritional status of children and women through cooperation and collaboration between different sectors and that he hoped this symposium would provide insight into the workings of multi-sectoral collaboration. He underscored the need to identify and target vulnerable groups and to act quickly to prevent more women and children from becoming malnourished. He touched upon the formation of the Multi-sectoral Nutrition Plan with support of aid agencies, academia and bilateral agencies and was hopeful that this approach is successful in reducing the burden of malnutrition in the country.

AGRICULTURE TO MARKET

The first link in the agriculture-to-nutrition pathway is 'agriculture-to-market'. This is primarily because this pathway is hypothesized to begin with the production of food. Following this, the market is where many rural households, that produce food, buy their inputs and sell their produce. In rural areas that are remote and have low population densities with limited and/or high transport costs, market access can be difficult. There are several factors that can weaken this link further when it comes to producing optimal amounts and quality of food. These include but are not limited to farming methods utilized, agricultural tools used, seed and soil quality, environmental factors or even poor market access. Possible strategies to challenge this may include intensifying agricultural production systems, increasing commercialization and specialization in higher-value crops, fostering markets that minimize transaction costs and risks, and creating a playing field that enables households living in marginally productive and weak infrastructure areas to also benefit.



From L-R: Ms. Shabnam Shivakoti, Mr. RK Neupane, Mr. Keshab Thapa and Mr. Ganesh Thapa

Research focusing on improving agricultural productivity in the hilly regions of Nepal is an important priority. Mr. Keshab Thapa from Local Initiatives for Biodiversity, Research and Development (LI-BIRD) presented the results of a two-year on-farm study on Conservative Agricultural Production Systems (CAPS) from 3 villages in a fragile hill land agricultural setting where low yields of corn (1.14 ton/ha), millet (0.91 ton/ha) and cowpea (0.87 ton/ha) persist. The traditional farming methods used in the sloping hills of Nepal result in low productivity and lack sustainability, a major concern being the erosion of these sloping farms. The study hypothesized that CAPS can sustain agriculture production by improving yield and soil quality and reducing the risk of crop failure. The study conducted among Chepang farmers in Dhading, Tanahun and Gorkha in 2011-12 randomized 24 farms to 4 treatments based on sole cropping, intercropping or strip-tilling for the summer (maize) and rainy season crop (either millet, cowpea or both [intercropping]). Results showed higher yields for intercropping, but no comparative yield advantage with strip-cropping. Mr. Thapa indicated that although strip-cropping showed similar yield to conventional tillage, it reduces soil erosion so can be preferred over conventional tilling. The effect of CAPS on soil quality was not reported, but more than 2 years is required for changes in soil quality to be detected by inter-cropping and other CAPS strategies. In conclusion Mr. Thapa stated that adopting the CAPS system in fragile hill (sloping) land agricultural setting could potentially lead to an increase in farm income and profits and is keen to scale-up these interventions in other areas in Nepal with similar climates.

Grain legumes constitute a key component of Nepal cropping systems due to their soil nitrogen fixation capacity and provide an inexpensive source of dietary protein. Research to improve legume yields and dietary consumption is therefore important. RK Neupane from Forum for Rural Welfare and Agricultural Reform for Development (FORWARD) presented the results of a pre-post study among ~3000 households in 10 districts that examined the adoption of improved lentil production technologies (e.g. improved varieties, rhizobium inoculation, seed priming, and basal application of DAP fertilizer), resultant yields and effect on household lentil consumption. On average, lentil yield increased by ~10 kg/katthas or ~100 kg/household representing a 38% increase in household production across all 10 districts. Legume consumption increased by ~10% and income derived from lentil production increased by 70% to 175%, on average, across all households. The study concluded that the technological improvements increased lentil yields, household dietary consumption, and income from lentil sales, but that access to improved seed varieties and knowledge on how to implement the technologies at the local level is vital for its adoption.

Lessons about ways to improve the agriculture-to-market link can also be gleaned from the use of secondary data to examine factors that might explain the improvements in nutritional status reported in Nepal from 2006 to 2011. Mr. G Thapa combined data from the 2006 and 2011 Demographic Health Surveys (DHS) and Nepal Living Standards Survey (NLSS) and used multiple linear regression models to identify factors that might explain the 0.2 Z-score improvements in mean height-for-age (HAZ) and weight-for-height (WHZ) over the 5 year survey interval. Factors positively associated with improvements included child-(DPT and BCG vaccinations), mother-(mother's education and employment), and household-level factors (higher wealth index and asset ownership, use of irrigation and household use of credit). Thapa also examined district level factors that might explain differences in mean district HAZ-scores relative to the national average revealing that districts with a higher proportion households using fertilizer had above average district HAZ scores, but that those with higher irrigation had lower HAZ scores. These associations, not causative in their revelations, require further in-depth investigation before further inferences can be drawn.

The session concluded with an interactive discussion led by the session moderator, Shabnam Shivakoti, Senior Agriculturist at MoAD that gave the audience the opportunity to voice their comments and questions. Participants were curious about the effects of CAPS on the soil in Mr. Keshab Thapa's study and also highlighted the need to find ways to motivate these farmers to adopt contract farming. The findings from Mr. G Thapa's district level analysis generated a healthy discussion on some of the significant associations seen between various factors and the reported improvements in nutritional status. The audience highlighted the need to address other issues in the agriculture to market pathway such as food safety and storage, irrigation, composting and the benefits and uses of indigenous farming practices.

MARKET TO HOME ENVIRONMENT

Not only is the market a place where farmers, as producers, sell their products, it is also where communities, as consumers, spend income earned from agricultural or non-agricultural work. It is where rural small-holder farmers can face the issue of securing fair or even competitive prices for their farm inputs and products from the more dominant “middlemen” often due to their lack of business and negotiating skills, limited knowledge of market dynamics, or lack of collective organization. It is unlikely that rural incomes can be meaningfully increased by exclusive reliance on subsistence food production. Therefore, there is a need to examine strategies to improve market access that enable better food security and higher income for rural households. Variation in food prices is an important factor for household food security because prices determine both the income received for food crops sold and the cost of food purchased by households. In recent years, most notably in 2007-08 and 2011-12, rising global food prices resulted in a global price spike of basic foods such as rice, wheat and maize. Such price hikes can affect people's ability to buy enough to feed their families, and the hardest hit is often the poorest.

Nepal's MIRA & UCL research group presented findings from a study in Dhanusha District that assessed the impact of the 2007-08 food price crises on the ability of different wealth groups to



From L-R: Dr. Devendra Gauchan, Dr. Keith West, Dr. Raman Shrestha and Dr. Naomi Saville

afford a nutritionally adequate diet. Data on commonly consumed food items, local market food prices, consumption pattern, and income levels were collected to estimate the cost of a nutritionally adequate diet. During both the years, data were collected during the months of September-October in 2005 and 2008, when the price of food is anticipated to reach its

maximum. The cost of an adequate diet was estimated using the “Cost of Diet” linear programming tool developed by Save the Children. Findings showed that relative to 2005 costs, a nutritionally adequate diet was 28% more costly in 2008 and unaffordable for the poorest households in the district. Although the food prices spiked in 2008, it appeared that affordability of food did not change much as a result of a concurrent increase in income levels of households associated with government-imposed wage increases. Hence, it was concluded that poorer households could not afford nutritionally adequate diet either before or after price increases in 2008.

Dr. Keith West presented a study on household food insecurity and infant size conducted in rural Bangladesh. Because household food security is an extremely challenging indicator to

measure, he offered that one can perhaps get a sense of household food security situation by measuring other relevant factors as well, to 'go beyond indicators of food insecurity'.

FAST, a set of 9 question is a perception-based tool used to measure household food insecurity. The goal of the study was to observe whether household food insecurity (HFI) is associated with maternal and infant nutritional outcomes and if a dose-response relationship exists between HFI and maternal and infant nutritional outcomes. As expected, nutritional status was shown to be associated with food insecurity and there was indeed a dose-response relationship between HFI and age of children. Among other factors that were also associated with HFI, maternal nutritional status pre and post pregnancy were considered highly significant.

Dr. Raman Shrestha presented results obtained from a secondary analysis of NNIPS cohort follow-up study conducted between 2006 and 2008. The study, conducted in Sarlahi, provided findings that explain links between food security and nutritional status of children. The absence of rice in a household was measured as a proxy of household food insecurity and MUAC was measured as the indicator of nutritional status of children. Cross-sectional surveys on households and 13,137 children aged 9-13 year were conducted in Sarlahi from 2006 to 2008. This study found that 17.3% of households had no rice. The absence of rice stores varied by season, but peaked during monsoon (lean) season by 22% in total households. Seasonal variation of absence of rice in households was high in Sudhras, while it was relatively stable in Brahmin. Being Madeshi, belonging to the Sudhra caste, having low asset/land ownership, and the monsoon (lean season) season were found to be risk factors of having no rice in one's household. Bivariate analysis showed that child MUAC was associated with household with no rice stores, but this association was not significant after adjusting for other covariates. Based on these results, he emphasized the importance of targeting of program interventions to those most vulnerable and also taking into account seasonal variations when evaluating the effect of such programs. This study demonstrated that assessing the presence of rice is a simple and sensitive indicator that can give us much more information about the household.

The discussion that followed this session was moderated by Dr. Devendra Gauchan, Senior Scientist at NARC and highlighted the paucity of data on the 'market-to-home' link in the pathway. Participants noted the need for research on how prices in the market are regulated and affected by government policy and how market dynamics influence food availability and affordability and its effect on nutritional status.

HOME TO NUTRITION OUTCOMES

In examining the agriculture to nutrition pathway, one of the most important aspects to consider is how household food availability, access and utilization affect eating patterns and nutritional outcomes. The session included research findings from programs implementing a combination of interventions at the household and community level such as homestead food production, community development and livestock production and the session also provided data on the relationship between infant, child and young feeding practices the nutritional status of women and children.



