

Agriculture, Food Security and Nutrition in Nepal: Taking Stock and Defining Priorities

Proceedings of the First Annual Nutrition CRSP Scientific Symposium

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Executive Summary

The Nutrition Collaborative Research Support Program (CRSP)- Asia through its partner, Johns Hopkins Bloomberg School of Public Health, organized a two-day scientific symposium in Kathmandu, Nepal, co-hosted by the Department of Community Medicine and Public Health at the Institute of Medicine (IOM). The Nutrition CRSP is a multidisciplinary research consortium, which seeks to determine investments needed in agriculture, health and nutrition, institutional and human capacity development, and program development to achieve large-scale improvements in nutrition outcomes.

The preliminary report of the 2011 Nepal Demographic Health Survey shows an improvement in child nutritional status between 2001 and 2006 with stunting, wasting and underweight prevalence decreasing from 49% to 41%, 31% to 11% and 39 to 29%, respectively[1]. Nonetheless, chronic undernutrition is still widespread, and wide disparities exist across socioeconomic groups and ecological regions with children from the poorest households and those living in the mountain and hill areas exhibiting the highest levels of stunting.

Nepal is one of the poorest countries in South Asia. A high proportion (estimates range from 25%-55%) of its population lives on less than <\$1.25/day[2]. More than 80% of the population works in the agricultural sector, most of whom work on subsistence-oriented family farms. Households employed in agriculture account for more than three quarters of Nepal's poor. Many of these households were deeply affected by the protracted conflict, drought and other natural disasters. Improvements in agricultural productivity have not maintained pace with population growth, particularly among small landholders and female farmers, the latter constituting more than 60% of the agricultural labor force. In 2009, the World Food Programme reported that 43 of Nepal's 75 districts faced a food deficit, and 23 districts were chronically food insecure. The inability of households to successfully "weather" transitory food supply shocks from drought, flood, market failure, or civil strife can impact their nutritional intake, nutritional status and health.

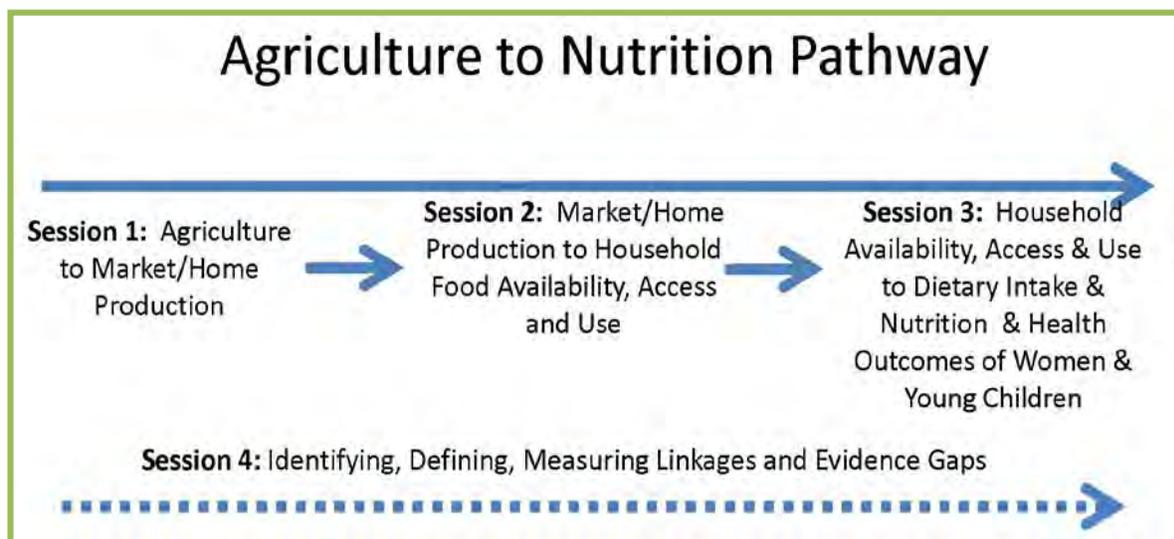
FAO's report, "Guiding Principles for Linking Agriculture and Nutrition: Synthesis from 10 development institutions," illustrated that the linkage between agriculture faces four "main constraints: (i) information on what to do; (ii) how to do it; (iii) how much it will cost (per benefit gained); and (iv) how it will be supported or rewarded"[3]. Further, Leroy et al. noted that the impact of multi-sectoral programs focusing on nutrition is limited in 2008[4].