From L-R: Dr. Uma Koirala, Dr. Saba Mebrahtu, Dr. Ram K Chandyo, Mr. Akoto Osei and Ms. Neena Joshi

Ms. Neena Joshi from Heifer International

(HI) presented the main findings of a follow-up longitudinal study that studied a holistic approach to improve livelihoods and nutritional status of children in households in rural areas. The intervention which seeks to impact child growth and health focuses on improving agricultural and livestock productivity and household food security. A prospective randomized-controlled trial was conducted in three areas in Nepal – Nuwakot, Chitwan and Nawalparasi where the program, primarily focused on community development, livestock and nutrition training was randomly assigned to communities within these areas over a two year period. The study included 415 households and 611 children under five. The main findings were that the intervention groups experienced improved household income, dietary diversity, productivity from kitchen garden and a larger change in child growth (height-for-age and weight-for-age z-scores) between baseline and 24 months. Although there were no improvements in child health outcomes, the intervention improved certain health practices within the household such as having a toilet in the home, treating water before drinking and using soap and iodized salt. Based on these results, HI plans to extend the follow-up period for up to 48 months to examine whether improvements in child health can be observed between intervention groups and control groups and also plans to evaluate the role of household characteristics, focused nutritional curriculum and women's empowerment on health outcomes.

Dr. Akoto Osei from Helen Keller International shared findings from the homestead food production (HFP) intervention from the Action Against Malnutrition through Agriculture (AAMA) project, specifically its impact on maternal and child health. There is evidence that HFP interventions such as improving household garden and cultivating diverse variety of crops can increase the diversity of food consumption, however few studies have evaluated the impact of HFP on anemia in women and child growth. HKI implemented the 'Enhanced homestead food production' (EHFP) intervention to address maternal and child undernutrition in certain areas of

Nepal. A cluster randomized controlled trial was conducted in Baitadi and Kailali districts over a 3 year period where EHFP was implemented in 20 VDCs and 120 wards. A total of 3,329 households with children under 2 years received inputs and trainings for home gardens and livestock, and nutritional education. Cross-sectional pre- and post-intervention surveys were conducted during the rainy season in 2009 and 2012 as this is a particularly vulnerable time with regards to nutrition status.

Based on the preliminary findings that require further analysis, he reported that EHFP has the potential to increase hemoglobin concentration and decrease the proportion of anemic women and children. However, there were no demonstrated improvements in child growth (stunting, wasting, and underweight) which may have been due to the short duration of exposure to the intervention (2.5 years). He noted that strong partnership with government/implementing agencies, with an emphasis on “program impact pathway” and formative research at baseline are important to successfully implement intervention. He urged that funding cycle should be longer to support appropriate duration of intervention.



Mr. Akoto Osei

Dr. Ram K Chandyo from University of Bergen shared results of a nutrition survey conducted in Bhaktapur. It is a densely populated, agriculture-based city and recently has experienced a rapid nutrition transition. A baseline survey was conducted in 2007-2008 to estimate the prevalence of micronutrient deficiencies and a follow-up survey was followed in 2012-2013 to better understand the food security, agriculture, and socioeconomic situation of households. Anthropometry and hemoglobin concentrations were measured as nutritional indicators and diverse SES and food insecurity features were collected. The main finding was that overweight among women (BMI > 25) has increased from 17% to 41% and anemia prevalence has dramatically increased from 8% to 29% between 2008 and 2013. He speculated that this observation is probably due to the rapid nutrition transition in urbanizing populations with persistent food insecurity. He called for further studies to understand the observed double burden of nutritional problems in quickly urbanizing regions of Nepal.

Dr. Saba Mebrahtu from UNICEF presented data on the importance of appropriate feeding practices to improve the nutritional status of infants and young children in Nepal. Although stunting has steadily decreased in Nepal, this reduction, as discussed earlier is found mostly among children in the richest quintile thus actually deepening nutritional inequity. She noted that it is important to understand which poor feeding practices are associated with child growth and anemia. To address this question, secondary data analysis was done using Nepal Demographic and Health Survey (NDHS) in 2011. Findings indicated that that dietary diversity, early initiation of breast feeding and minimum acceptable diet were all positively associated with child HAZ. Dietary diversity and minimum meal frequency were clearly positively associated with WAZ, suggesting diversity and frequency of feeding are likely to be important factors in contributing to infant and young child growth. Neither diet diversity nor minimum meal frequency were associated with Hg level, controlling for child age and gender. She suggested that infant and young child feeding practices programs should prioritize targeting certain regions of Nepal – the

terai, central and mid-western areas, where children have the least diverse diets, lowest frequency of meals and where they experience late initiation of breastfeeding. She noted that these results would contribute to informing national IYCF strategies, which feed into the government's Multi-Sector Nutrition Plan.

The discussion following this session, moderated by Dr. Uma Koirala, raised questions about the need to identify the reasons behind the decreasing rates of stunting in Nepal. Participants discussed the need to identify the factors that affect adoption of IYCF practices and how they affect growth and the need to study the effect other factors such as cooking practices and changes in dietary diversity that may impact nutrition outcomes. A collective call was made by the audience for further research that helps understand the nature and dimensions of the issues of undernutrition and anemia themselves as well as their relationship with household food security and other household dynamics.

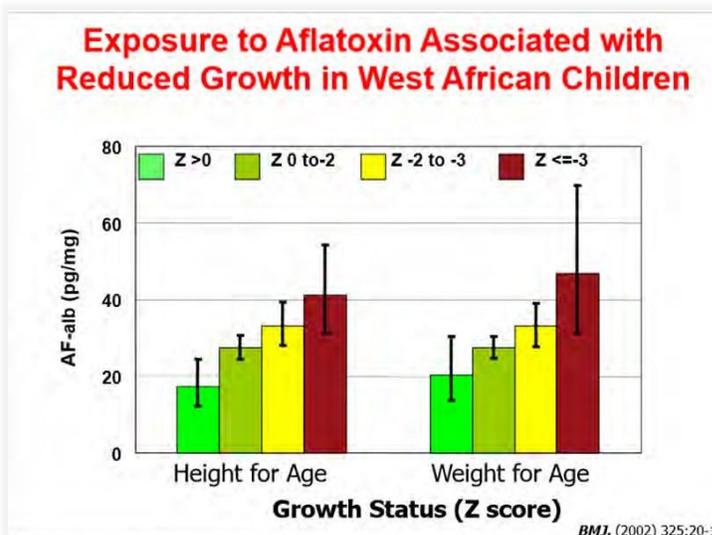
DAY 2: KEYNOTE ADDRESS

Aflatoxins, naturally occurring mycotoxins produced by some members of the fungi *Aspergillus*, are known carcinogens found commonly in poorly stored and infected cereals (such as maize, wheat and rice), peanuts, and soybean, amongst other foods. The second keynote speaker, Dr. John Groopman delved into a body of evidence, presenting the effects of aflatoxins exposure in population across the world, and made a strong argument for the need to quantify the prevalence of aflatoxin exposure in mothers and young children in South Asia, including Nepal and Bangladesh to be able to assess subsequent consequences.

Aflatoxins are immunotoxic to humans and there is a well-established link between aflatoxins and the risk of hepato-cellular carcinoma. Considering the very high liver cancer mortality rates in South East Asia and Africa, the role of aflatoxins must be considered. Moreover, aflatoxins are commonly found in grains such as corn, wheat and rice, all of which are staple foods in these regions. Dr. Groopman described a study conducted in Kenya that attributed several hundred deaths to consuming maize contaminated by large amount aflatoxins (more than 50g). The results of a study carried out in China in 1979 showed that aflatoxin exposure in healthy men aged 45-65 increased their risk of liver cancer by three and a half times and more strikingly the study showed that a combination of exposure to aflatoxins and Hepatitis B virus resulted in a 60 times greater risk of liver cancer.



Aflatoxins have many other harmful effects and there is ample evidence of a correlation between aflatoxin levels and linear growth in humans yet the mechanisms involved have not yet



GROOPMAN: *Exposure to Aflatoxin by Mothers and Young Children in South Asia: Public Health Implications.*

been clearly elucidated. In a study of West African children a rough dose response relationship was observed with increasingly poorer z scores of growth measures seen with increased level of aflatoxin. Examining the level of exposure in a NNIPS trial cohort of pregnant women in Sarlahi, Nepal, Dr. Groopman found little variation in the levels of aflatoxin comparing the first and third trimesters of pregnancy or by season. He also found that aflatoxin is transferred to the fetus from the mother and the same levels of aflatoxin were also seen at two years of age. He

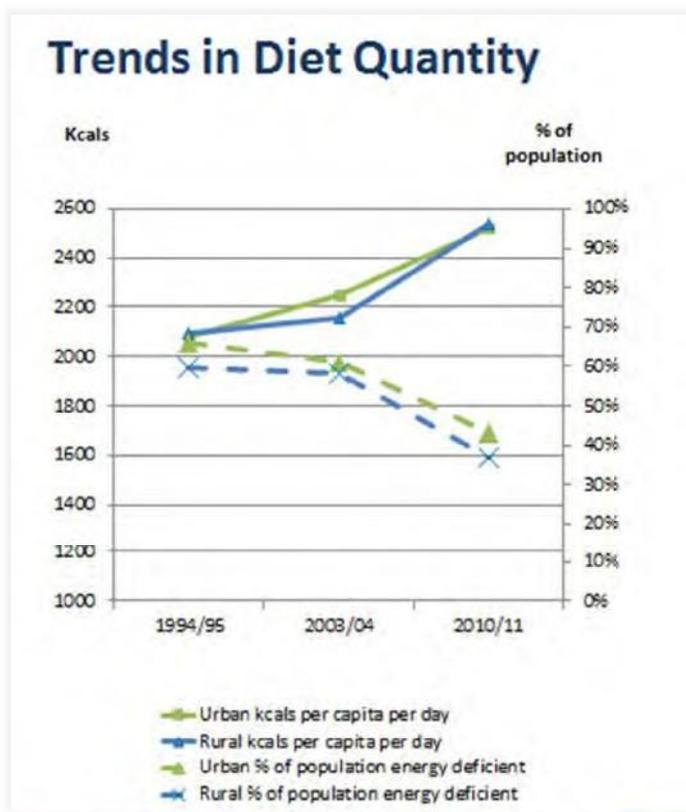
cautioned that the levels of aflatoxin found in the study in Sarlahi were higher than the highest levels in West Africa suggesting that quantifying aflatoxin levels in mothers and children in Nepal and Bangladesh is a pressing issue that requires immediate attention.