Improved agriculture leading to better household food security has been identified as a fundamental determinant of processes that lead to food security, adequate dietary intake and nutritional status, and health, yet limited empirical evidence exists on the kinds of actions in agriculture that do (or do not) support nutrition and health for impoverished segments of the population or groups passing through vulnerable life stages. Little data exists beyond pilot projects that reveal ways to optimize the production, availability and access of food products that assure dietary diversity among the poor. The pathways that lead from food production to household food security to improved nutrition are complicated, with multiple determinants.

Yet, systems do exist that convey food within and across communities throughout the year, with varied efficiency, quality and impact. It is the connected pathways that we need to understand, measure and classify, and address their modifiable components in order to reduce food insecurity and undernutrition in high risk geographic areas and socioeconomic groups. These represent critical steps towards effective programming.

The intent of the Symposium was to share, understand and assimilate country-relevant evidence about factors that contribute to causal pathways that lead from agriculture to nutrition, in national, regional and local contexts. A national call for abstracts was made to researchers conducting work across these diverse but connected fields to present their work. The event was attended by approximately 140 participants from the scientific, research, program, policy maker and development partner communities.

The Symposium sought to understand, from data relevant to Nepal: (a) aspects of agricultural production that affect food production quality, quantity and availability in markets across ecological zones and seasons; (b) market dynamics that affect year-round and seasonal household access to food, through purchase or home production; (c) household food security and consumption norms that determine dietary intake; and (d) elements of dietary adequacy and hygiene that affect nutritional status, health, development and survival. The symposium was organized into four thematic sessions: (1) Agriculture-to-Market; (2) Market Purchase or Home Production-to-Household; (3) Household Diet to Nutritional Status of Women and Young Children; and (4) Linkages Across the Causal Spectrum.



The four sessions deconstructed and assessed the strength of evidence of key factors along this pathway, described methods for measuring these factors, explored factors that link domains within the pathway and attempted to identify evidence gaps. Oral and poster presentations of abstracts on Day 1 covered varied topics, including the impact of the consumption of legumes on health outcomes, results of combined interventions (agricultural production, income generation, home gardening) on health and nutritional outcomes, methods available to assess food insecurity, and reviews of findings from randomized nutritional intervention trials.

Day 2 of the Symposium consisted of a participatory and dynamic discussion of domains of concern that span the agriculture-to-nutrition pathway, to identify gaps in knowledge, design and measurements issues, and capacity building. Themes raised included: 1) improving dietary intake (quality and quantity) of poor and malnourished women and children; 2) setting of practical dietary goals in the home that may improve nutritional conditions; 3) contextual factors that influence dietary adequacy; 4) relationships between home food production, storage and processing to dietary adequacy; 5) market factors that affect year-round food access; and 6) agricultural factors that affect availability, market prices and access (effective demand) to food in the household.

Symposium participants identified knowledge gaps both within and between the domains. These included needs to better understand: (i) determinants of household and child malnutrition; (ii) how different target groups perceive nutrition information; (iii) effects of common cooking and food preparation methods on nutritional value; (iv) women's roles in agriculture with respect to control of household resources, decision-making, intra-household food allocation, their own nutrition and their ability to care of their children; and (v) roles of poverty alleviation strategies for improving the nutritional status of women and children. There is a need to build research capacity within Nepal and to translate research findings into policy and programs across the country and mobilizing evidence-based advocates within government to present convincing and better-understood findings are necessary. Based on discussions that transpired throughout the Symposium, the Symposium Organizing Committee identified the following priority actions as recommended "next steps" for the Nepal research community:

- ❖ Form a cross-disciplinary working group composed of established researchers from each relevant sector—agriculture, economics, marketing, food security, dietary intake, public health and nutrition—to identify the key research questions that need to be addressed in the next 3, 5 and 10 years to inform the agriculture-to-nutrition causal pathway.
- ❖ Conduct efficacy (i.e. under optimal conditions) and effectiveness (under real-life and programmatic conditions) research on promising and relevant interventions.
- ❖ Establish community-based surveillance sites in the major agro-ecological zones in Nepal to: (i) provide longitudinal measures of trends and changes over time in food availability, access and utilization, and relate them to household food security, dietary intake and nutrition and health status; and (ii) generate empirical evidence about integrated agriculture and other food and nutrition program interventions which have an effect on nutrition and health outcomes. This should be a priority area for the Nutrition CRSP.
- ❖ Organize a bi-annual or annual forum for policy makers from the NPC, MoAC and MoHP and researchers to discuss and translate research findings that pertain to improvement of nutrition status through a multi-sectoral approach.
- ❖ Organize an annual scientific symposium or "evidence summit" to facilitate the rapid sharing of findings and innovative solutions.

PROGRAM AT A GLANCE

March 21, 2012: Day 1

9:00-9:20	Morning Tea and Participant Registration
9:20-9:30	Welcome (Dr. Sharad Onta)
9:30- 9:40	Welcome and Remarks on Feed the Future and Global Health Initiative: USAID Mission Director (Mr. David Atteberry)
9:40 -10:00	Keynote address on Agriculture – Nutrition Pathway (Dr. Rolf Klemm)
10:00-10:10	Official Opening and Inaugural Remarks by Chief Guest (Honorable Dr. Shiva Kumar Rai)
10:10 – 10:20	Opening Remarks (Dr. Praveen Mishra, MoHP)

SESSION 1: AGRICULTURE TO MARKET

10:30 – 10:50	State of the Art/Evidence (Dr. Devendra Gauchan)
10:50 – 11:05	1.1 Household Consumption of Grain Legumes in Nepal Terai: A Study on Impact of Improved Technologies (Dr. Ram Krishna Neupane, FORWARD Nepal)
11 05-11:20	1.2 Efficiencies in Linking Agricultural Development with Health and Nutrition Training in Nepal (Dr. Luke Covalito, IDE)
11:20- 11:35	1.3 High Impact, Integrated Approaches for Improved Food Security and Nutrition of Rural Poor (Joe Sanders, Fintrac)
11:35- 12:00	Q&A, Rapporteur Key Comments, Identifying the Evidence Gaps
12:00 – 12:45	Lunch

SESSION 2: FOOD MARKETS AND/OR HOME PRODUCTION TO HOUSEHOLD ACCESS

12:45-1:05	State of the Art/Evidence: Improving Access to Nutritious Foods in Rural Markets (Dr. Marie Ruel)
1:05-1:20	2.1 Application of the Household Economy Approach for Assessing Food Security and Describing Livelihoods in Nepal (Dr. Naomi Saville, MIRA & UCL)
1:20-1:35	2.2 Homestead Food Production Contributes to Dietary Intake among Children 6-23 Months Old in Kailali District, Far Western Terai (Debendra Adhikari, HKI)
1:35-1:50	2.3 Food Security, Food Price and Income Trends in Dhanusha District Nepal between 2005-2011 (BP Shrestha, MIRA)
1:50-2:05	2.4 Validating District-Level Assessment with Survey Data: Example from the Nepal Food Security Monitoring System (Mariko Kawabata, WFP)
2:05-2:30	Q&A, Rapporteur Key Comments, Identifying the Evidence Gaps
2:30-3:00	Tea

SESSION 3: HOUSEHOLD AVAILABILITY, ACCESS AND USE TO DIETARY INTAKE AND NUTRITION AND HEALTH OUTCOMES OF WOMEN AND YOUNG CHILDREN

3:00-3:20	State of the Art/Evidence (Dr. Ramesh Adhikari)
3:20-3:35	3.1 Nutrition Interventions that Improve Child or Maternal Health or Survival: Findings from RCTs in the Terai of Nepal NNIPS Research (Dr. Keith West, JHU)
3:35-3:50	3.2 Growth and Health of Rural Children in 3 Districts of Nepal: Effect of a Community Development Intervention (Neena Joshi, Heifer International)
3:50-4:05	3.3 Impacts of Changes in Grain Pulse (Legume Consumption) on Micronutrient Supply of Rural Women in Nepal and North (Dr. Peter Andersen, UIB)
4:05-4:20	3.4 Correlates of Infant and Young Child Feeding Practices in Chepang Community of Makawanpur (Dr. Subedi, Nepal Public Health Foundation, IOM)
4:20- 4:45	Rapporteur Key Comments, Identifying the Evidence Gaps
4:45- 5:00	Closing Remarks (Dr. Adhikari/ Dr. Klemm)

March 22, 2012: Day 2

SESSION 4: IDENTIFYING, DEFINING, MEASURING LINKAGES AND EVIDENCE GAPS

9:30-9:45	Objectives for Day 2 (Dr. Keith West & Dr. Sharad Onta)
9:45-12:15	Agriculture-Nutrition Pathway: Research Gaps in the Nepal Context (General Discussion, Moderators: Dr. Keith West & Dr. Sharad Onta)
12:15-12:20	Closing Remarks (Dr. Patrick Webb)
12:20-12:30	Vote of Thanks (Dr. Sharad Onta)
12:30-1:30	Lunch
1:30	Meeting Adjourned

Opening

Dr. Sharad Onta, the Dean of Community Medicine and Public Health at the Institute of Medicine, co-host for the event, opened the Nutrition CRSP's **"Nepal Agriculture, Food Security and Nutrition in Nepal: Taking Stock and Defining Priorities"** symposium by setting forth the purpose for the symposium. The aim, Dr. Onta stated was to review evidence and assess research gaps relating agriculture, markets, household food security and ultimately nutrition status. Through this, Dr. Onta stated that the Symposium would serve as a platform to map future research agendas, priorities and collaborations. Dr. Onta **welcomed honorable guests and participants and then introduced Dr. Praveen Mishra**, the Secretary of the Ministry of Health and Planning (MoHP).



In his opening remarks, Dr. Praveen Mishra, Secretary, MoHP, stated that the components of farm to health and fitness need to be explored in a time, cost and resource-effective manner. He also pointed out the need to identify and access the mechanism of food source, flow and trends of availability throughout the country.

Next, Mr. David Atteberry, USAID Mission Director provided opening remarks on USAID's efforts and commitment to a multi-sectoral, integrated approach to address food insecurity and malnutrition. According to Mr. Atteberry, agriculture, food security and nutrition are the top three foreign assistance priorities of the United States Government. He emphasized a clear intersection across development sectors to achieve better and accelerated results. He also noted gaps in our understanding of the relationships between agricultural production, consumption, market access and nutrition outcomes, and the need to fill these gaps, especially in light of USAID's flagship program, Feed the Future, which seeks to improve agricultural production, income generation and health and nutrition educational activities to decrease hunger and poverty. A research agenda to better elucidate the agriculture-nutrition link, he emphasized, is part of this new program. Atteberry noted key USAID investments in Nepal's efforts to improve nutrition through agriculture, including the Svaahara Program which will commence implementation later in 2012, the Global Agriculture and Food Security Program (GAFSP), managed by the World Bank, and a Nepal-based 'Feed the Future' program. He lauded the GON's commitment towards multi-sectoral planning as evidenced by the National Planning Committee's formation of a joint food security and nutrition steering committee and its Multi-Sectoral Nutrition Plan. He stressed the importance of research to inform evidence-based programming. He encouraged a multi-disciplinary research spanning technical areas of public health, social sciences, economics, and agriculture to collectively study the relationship between malnutrition and food production and create



innovative methods and solutions to address multi-faceted problem. He concluded by challenging the participants to remove their “technical hats” and step outside of their technical silos to find innovative ways to solve this persistent and significant global public health problem.