Mr. Krishna Prasad Rai from the Department of Food Technology and Quality Control (DFTQC) also presented findings from a study that measured total aflatoxin levels in foods in Nepal using the Total Diet Study tool which indicated that the average total aflatoxin content and dietary exposure of such contaminants through foods was at acceptable levels from samples collected across 35 districts of Nepal. The study found that 68% of samples showed the presence of aflatoxins in different concentrations with 18.32 % of the total samples exceeding the mandatory standard of 20µg/kg. However the use of convenience sampling in the study indicates the need for more research using more systematic methods to better ascertain aflatoxin content of foods in Nepal. Measuring aflatoxin in food is not a precise method due the heterogeneity of the toxin in the food resulting in high variability in the results from different samples indicating a need to evaluate exposure in humans using biomarkers to get accurate an accurate picture. The high aflatoxin levels seen in Nepal and Bangladesh indicate a pressing need to conduct further research regarding aflatoxin exposure to understand the magnitude of the problem and to gather evidence to develop prevention and treatment strategies.

The discussion that followed moderated by Dr. Ramesh Adhikari raised questions regarding the effect of climate change and extreme climatic conditions such as droughts and floods on aflatoxin contamination. Drought prone regions such as the far-west of Nepal showed higher levels of aflatoxin contamination and such associations need to be explored further. Although the Sarlahi Study showed high levels of aflatoxin exposure in human blood, contamination in the majority of food samples from the Terai were below the acceptable level. The difference may be due to the fact that human biomarkers measure aflatoxin accumulated over thirty days whereas the food samples are a one-time measurement. Furthermore samples taken from food are not a very reliable measure of aflatoxin as different samples from the same source show high variation in identifying contamination. In studying the effect of aflatoxin on growth, it is also important to consider the effect on the fetus during pregnancy and whether this affects stunting in early childhood. Participants also discussed methods to minimize contamination of food by preventing pest infestations that facilitate mold, using proper storage methods (e.g. “suprabags” used to keep grains dry) and disposing of contaminated foods.

FINDINGS FROM LARGE SCALE SURVEYS

The National Living Standards Survey III (NLSS) of 2010/2011 conducted by the Central Statistics Bureau of Nepal provides a rich data on a variety of household patterns including socioeconomic status, income, expenditure, food security and food consumption patterns. Ms. Nicole Menage from the World Food Program presented findings on household food security and nutrition in Nepal based on secondary analysis of the NLSS III. This survey included 6,000 households and 2,500 preschool aged children below 60 month of age, and prepared jointly by WFP, World Bank, UNICEF, and AusAID. Her presentation highlighted significant changes in socioeconomic status, diet quantity and quality which are altering Nepal's national food security situation and nutrition landscape noting that 20% of the total population experienced inadequate food consumption with higher levels of inadequacy seen in rural compared to urban areas. Geographic (mountain areas), season (lean season), socioeconomic status, caste (Dalit), and education were highly related to food insecurity. Child stunting was the most important indicator among child nutritional status, strongly associated with all indicators of food insecurity. Ms. Menage emphasized that programs and policies should provide targeted assistance to marginalized households especially in the most vulnerable regions and during the lean season, a recommendation that echoed the recommendations of other presenters. She also stressed that improvement in education, expansion of agricultural investment, encouragement of fruits, vegetables, and proteins consumption should be priorities in further policy and programming. After the presentation, participants noted that further evidence is needed in understating the pathway between poverty reduction, food security and nutritional status. The effect of migration of young adults especially in the mountain region on household food security of households left behind was also raised by the audience as an area that needs to be examined.



MENAGE: *Thematic Findings on Food Security and Nutrition: An analysis of the National Living Standards Survey III.*

THE PLASMA PROTEOME: A NEW APPROACH TO ASSESSING MICRONUTRIENT STATUS

An important aspect of research is incorporating new technologies and investigative techniques that can improve the quality and feasibility of the research undertaken. Dr. West from the Johns Hopkins Bloomberg School of Public Health guided the audience to a novel way to address micronutrient deficiencies by using plasma proteomics. There is an extensive body of evidence on the interactions between micronutrient status and infant/child health, including survival and cognitive function as well as long-term health consequences such as chronic diseases.

However, public health efforts have been focused on a few micronutrients including vitamin A, iodine and recently zinc, and

deficiencies in other micronutrients are still as hidden as they were 20 years ago. One of the reasons for the lack of effort is that it is not feasible to have expensive and high-performance techniques and laboratories to assess micronutrient status in low-resource settings. The plasma proteome has the potential to fill this research gap because proteins are involved in every metabolic process of nutrients. The proteomics team at JHSPH has

explored the plasma proteome of children aged 6-8 years in Sarlahi, Nepal with the aim to discover plasma nutriproteins which are highly associated with micronutrients in plasma. The study found proof of principle of 5 micronutrients: retinol-binding protein 4 for vitamin A, apolipoprotein C-III for vitamin E, vitamin D binding protein for vitamin D, selenoprotein P isoform 1 for selenium, and ceruloplasmin for copper. More than 100 proteins playing important roles in biological and physiological processes were strongly associated with vitamin A and vitamin E status. These findings are invaluable to support the development of a single platform that assesses micronutrient status of population in a quick, precise, cheap, and efficient way. Nutriproteomics would help to understand the biology in public health applications and to develop more targeted and evidence-driven intervention to prevent hidden hunger in less privileged countries. Following the presentation the audience gave their thoughts on this new approach to measuring micronutrient deficiency, discussing the feasibility of using proteomics in low resource settings and the role proteomics may play in facilitating research into deficiencies of many more micronutrients that have not been adequately explored.



Dr. Keith West, Johns Hopkins University

NATIONAL POLICY RESPONSE TO THE 'SCIENCE'

The afternoon session of the second day began with a panel discussion that brought forth the insights and experiences of policy makers to enable the translation of evidence presented during the symposium into policy and practice. The panel comprised of Dr. Praveen Mishra, Secretary at MoHP, Mr. Rajendra Adhikari, Joint Secretary at MoAD, Mr. Bishnu Nepal, Joint Secretary at NPC and Dr. Saba Mebrahtu Chief of Nutrition at UNICEF. There was unilateral agreement by all members of the panel on the importance of a multi sectoral approach to combat malnutrition and discussed the challenges associated with making this approach successful. Multi-sectoral collaboration has been written into the policy in the Multi-Sectoral Nutrition Plan (MSNP) and various ministries and development partners have already been involved in the piloting of the plan. However, there are still many issues that need to be addressed in order to foster multi- sectoral collaboration especially at the local level.



From L-R: Mr. Bishnu Nepal, Mr. Rajendra Adhikari, Dr. Patrick Webb and Dr. Saba Mebrahtu

Dr. Mebrahtu stated that although there has been strong leadership from the NPC and a good understanding of why nutrition is an important issue across all sectors in Nepal, the discussions at the national level have experienced bottlenecks in their attempts to translate these key messages to district level offices. Collaboration between different sectors requires extra effort and time and it is vital that the actors at the local level understand policies drawn up at the central level and why it is crucial that different sectors work together despite the extra effort required to accelerate improvements in malnutrition. Dr. Mishra added that due to the involvement of different sectors, multi-sectoral programs and interventions run the risk of not having clear accountability and ownership of the responsibility of each sector. Therefore it is crucial to clearly outline the roles and responsibilities of the different sectors and develop a comprehensive mechanism for collaboration. There is a need to assess and build local capacity to be able to carry out the plan once it has been developed. Mr. Nepal highlighted the need to budget and allocate funding from the government and development partners in order to develop capacity at all levels (national to community level) in terms of implementation and monitoring and evaluation skills.

Mr. Adhikari noted that while researching evidence for designing intervention it is necessary to incorporate indigenous knowledge and practices from the community and test them in a scientific



Mr. Rajendra Adhikari, MoAD

manner. He indicated that the MoAD understands the importance of nutrition and that they have included a food and nutrition security plan as an important component in their Agriculture Development Strategy.

Dr. Mebrahtu encouraged the nutrition community to work with the government on the MSNP and that all new nutrition activities are designed to complement the strategies adopted in the plan. Along with the implementation of the MSNP it is also important to conduct rigorous evaluations of the different components of the plan in order to identify successful interventions as well as failures and locate the reasons behind the results to improve future policy and planning. All the members of the panel highlighted MSNP as the way forward.

Evidence based nutrition policy and programs are only as good as the research behind the evidence and Mr. Adhikari emphasized the need to improve research methodology and the quality of evidence being generated in Nepal. Dr. Mishra concluded that all policies are good but the key to a successful policy lies in identifying the details necessary to translate the policy into reality. These details need to come from the research community and collaboration between researchers and policy makers is vital for creating a policy that can be successfully implemented at all levels.

Following the panel's input, the audience shared their thoughts noting that though collaboration is taking place at the national level, there is a need to improve co-ordination and multi-sectoral collaboration at the district level. Interventions must be designed to incorporate the existing resources and infrastructure in order to foster collaboration with other sectors, local government and non-government organizations. Participants felt that the development community needs to be better informed on nutrition sensitive interventions which are a relatively new concept in Nepal. Members of the audience felt that despite the push for evidence based policies, often the reality is that not all policy is based solely on the evidence and there are many other factors that influence it. It was also pointed out that the symposium lacked representation from certain sectors such as the Ministry of Local Development, and the Ministry of Physical Planning and Construction that are necessary to make the multi-sectoral approach successful. Participants also discussed how to move forward and give life to the MSNP now that the policy is in place, highlighting a need to provide a 'nutrition lens' to people working in other sectors and clearly define their roles in order to foster collaboration.



POSTER PRESENTATIONS

An interactive poster presentation session was also held on the second day showcasing eleven abstracts highlighting ongoing research in Nepal focused on the theme of the symposium. The posters included interesting topics such as the effect of aquaculture; one poster discussed how cultivating nutritious indigenous fish in small family ponds with an emphasis on consumption could possibly improve nutritional status and another focused on strategies to improve market access for aquaculture. Micronutrients were another prominent theme with posters that discussed issues such as improving vitamin A supplement delivery to children 6-11 months of age through focused communication messages and social mobilization, iodine status in school children, the results of a study of the effects of antenatal supplementation with different combinations of micronutrients on growth and lipid metabolism in children by measuring the plasma proteome of the children born to mothers in the study. Another study highlighted the success of the government led implementation of Community Management of Acute Malnutrition as an efficient and cost-effective method in a pilot study in three districts of Nepal. Food insecurity was also an issue that received attention with a poster finding that low productivity of land, unfavorable climate and small farm size contribute to the high levels of food insecurity seen in the Chepang community. Other posters also presented on findings such as the benefits of Community Led Total Behavior Change in Sanitation and Hygiene in improving health and nutrition as well as formative research findings showing education to be an important determinant of health behavior from the perspective of for community based, integrated nutrition programs.



The audience were requested to vote for their favorite posters and at the end of the session, the poster with the most votes was given an award which was won by the poster titled *“Innovative Delivery Mechanism For Improving Vitamin A Supplementation Coverage Among Children Age 6-11 Months: A Pilot In Three Districts Of Nepal, October 2012 – December 2013.”* presented by Mr.MR Maharjan from Micronutrient Initiative.

LESSONS LEARNED, INSIGHTS AND RESEARCH PRIORITIES

The final session consisted of an open discussion on the lessons learned, insights and research priorities for the agriculture to nutrition agenda led by a panel consisting of Dr. Sharad Onta (IOM), Dr. Keith West (JHU), Dr Kedar Baral (PAHS) & Dr. Devendra Gauchan (NARC). There was an energetic interaction between high level civil servants and the research community discussing the research gaps and the perspectives of participants of different sectors.



From L-R: Dr. Devendra Gauchan, Dr. Kedar Baral, Dr. Sharad Onta and Dr. Keith West

Dr. Keith West initiated the session by talking about the need for a trans-sectoral approach where efforts are made to truly engage across disciplines and learn from each other's perspective's to gain common ground. He also pointed out that looking at the presentations submitted for the symposium there seems to be a lack of adequate research in the agriculture to market section and especially in the market to home section.

Dr. Gauchan underscored important research questions from the first link in the pathway, 'Agriculture to Market', namely (a) the feasibility of the cultivation of nutritious indigenous foods such as buckwheat and barley especially in the mountains area which has inadequate nutritious food (b) the impact of improved irrigation on agricultural production and health and nutritional status (c) women friendly crops and technologies (d) effects on food quality when using improved harvest to market, storage and transportation methods.

Dr. Onta highlighted the importance of ensuring the quality of food in the diet along with quantity. Citing Dr. Groopman's presentation, he encouraged research about aflatoxins and its impact on health and approaches to reduce exposure. He also brought attention to how we can move this multi-sectoral research further and how research can be well translated into policy level and opened the floor for discussion.

During the open discussion members of the audience gave many suggestions on the topics relevant to the agriculture to nutrition pathway that they would like to see included in the next symposium such as issues of crop storage and post-harvest loss, use of chemicals in food

production and its impact on health, policies and mechanisms influencing food accessibility and price control, discussion on other health outcomes that are relevant to nutrition such as infectious diseases and examining the nutritional status of other populations such as the elderly. It was acknowledged that a salient recommendation was to ensure that when it comes to improving nutrition in Nepal, targeting of those most vulnerable – geographically, socio- economically or ethnically, was key.

The participants also provided suggestions and comments on how to move forward and to make the next edition of the symposium even better. Suggestions included ideas such as having small discussion groups organized along the lines of research, program and policy for brain storming and contributing to multi-sectoral discussion; developing a comprehensive review on science, program, and research gaps; and expanding multi-sectoral research to multi-sectorial training. Developing a set agenda for the next five years to improve food security and develop tools to monitor intra- household food security to understand what food dynamics are at play within the household, especially during a crisis was also proposed. Participants highlighted a need for a better method to disseminate research findings to policy makers from the central government, academia, civil society and the grassroots level where implementation takes place. A majority of the attendees felt that integration works best when those at the grass roots level are engaged which remains one of the bigger challenges of multi-sectoral work.

Based on the discussions and presentations, the salient messages from the event were:

- ⇒ **The need to prioritize research on post-harvest storage and loss, benefits of indigenous foods and practices, irrigation, composting and intra-household food security as these topic areas repeatedly emerged as areas that were not only under-explored but also were crucial links in understand the pathway, especially within Nepal’s contextual characteristics.**
- ⇒ **The need for programs and policies to target economically and socially disadvantaged groups to achieve greater nutrition gains: the evidence presented during this symposium from experimental and non-experimental research designs, unanimously called for this type of informed targeting.**
- ⇒ **The need for more rigorous methods to be used when examining the agriculture – nutrition pathway: this would include a movement away from disciplinary/ sector-based work to a more cross-disciplinary discussion to both set the research agenda in the long and short-term for Nepal to be able to study the linkages across the agriculture – nutrition pathway but also to join forces when creating appropriate metrics to study this pathway that are both reliable and validated.**

APPENDIX

I. PRESENTERS

PRESENTATION TITLE	PRESENTED BY
Lancet Review: Nutrition Sensitive Interventions.	Dr. Patrick Webb, Tufts University
PoSHAN Community Studies: Finding pathways to accelerate nutritional impacts.	Dr. Rolf Klemm, Johns Hopkins University
PoSHAN Process: Understanding processes that support nutrition program impacts.	Dr. Shibani Ghosh, Tufts University
Implementation and lessons learned for integrated nutrition programming.	Ms. Pooja Pandey, Suaahara
Agriculture and child nutrition: An analysis of district-level performance in Nepal.	Mr. Ganesh Thapa, Department of Agricultural Economics, Purdue University
Diversifying family nutrition of small-holder tribal farmers through different conservation agriculture crop production systems in the sloping lands of Nepal in the hills.	Mr. Keshab Thapa, Local Initiatives for Biodiversity, Research and Development (LI-BIRD)
Household consumption of lentils in selected terai districts of Nepal: A study on impact of improved technologies.	Mr. RK Neupane, FORWARD Nepal
Impact of the food price crisis on the affordability of a nutritionally adequate diet across socioeconomic groups in the rural plains of Nepal in 2005 and 2008.	Dr. Naomi Saville, UCL/MIRA
No rice in the house: Risk factors and associations with nutritional status of Nepalese 9- 13 year olds.	Dr. Raman Shrestha, Nutrition Innovation Lab/Johns Hopkins University
Household food insecurity leads to poor infant growth: what are the linkages?	Dr. Keith West, Johns Hopkins University
Growth and health of rural children in 3 districts of Nepal: Effect of a community development and livestock promotion intervention over 24 months.	Ms. Neena Joshi, Heifer International
Impact of homestead food production in the nutritional status of children 12-48 months and their mothers in Baitadi District, Nepal	Mr. Akoto Osei, Helen Keller International
Socio economic status, food security and anemia among mothers in Bhaktapur.	Dr. Ram K Chandyo, University of Bergen
Infant and young child feeding practices as associated with child nutritional status in Nepal: Analysis of the 2011 Nepal Demographic Health Survey.	Dr. Saba Mebrahtu, UNICEF
Thematic Findings on Food Security and Nutrition: An analysis of the National Living Standards Survey III.	Ms. Nicole Menage, World Food Programme
Revealing hidden hunger through the plasma proteome of Nepalese children: A new approach to assess micronutrient status.	Dr. Keith West, Johns Hopkins University

POSTER PRESENTATIONS	PRESENTED BY
Innovative delivery mechanism for improving Vitamin A supplementation coverage among children age 6-11 months: A pilot in three districts of Nepal, October 2012 – December 2013.	M.R Maharjan, Director, Micronutrient Initiative (MI)
Antenatal micronutrient supplementation affects plasma proteins involved in growth and lipid metabolism in school-aged offspring in Sarlahi, Nepal.	Lee Sun, PHD Candidate, JHSPH
Enhancing the food, health and nutritional security through improving livestock and agriculture farming system in Nepal.	Tara Nath Gaire, Veterinarian, IAAS, Rampur
Small-scale family pond aquaculture for rural household nutrition.	Madhav Shrestha, Professor, IAAS, Rampur
Iodine status among the school children of hilly and plain region of Eastern Nepal	Prem Raj Shakya, Lecturer, PAHS/BPKHIS
An experience of public, private and NGO partnership program in farmers training in Nepal.	Bharat Kumar Paudel, Senior Vegetable Development Officer, Central Vegetable Seed Production Center
Community perspectives on the role of education in maternal and child nutrition: Findings from the formative research for an Integrated Nutrition Program in Nepal.	Jeevan Lohani, Director Of Programs, RIDA
From pond to pan: Ensuring successful markets for aquaculture.	Varsha Upreti, Research Officer, CEAPRED,
Food insecurity analysis in two Chepang communities in Nepal.	Binod Khanal, Student, IAAS, Rampur
Community Let Total Change: Can it be a tool for agriculture-food-nutrition-health-economic and overall transformation of Nepal.	Krishna Kaphle, Head of Department of Theriogenology, IAAS, Rampur
Formative evaluation of Community Management of Acute Malnutrition Programme: The Nepal case study.	Anirudra Sharma, Nutrition Specialist, UNICEF Nepal

II. ABSTRACTS

SESSION I: AGRICULTURE TO MARKET

AGRICULTURE AND CHILD NUTRITION: AN ANALYSIS OF DISTRICT-LEVEL PERFORMANCE IN NEPAL. GERALD SHIVELY AND GANESH THAPA, Department of Agricultural Economics, Purdue University, West Lafayette, IN 47907 USA.
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BACKGROUND: In Nepal, child nutrition outcomes (such as rates of stunting and wasting) vary considerably across districts. At the same time, agricultural indicators (such as yields or use of improved inputs) also vary across districts. The issue investigated in this empirical study is whether agricultural indicators closely track nutrition indicators.

AIMS: This paper investigates connections between district-level agricultural performance and district-level child nutrition outcomes in Nepal. The goal is to improve our understanding of what kinds of agricultural policies and interventions might have the greatest impact on child nutrition outcomes.

METHODS: We use data on child nutrition outcomes from the 2006 Nepal Demographic and Health Survey (DHS) and data on agricultural performance from the 2004 Nepal Living Standards Survey (NLSS). We identify districts with above average and below average performance on agricultural measures and nutrition outcomes. We then use a series of Multinomial Logistic regressions to explain district-level patterns of stunting (low height-for-age) and wasting (low weight-for-height) in the context of agricultural yields, input use, and other factors.

RESULTS: We find that fertilizer use and irrigation are key factors associated with both above average agricultural performance and above average nutrition outcomes.

CONCLUSION: Findings underscore the importance of agricultural performance to nutrition outcomes and provide insights for policy makers and others for whom food security and agriculture development are priorities. The main conclusion is that fertilizer promotion and irrigation development are likely pathways through which agriculture can lead to improved child nutrition.

DIVERSIFYING FAMILY NUTRITION OF SMALLHOLDER TRIBAL FARMERS THROUGH DIFFERENT CONSERVATION AGRICULTURE CROP PRODUCTION SYSTEMS IN THE SLOPING LANDS OF NEPAL MID-HILLS. THAPA K¹, PAUDEL B², TAMANG BB¹, CROW S², HALBRENDT J², CHAN-HALBRENDT C², RADOVICH T², KHADKA K¹, CHAUDHARY P¹, SHRESTHA DN¹ 1. LI-BIRD, Nepal. 2. University of Hawai'i at Manoa, USA. Email address of corresponding author: kthapa@libird.org

BACKGROUND: In Nepal, majority of current farming practices in sloping lands are not sustainable due to mono-cropping and frequent cultivation leading to soil erosion and fertility degradation. This has challenged food security of small holder farmers who are already under poverty, and malnutrition.

AIMS: The research aimed at enhancing the food and nutrition security of Chepang people, a tribal community of three villages in Dhading, Gorkha and Tanahu by increasing crop productivity by providing cropping and farm practices options through various conservation agriculture production systems (CAPS).

METHODS: We designed on-farm experiments through participatory consultation with the Chepang farmers with due consideration of the existing cropping systems in the study sites. The experiments were carried out in 24 farmers' fields (8 farmers per village) for two consecutive years (2011 and 2012) using the following four production systems as treatments: 1) conventional tillage + maize followed by millet, 2) conventional tillage + maize followed by legume, 3) conventional tillage + maize followed by intercropping millet and legume, and iv) strip tillage + maize followed by intercropping millet and legume.

RESULTS: Analysis of the two year data revealed no significant effect of treatments on maize yield, but observed major differences on performance of following season crops. Land equivalency ratio (LER) of millet + legume intercropping was significantly higher than that of sole crop in both years. Moreover, LER of intercropping system improved in second year in both tillage practices though LER of intercropping with conventional tillage did not differ significantly with strip tillage.

CONCLUSION: Intercropping millet with legumes in the millet based production systems supply more carbohydrate and proteins and generate income for farming households, increase the overall productivity of the cropping system leading to improved food and nutrition security of small holder farmers.

HOUSEHOLD CONSUMPTION OF LENTILS IN SELECTED TERAI DISTRICTS OF NEPAL: A STUDY ON IMPACT OF IMPROVED TECHNOLOGIES. NEUPANE RK, SHARMA A, ARYAL D, SHAH R FORWARD Nepal, Bharatpur, Chitwan, Nepal. Email address of corresponding author: rk_neupane58@rediffmail.com

BACKGROUND: Grain legumes play important roles in the nutrition of the poorer sectors of society who cannot afford expensive animal protein foods in their daily diets. Lentil (*Lens culinaris* L. Medik), has a major share in area and production of legumes in the country. However, against a steady declining trend, daily dietary intake of pulses including lentil varies across rural households, and little to date has been documented on the impact technology interventions such as improved varieties, seed priming rhizobium inoculation and Diammonium Phosphate (DAP) application as a package have had on household lentil consumption.

AIMS: To estimate the changes in daily consumption of lentils by rural Terai households as a result of technology interventions.

METHODS: Household consumption surveys were conducted before and after a project intervention that introduced improved varieties of lentils, seed priming and DAP application among 17,735 HHs of eleven terai districts – Siraha, Saptari, Sarlahi, Rautahat, Bara, Parsa, Nawalparasi, Banke, Bardia, Dang and Kailali. A total 3631 households (Sample size= 21% of beneficiaries) were randomly selected from the project area of the eleven districts. A semi-structured questionnaire was developed, pretested and used. Data were analyzed using SPSS package.

RESULTS: Average productivity of lentil increased by about 47% over the base year. Average household consumption increased from 82 kg at base year to 92.6 kg/HHs/annum after project intervention. The level of consumption varied by area coverage by lentils. Households with more than 1ha of land showed consumed 499 kg/annum, while only 44 kg/annum were reported from households owning less than 0.1 ha. After project intervention, productivity increases of lentils were higher in smaller than in larger farms. Proportion of produce used in HH consumption also showed similar trends.

CONCLUSION: Technology intervention led to improve lentil productivity and increase in household consumption irrespective of household sizes, and ethnicity, although farmers with larger holdings tended to include more lentils in their daily diets.

SESSION II: MARKET TO HOME

IMPACT OF THE FOOD PRICE CRISIS ON THE AFFORDABILITY OF A NUTRITIONALLY ADEQUATE DIET ACROSS SOCIOECONOMIC GROUPS IN THE RURAL PLAINS OF NEPAL IN 2005 AND 2008. AKHTER N², SAVILLE^{1,2}, SHRESTHA B¹, MANANDHAR DS¹, OSRIN D², COSTELLO A², SEAL A² 1. Mother and Infant Research Activities, Kathmandu, Nepal. 2. UCL Institute for Global Health, University College London, London, United Kingdom. Email address of corresponding author: n.saville@ucl.ac.uk

BACKGROUND: Undernutrition, associated with poverty, food insecurity, infections and inappropriate care was prevalent in Nepal, even before the global food price crisis in 2008. Widening income inequality and large gaps in undernutrition between rural/ urban, ecological, and administrative regions were evident. The 2008 food price crisis may have increased the risk of undernutrition for poor households.

AIMS: We aimed to assess the impact of the food price crisis by estimating the cost of a nutritionally adequate diet in the rural plains of Nepal in 2005 and 2008 and its affordability among socio-economic groups.

METHODS: We used the 'Cost of Diet (CoD)' linear programming tool, developed by Save the Children UK to estimate the cost of a nutritionally adequate diet. Data on commonly consumed food items, local market food prices, consumption pattern, and income levels in Dhanusha district in rural plains Nepal were inputted to the CoD model. We collected food price data from local markets in Dhanusha District for the September-October (pre-festival peak price) periods of 2005 and 2008. We also used data from a participatory 'Household Economy Approach' study in 2006, a market price and income study in 2008, and a household surveillance system of households with recently delivered women that was in place between 2006 and 2011.

RESULTS: The cost of a nutritionally adequate diet increased by 28% in 2008, in comparison with the 2005 cost. The nutritionally adequate diet was unaffordable for the poorer households in Dhanusha in both 2005 and 2008. The affordability scenario did not change much in 2008 due to an accompanying increase in income levels of the households, associated with government-imposed wage increases.

CONCLUSION: Poverty restricts households' ability to access a nutritionally adequate diet in Dhanusha. The poorer purchase-dependent households in Dhanusha may need external support enabling them to meet their nutritional requirements.

NO RICE IN THE HOUSE: RISK FACTORS AND ASSOCIATION WITH NUTRITIONAL STATUS OF NEPALESE 9-13 YEAR OLDS. SHRESTHA R¹, KLEMM R², WEST K² 1. Nutrition Innovation Lab/JHU, Kathmandu, Nepal. 2. Department of International Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA. Email address of corresponding author: rshrestha@nutritioninnovationlab.org.np

BACKGROUND: Although research has shown a high prevalence of food insecurity and malnutrition in Nepal, there is very little research examining the factors associated with household food insecurity and the relationship of household food insecurity to the nutritional status of children.

AIMS: The aim of the study is to examine the association between household characteristics and 'rice insecurity' (defined as the presence or absence of rice stores in the household) as a measure of food insecurity and to explore the relationship between rice insecurity and the nutritional status of children 9 -13 year of age in a rural population in Sarlahi District of Nepal.

METHODS: A secondary data analysis was conducted using a cross-sectional survey of 13,137 households with children between 9 to 13 years of age. The data contained information on household socio-demographic characteristics, household rice stores and mid-upper arm circumference of the children.

RESULTS: 17.3% of the households had no rice stores and were classified as 'rice insecure'. Caste, ethnicity, asset ownership, land ownership, household construction type and season were all significantly associated with rice insecurity ($p < 0.001$). There was no significant association between rice food insecurity and mid upper arm circumference ($p = 0.1$). Asset ownership, land ownership, household construction type and season were all significantly associated with mid-upper arm circumference.

CONCLUSION: The significant associations between rice insecurity and the household characteristics show that the absence of rice stores in a household can be indicative of the household's characteristics such as socio-economic status, caste and ethnicity. The significant association between rice insecurity and season suggests a seasonal variation in household food insecurity. The nutritional status of children was not significantly associated with rice insecurity in this study. Further research is needed in order to fully understand the multifaceted relationship between food insecurity and nutritional status in order to design integrated intervention strategies aimed at reducing the burden of household food insecurity and malnutrition in Nepal.

ASSOCIATION BETWEEN HOUSEHOLD FOOD INSECURITY AND INFANT GROWTH IN RURAL BANGLADESH. NA M¹, WEST KP JR.¹, SHAMIM AA², MEHRA S¹, LABRIQUE A¹, ALI H², KLEMM R¹, CHRISTIAN P¹ 1.Johns Hopkins University, Baltimore, Maryland, USA; 2.JiVitA Project, Gaibandha, Bangladesh. Email address of corresponding author: kwest@jhsp.edu

BACKGROUND: Food insecurity is a concern worldwide. In 2012, the number of people suffering from insufficient dietary energy supply remained unacceptably high at about 870 million globally. Food insecurity is a multidimensional problem with progressive stages: ranging from uncertainty in food acquisition to quality reduction and further food quantity insufficiency. Developing and validating methods to reflect the continuum of food insecurity experiences is important in terms of early targeting, surveillance and intervention evaluation.

AIMS: This study examined the association between household food insecurity and early infant growth in rural Bangladesh.

METHODS: We assessed the association between household food insecurity and in prospective data collected during a cluster-randomized, controlled trial of antenatal multiple micronutrients vs. iron-folic acid supplementation in a typical rural area of northern Bangladesh. We measured infant growth and household food insecurity (using the Food Assess Survey Tool) longitudinally at birth and 6-m of age, and created a household food insecurity index (HFI) and assessed its association with infant size (weight, length, mid-upper arm, head and chest circumference) at 6 months of age.

RESULTS: There was a dose-response gradient between the severity of household food insecurity and infant weight. The more food insecure a household, the smaller the 6-m weight, length, MUAC, head and chest circumference. After adjusting sequentially and cumulatively for infant sex and age, maternal nutritional status and birth size, the strength of association between household food insecurity and child size at 6 months decreased by 55-85%. Adjusting further for socioeconomic status explained the remaining variance in all size measurements except infant length.

CONCLUSION: The associated proximal causes of growth stunting and household food insecurity were largely acting in utero and over the years during which mothers were exposed to an environment that was chronically food insecure.

 SESSION III: HOME TO NUTRITION OUTCOMES

GROWTH AND HEALTH OF RURAL CHILDREN IN 3 DISTRICTS OF NEPAL: EFFECT OF A COMMUNITY DEVELOPMENT AND LIVESTOCK PROMOTION INTERVENTION OVER 24 MONTHS. MILLER LC^{1,2}, JOSHI N¹, LOHANI M¹, ROGERS B², SUBBA P³, THAPA D³, HOUSER R², LORADITCH M², SINGH P¹, MAHATO S¹ 1. Heifer International, Nepal. 2. Tufts Friedman School of Nutrition, Boston, MA, USA. 3. NTAG, Nepal Email address of corresponding author: rshrestha@nutritioninnovationlab.org.np

BACKGROUND: The effect of poverty alleviation programs on child nutritional status is not known with certainty. Because child nutrition is a vital cornerstone of community development, Heifer-Nepal, an NGO which promotes community development via livestock production, conducted a longitudinal randomized controlled trial to evaluate the effects of its programs on this important outcome.

AIMS: (1) systematically assess effects of Heifer-Nepal activities on child nutrition, (2) delineate family and child characteristics affecting this outcome. Study design: 6 communities in 3 districts of Nepal [Chitwan/Nawalparasi (Terai), Nuwakot (hill)], were pair-matched for specific characteristics, then randomly assigned to receive Heifer community development activities at baseline (INT) or 1 year (CON). At 6 month intervals (5 household visits), a 125- item questionnaire addressing family demographics, SES, diet, and child nutrition was completed, along with child growth monitoring.

RESULTS: 415 households (3001 individuals, 611 children) were enrolled. INT and CON communities were similar for baseline SES, household size, land ownership, and child nutrition, but Terai and hill districts differed. Growth of INT children improved more than CON for HAZ (baseline to 12 months [B12], $p=0.03$, B24, $p=0.02$) and WAZ (B24, $p=0.01$). In the Terai, HAZ for INT children B12 and B18 increased more than CON (each $p=0.02$); WAZ increased more from B6, B12, and B18 ($p=0.05$, $p=0.04$, $p=0.02$). After controlling for child characteristics and HH demographic variables, HAZ B12 was better in INT children ($p=0.042$). After 24 months, INT SES increased more than CON (+0.95 vs +0.72, $p=0.04$); Terai INT communities had ~2x the SES score of CON at 12 and 24 mo.

CONCLUSION: Community development interventions may favorably impact child growth, even if this outcome is not specifically targeted. Family clustering and other household characteristics likely affect this relationship. Extended follow-up will refine understanding of these factors and identify specific targets for improvement.

IMPACT OF HOMESTEAD FOOD PRODUCTION ON THE NUTRITIONAL STATUS OF CHILDREN 12-48 MONTHS AND THEIR MOTHERS IN BAITADI DISTRICT, NEPAL. AKOTO

OSEI AND POOJA PANDEY, Helen Keller International. Email address of corresponding author: ppandey@hki.org

BACKGROUND: The impact of nutrition-sensitive agriculture interventions on nutritional status of children and women has not been clearly elucidated.

AIMS: We assessed the effect of a 3-year homestead food production (HFP) project on stunting, underweight, wasting and anemia among children 12–48 months and underweight and anemia among their mothers in Baitadi district, Nepal.

METHODS: This study utilized a cluster randomized, controlled design. Cross-sectional data were collected from 2,106 and 2,614 mother-child pairs at baseline and post-intervention, respectively, in villages assigned to receive HFP activities (treatment) or not (control). Findings from bivariate analysis are presented. Multivariate analysis results will be included at the time of the congress.

RESULTS: Comparing baseline to post-intervention, food secure households was 26 percentage points (PP) higher in treatment, as compared to 9 PP in control communities. Children fed the WHO recommended minimum acceptable diet were 44 PP higher at post-intervention than baseline in treatment compared to 6.4 PP in control communities. For children, stunting did not change from baseline to post-intervention in either the treatment (57.7% vs. 55.7%) or control (65.8% vs. 63.5%) group. Also, wasting did not differ between baseline and post-intervention in the treated (10.6% vs. 10.5%) and control (10.1% vs. 9.7%) groups. Whereas underweight (43.4% vs. 41.0%) and anemia (30.8% vs. 28.2%) did not change among children in the treatment communities, underweight (40.6% vs. 48.0%) and anemia (42.5% vs. 31.6%) were significantly lower at post-intervention compared to baseline among the control children. Maternal underweight did not change significantly in the treatment communities (28.2% vs. 26.6%), but was higher at post intervention (23.0%) than baseline (17.5%) in control communities. Maternal anemia was higher at post-intervention than baseline in both treatment (24.6% vs. 19.6%) and control (35.8% vs. 21.1%) groups, though this change was less in the treatment group.

CONCLUSION: This study indicates HFP improved household food security and child feeding practices, and had a potentially positive impact on child and maternal anemia as well as maternal underweight. However, there was no demonstrated impact on child stunting, underweight and wasting.

SOCIO ECONOMIC STATUS, FOOD SECURITY AND ANEMIA AMONG MOTHERS IN BHAKTAPUR. Chandyo RK¹, Ulak M², SHRESTHA PS², STRAND TA¹, THORNE-LYMAN A³ LOCKS L⁴, FAWZI W⁴. 1. University of Bergen, Norway. 2. Institute of Medicine, Nepal. 3. Columbia University, USA. 4. Harvard School of Public health, Boston Email address of corresponding author: rshrestha@nutritioninnovationlab.org.np

BACKGROUND: Over the past ten years, the profile of urban Nepal has changed dramatically as people have migrated from rural areas to the Kathmandu Valley. Little data is available on the nutritional or socio-economic situation among Nepalese residing in peri-urban Nepal.

OBJECTIVE: To describe prevalence of anemia and status of household food security, socio-economic and agriculture productions among mothers residing in Bhaktapur municipality of Nepal.

METHOD: From August 2012-June 2013, we followed up 250 mothers who had participated in a prior survey in Bhaktapur municipality and obtained in-depth information about their socio-economic condition, household food security and agriculture production. We also measured anthropometry and hemoglobin concentrations using Hemocue microphotometers.

RESULTS: Fifty four (22%) families were staying on rented houses and 60 families (24%) were living in a single room. Three fourth of households were using liquid petroleum gas as the main source of cooking fuel. The mean (range) age was 30 years (20-49) and 10% (n=24) of mothers were above 35 years of age. The majority of households (62%) had agricultural land with mean 1,431 m² of area and rice was main production (73%) followed by vegetables (64%), wheat (34%) and maize (31%) in the previous year. The mean (SD) body mass index was 24.2 (3.6) kg/m² and the prevalence of underweight, (<18.5) overweight (>25) and obesity (>30) were 2%, 40% and 6%, respectively. The mean (SD) hemoglobin concentration was 12.5 g/dL (1.4) and 27% of mothers were anemic (< 12 g/dL). In the past six months, 66 mothers (28%) reported they were worried that food will be not enough for household and 7% families experienced scarcity of food at some time due to lack of resources.

CONCLUSIONS: The population in Bhaktapur, Nepal, is undergoing a nutrition transition in which overweight, anemia, and food insecurity coexist among adult women. Efforts to improve the nutritional status of the population should consider the implications of policies for both under and over-nutrition.

INFANT AND YOUNG CHILD FEEDING PRACTICES AS ASSOCIATED WITH CHILD NUTRITIONAL STATUS IN NEPAL: ANALYSIS OF THE 2011 NEPAL DEMOGRAPHIC HEALTH SURVEY. MEBHRATU S¹, CRUM J², DAHAL P¹, POKHAREL RK³, MASON J²

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BACKGROUND: Nepal has seen a decline in undernutrition over the last decade. However, it remains a serious problem with 41 per cent stunting and 11 per cent wasting among children less than five years of age in 2011. Anemia affects 70 per cent of children ages 6-23 months. Additional efforts are required to further improvements made thus far. Appropriate infant and young child feeding (IYCF) practices can contribute towards reducing undernutrition among children in Nepal.

AIMS: The project aimed to analyze associations of IYCF practices with child nutrition outcomes of underweight, stunting, wasting and anemia to contribute to policy and programmatic decisions for addressing undernutrition in Nepal.

METHODS: Analysis of 2011 Nepal Demographic and Health Survey (NDHS) data was performed using a dataset with 971 children ages 0-23 months. Indicators of child nutritional status were examined with selected variables of IYCF practices using bivariate and multivariate analyses.

RESULTS: Diet diversity and minimum meal frequency are significantly, positively associated with weight-for-age and height-for-age among children 6-23 months, with the greatest effect among ages 6-11 months, even when controlling for other factors. The combination of adequate diversity and meal frequency had the greatest effect on all three indicators of child growth. However, anemia was not associated with food intake. The lowest prevalence of optimal IYCF practices was found in the Terai, Central region, and among the Madeshi ethnic/caste group. Maternal nutritional status was strongly, positively associated with all indicators of child growth.

CONCLUSION: Counseling for optimal IYCF practices should begin early in infancy to maximize adequate growth through two years of age. The largest effect occurs when both diet diversity and minimum meal frequency are present. Potential targeting options include the Terai, Central region and Madeshi ethnic/caste group. Interventions for improved child undernutrition, especially related to micronutrients, should begin with mothers.

THEMATIC FINDINGS ON FOOD SECURITY AND NUTRITION: AN ANALYSIS OF THE NATIONAL LIVING STANDARDS SURVEY III. NICOLE MENAGE, World Food Programme. Email address of corresponding author: nicole.menage@wfp.org

Nepal gives high priority to food and nutrition security. Data from the Nepal Living Standard Survey can be used to measure progress to achieve this goal and highlight areas of concern. The World Food Programme, World Bank and UNICEF supported the Central Bureau of Statistics in doing so and published a comprehensive thematic report on the state of food and nutrition security.

Key food security and nutrition indicators were derived from the third Nepal Living Standard Survey (2010/11). Trends were determined by comparing outcomes from earlier comparable surveys in 1995/6 and 2003/04. Food security was determined by taking into consideration diet quantity (kilo calorie intake), quality (diversity of diet) and adequacy (food consumption and food poverty). Nutrition was assessed through anthropometry (stunting, wasting and underweight) of children under the age of 5.

The national average energy intake is 2,536 Kcal per person per day; a level higher than the minimum requirement of 2,220 kcal. However, 38 percent of the population still consumes less than needed and most energy is derived from staple foods. Despite progress in nutrition outcomes, chronic malnutrition, as measured by stunting, remains high at 46 percent and acute malnutrition, as measured by wasting, increased to almost 15 percent nationwide. In areas of the Terai, wasting is generally above 20 percent. Chronic malnutrition showed a stronger association with food security than acute malnutrition. For the latter, health and behavioral factors may play a more significant role.

Key trends include: an improved dietary intake, a closing food expenditure gap between urban and rural areas, declining poverty, continuing remittances inflow, poor agricultural performance with marginal surplus in staple production, and a worrying climate change outlook.

Overall, household access to nutritious food is inadequate to guarantee improvements in child malnutrition. Targeted interventions in agriculture, income support and nutrition advocacy are needed.

REVEALING HIDDEN HUNGER THROUGH THE PLASMA PROTEOME: A NEW APPROACH TO ASSESS MULTIPLE MICRONUTRIENT STATUS?

PROF. KEITH WEST, Dr.P.H., R.D., Center for Human Nutrition, Johns Hopkins Bloomberg School of Public Health. Co-authors: Robert Cole, Kerry Schulze, Ingo Ruczinski, Joshua Betz, Lee Wu, Subarna Khatry and Parul Christian. Email address of corresponding author: kwest@jhsph.edu

Micronutrient deficiencies are common but preventable, with a wide range of public health benefit in South Asia. In Nepal, antenatal iron has been shown to prevent maternal anemia, and improve birth size, survival and cognition of offspring; vitamin A to reduce maternal night blindness, morbidity and mortality, and improve immunity and lung function of offspring; folic acid to improve preterm infant survival, and preserve kidney function and metabolic health later in childhood; and zinc to improve later child growth and body composition. Iodine is known to protect growth, development and cognition. In Nepal, preschool vitamin A has been shown to reduce xerophthalmia, mortality and hearing loss from ear infection and zinc to improve preschool child survival.

But there are > 35 essential micronutrients, including vitamins, minerals, amino acids and fatty acids, each with potential health consequence if deficient, and benefit if adequate. Most receive little attention because they require different, difficult, time-consuming and costly biochemical methods to assess, underlying their designation as “hidden hunger”. A new paradigm is needed to enable deficiencies of many nutrients to be evaluated concurrently, quickly, validly, at low cost and locally to inform supplementation, fortification and dietary intervention practices. No such method exists.

However, plasma proteomics offers promise assuming (a) every nutrient reliably interacts with a proteome (defined set of proteins) and (b) plasma accurately reflects nutrient: protein metabolism. This approach is being pursued to quantify protein biomarkers by mass spectrometry and bioinformatics, model their prediction of nutrient status, and quantify nutrient-predictive proteins which, in the future, could be measured on a single platform.

To date, 20 micronutrients and nearly 1000 proteins have been measured in plasma of 500 children 6-8 y of age born during the NNIPS-3 antenatal micronutrient supplementation trial in Sarlahi in 2000-2001. Preliminary data show a wide range of proteins correlate with plasma nutrients, with protein biomarkers explaining up to ~80% of the variation (R^2) in nutrient concentrations, offering new potential to assess multi-nutrient population status in the future.

III. PROGRAM OVERVIEW

Day 1: Tuesday, August 13th, 2013

9:00 – 9:30	Tea & Registration
9:30 – 9:40	Welcome by Dr. Sharad Onta, IOM
9:40 – 10:05	Keynote Address Lancet Review: Nutrition Sensitive Interventions. <u>Presenter</u> : Dr. Patrick Webb, Tufts University
10:05 – 10:15	Multi-Sectoral Nutrition Research and Implementation: A year of progress and lessons 1. PoSHAN Community Studies: Finding pathways to accelerate nutritional impacts. <u>Presenter</u> : Dr. Rolf Klemm, Johns Hopkins University) 2. PoSHAN Policy: Understanding processes that support nutrition program impacts. <u>Presenter</u> : Dr. Shibani Ghosh, Tufts University) 3. Implementation and lessons learned for integrated nutrition programming. <u>Presenter</u> : Ms. Pooja Pandey, Suahaara) Moderator: Dr. Sharad Onta & Dr. Keith West
10:15 – 10:30	
10:30 – 10:45	
10:45 – 11:25	
11:25 – 11:45	Tea break
11:45 – 12:30	Presentations on ‘Agriculture to Market’ 1. Agriculture and child nutrition: An analysis of district level performance in Nepal. <u>Presenter</u> : Mr. Ganesh Thapa, Purdue University 2. Diversifying family nutrition of small-holder tribal farmers through different conservation agriculture crop production systems in the sloping lands of Nepal in the hills. <u>Presenter</u> : Mr. Keshab Thapa, Local Initiatives for Biodiversity, Research and Development (LI-BIRD) 3. Household consumption of lentils in selected Terai districts of Nepal: A study on impact of improved technologies. <u>Presenter</u> : Mr. RK Neupane, FORWARD Nepal
12:30 – 1:00	Q&A Moderator: Ms. Shabnam Shivakoti, MoAD
1:00- 1:45	Lunch
1:45 – 2:30	Presentations on ‘Market to Home Environment’ 1. Impact of the food price crisis on the affordability of a nutritionally adequate diet across socio-economic groups in the rural plains of Nepal in 2005 and 2008. <u>Presenter</u> : Dr. Naomi Saville, MIRA/UCL 2. No Rice in the House: Risk factors and associations of nutritional status of Nepalese 9- 13 year olds. <u>Presenter</u> : Dr. Raman Shrestha, Nutrition Innovation Lab/Johns Hopkins University 3. Household food insecurity leads to poor infant growth: what are the linkages?

	<u>Presenter</u> : Dr. Keith West, Johns Hopkins University
2:30 – 2:50	Q&A Moderator: Dr. Devendra Gauchan, NARC
2:50 – 3:00	Tea break
3:00 – 4:00	Presentation on ‘Home to Nutrition Outcomes’ 1. Growth and health of rural children in 3 districts of Nepal: Effect of a community development and livestock promotion intervention over 24 months. <u>Presenter</u> : Ms. Neena Joshi, Heifer International 2. Impact of homestead food production in the nutritional status of children 12-48 months and their mothers in Baitadi District, Nepal. <u>Presenter</u> : Dr. Akoto Osei, Helen Keller International. 3. Socio economic status, food security and anemia among mothers in Bhaktapur. <u>Presenter</u> : Dr. Ram K Chandyo, University of Bergen 4. Infant and young child feeding practices as associated with child nutritional status in Nepal: Analysis of the 2011 Nepal Demographic Health Survey. <u>Presenter</u> : Dr. Saba Mebrahtu, UNICEF
4:00 – 4:30	Q&A Moderator: Dr. Uma Koirala, Padma Kanya Campus, (affiliated to) Tribhuvan University

Wednesday, Day 2: August 14th, 2013

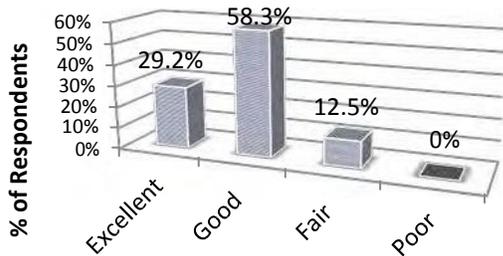
9:00 – 9:30	Tea & Registration
9:30 – 10:00	Keynote Address Exposure to Aflatoxin by Mothers and Young Children in South Asia: Public Health Implications. <u>Presenter</u> : Dr. John Groopman, Johns Hopkins University
10:00 – 10:15	Total Diet Study (TDS) on total aflatoxins (B1, B2, G1, G2) through selected foods in selected clusters of Nepal. <u>Presenter</u> : Mr. K. P. Rai, DFTQC
10:15 – 10:45	Q&A Moderator: Dr. Ramesh Adhikari
10:45 – 11:05	Findings from a Large Scale Nutrition, Agriculture & Health Surveys Thematic Findings on Food Security and Nutrition: An analysis of the National Living Standards Survey III. <u>Presenter</u> : Ms. Nicole Menage, World Food Programme
11:00 – 11:15	Q&A Moderator: Dr. Rolf Klemm
11:15 – 11:30	Revealing hidden hunger through the plasma proteome of Nepalese children: A new approach to assess micronutrient status. <u>Presenter</u> : Dr. Keith West, Johns Hopkins University
11:30 – 12:15	Poster Presentation
12:15 – 1:00	Lunch
1:00 – 1:15	Winning Poster Presentation
1:15 – 3:00	National Policy Responses to “the science” (with open discussion) Panel: MoHP/ CHD Representative, NPC Representative, MoAD Representative,

	UNICEF Representative Moderator: Dr. Patrick Webb & Dr. Kedar Baral
3:00 – 3:15	Tea break
3:15 – 4:30	Lessons learned, insights and research priorities for the Agriculture to Nutrition Agenda (with open discussion) <u>Presenters:</u> Dr. Sharad Onta, Dr. Keith West & Dr. Devendra Gauchan
4:30 – 4:35	Vote of thanks (Dr. Sharad Onta)
4:30 – 5:00	Symposium Wrap up

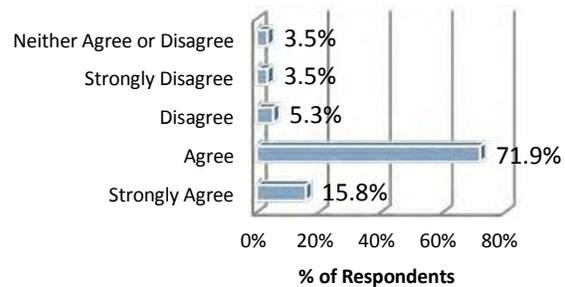
IV. PARTICIPANT FEEDBACK

The participants of the symposium were all requested to complete an online feedback survey to get their perspective. The results of the poll questions are shown below. The organizers hope to use the feedback in order to improve the next edition of the symposium.

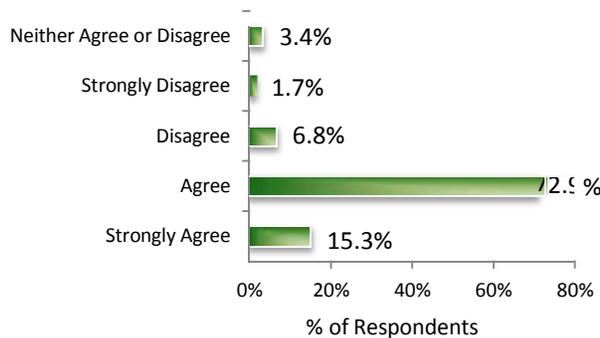
Q. Please rate the 2013 "Science and Policy for Health, Agriculture, Nutrition & Economic Growth" Scientific Symposium held in Kathmandu, Nepal.



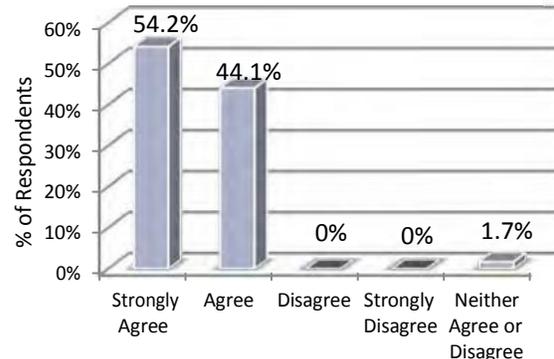
Q. The Scientific Symposium matched my expectations.



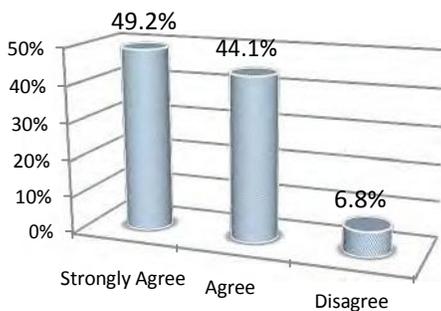
Q. The meeting achieved the appropriate balance between scientific research, policy, and programs.



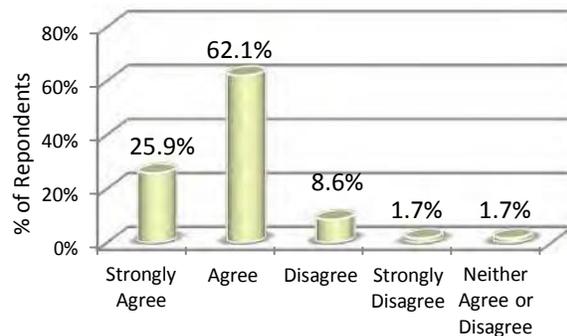
Q. I plan to attend the Scientific Symposium planned for 2014.



Q. I would recommend this Scientific Symposium to others.



Q. Compared to other Symposiums of this type that you have attended, this was excellent. The Scientific Symposium provided an update on the latest scientific findings on agriculture to nutrition



V. LIST OF PARTICIPANTS

Abhigyna Bhattarai	Research Officer	Nutrition Innovation Lab
Abhishek Khadka	Student	Center Campus of Technology
Akoto Osei	Nutrition Advisor	HKI
Akriti Singh	Sr. Nutrition Co-coordinator	Suaahara
Ama Vaidya	Associate Professor	PK Campus
Amod K Poudyal		IOM
Amy Prevatt	Food Security Specialist	USAID
Ananda Kumar Karn	Student	
Andrew Trotter	Professor	TUFTS/IOM
Angela Bukenya	Intern	NNF/NTAG
Anil KC	MPH	IOM
Anirudra Sharma	Nutrition Specialist	UNICEF
Anita Shrestha	Student	IOM
Anjana Sharma	Administrative Associate	HKI
Annette Reiling		KU
Anthony Costello	Director, UCL Institute for Global Health	UCL
Atmaram Pandey	Secretary	Ministry of Defense
Babu Ram Bhusal	MPH	IOM
Barsha Thapa	MPH	IOM
Basundhara Sharma	Lecturer	KMC
Bhim Kumari Pun	Manager	Suaahara
Bibhu Thapaliya	Researcher	RIDA
Biju K Shrestha	Under Secretary	MOCPA
Bikram Dhimal	MPH	IOM
Bina Bhandari	Lecturer	KMC
Binesh Man Sakha	Senior Scientist	NARC
Binjawala Shrestha	Faculty	IOM
Binod Khanal	Student	IAAS, Rampur
Bishnu Prasad Nepal	Joint Secretary	NPC
Bivekananda Mahat		IAAS
Buddhi Devkota	QC Officer	NTAG
Chetan Nidhi Wagle	MPH	IOM, MMC
Dale Davis	Country Director	HKI
Dan Sinclair	Deputy Director	USAID
Debendra Adhikari	Nutrition Specialist	USAID
Deepak Jha	Student	IOM
Deepak Thapa	Program Manager	NTAG

Deirdre Zimmerman	Advisor Nutritionist	NPCS
Dev Raj Gautam	Data Center Programmer	Nutrition Innovation Lab
Dhananjaya Poudyal	Consultant	NNF
Dhundi Raj Sharma	Student	IOM
Dipesh Bhattarai	Student	IOM
Diplav Sapkota	Country Representative	TUFTS
Diwaker Basnet		RIDA
Dr Aruna Upreti	DNMT	
Dr Ram P. Bichha	Director	KCM
Dr Uma Koirala	President	NNF
Dr. Bharat Kumar Poudyal	SUDP	CVSPC
Dr. C.L Bhusal	Chair person	NARC
Dr. Chet Raj Upreti	Senior Scientist	NARC
Dr. Debkala Bhandari	Director General	MOHP
Dr. Devendra Gauchan	Senior Scientist	NARC
Dr. Dharma S. Manandhar	Professor, President	MIRA
Dr. Indira Sharma	Professor	
Dr. Kalpana Tiwari	PHD	NHRCS
Dr. Krishna Adhikary	Associate Professor	KIST Medical College
Dr. Krishna Kaphle	Associate Professor	IAAS
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Dr. Lakhon Sah	DG	
Dr. Madan Koirala	Student	IOM
Dr. Madhurima Bhadra	Consultant	
Dr. Natalia Oli	Lecturer	KMC
Dr. Rajendra Raj Wagle	HOD , Community Department	IOM
Dr. Ram Chandra Bhusal	Value Chain /Marketing Specialist	CEAPRED
Dr. Raman Shrestha	Public Health Scientist	Nutrition Innovation Lab
Dr. Saba Mebrahtu	Chief Nutrition	UNICEF
Dr. Subarna Khatry	Director	NNIPS
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Elena Broaddus	Full Bright Grantee	JHU
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Janak Thapa	Program Manager	NPHF
Janardan Devkota	Student	Novel College
Jasmine Maskey	Student	IOM
Jasmine Tempa Lama	MPH Student	B.U.
Jayram Karmacharya	Student	National College
Jeevan Raj Lohani	Director	RIDA
Jiwan Prabha Lama	DG	DFTQC
John Groopman	Professor	JHU
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Man Bahadur Shrestha	Chief	NARC
Manisha Shrestha	Operational Specialist	World Bank
Manju Gurung	Student	National College
Manoj Adhikari		CMDN/USAID
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Peter Oyloe	Chief of Party	Suaahara
Phulgendra Singh	Student	MPH
Pooja Pandey	Director of Program	Suaahara
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Prajula Mulmi	PHD Candidate	TUFTS
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Purna Chhetri		WB

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Ramesh Bhandari	Student	IOM
Ramesh Kant Adhikari	Professor	KMC
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Richa Adhikary	Student	MCOMS
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Shahani Singh	Journalist	
Shanda Steimer	Director, Health	USAID
Sharad Onta	Professor	IOM
Sharada Pandey	Former Nutrition Chief	MOHP
Shibani Ghosh	Associate Director	TUFTS

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Steven Leclerq	Field Director	NNIPS/JHU
Sudip Ale Magar	MPH Student	IOM
Sujay Bhattacharya	PC	UNICEF
Sumi Devkota	Consultant	NA
Sumi Maskey	Regional Program Officer	USAID, Kishan
Sumina Shrestha	MPH Student	IOM
Sumit Karn	TC-NP	CHD/Suaahara
Sun Eun Lee	Doctoral Student	JHU
Suraj Bhushal	MPH Student	IOM
Surendra Chaurasiya	MPH Student	IOM
Susan Paudel	MPH Student	IOM
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