Following Mr. Atteberry’s speech, Dr. Rolf Klemm, of the Johns Hopkins Bloomberg School of Public Health, gave the keynote address. Details of his talk are found in the next section. The Honorable Member of the National Planning Committee (NPC) and Chief Guest, Dr. Shiva Kumar Rai, officially inaugurated and declared the Scientific Symposium open. He welcomed all participants and reiterated the importance of evidence as a basis for informing government policy. He expressed the GON’s commitment to a multi-sectoral approach to address malnutrition and food security in the country. He reminded participants about the importance of integrity while conducting and publishing research and the need to be vigilant of researchers falsifying results for their own professional advancement. He rallied for researchers to continue in their efforts while fulfilling all ethical obligations to their subjects and the larger research, program and political communities.

Symposium Keynote Address: Role of Evidence in Leveraging Agriculture for Improved Health and Nutrition

Background

Nepal is a food deficit, land-locked country of ~30 million people, with high levels of undernutrition in women and children. Recent estimates have shown a decline in stunting prevalence among children under five years of age from 49% in 2006 to 41% in 2011 (DHS, 2011), but aggregate rates mask differences across regions, socio-economic or caste strata. Childhood stunting remains highest among rural children residing in mountains and hill districts, which also have the highest rates of food insecurity (FAO, Assessment of food Security and Nutrition Situation in Nepal, 2010).

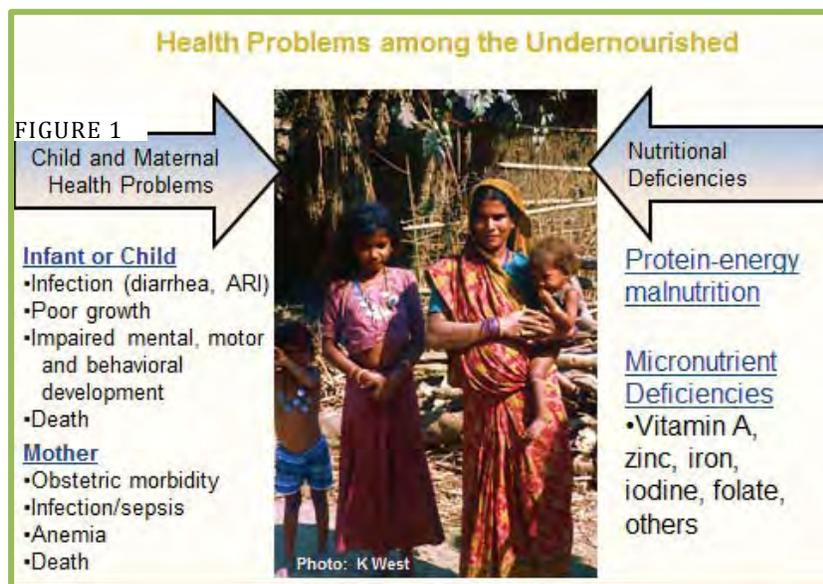
The causes of poor maternal and young child nutrition are multifaceted and are generally age-specific. At birth, infant weight and length are determined by maternal factors—including nutrition—and gestational age, i.e. whether the infant is full term. However, from about six months through two years of age infant feeding practices, particularly breastfeeding and complementary feeding practices, along with exposure to infectious disease appear to be the main influences on growth. Studies conducted in poor populations indicate that this is also the period when growth failure and nutritional stress are greatest.

Among undernourished young children poor nutrition is associated with increased mortality, higher incidence and greater severity of infection, suppressed immune-competence, and delayed motor and cognitive development (Figure 1). Suboptimal nutrition in early life often leads to

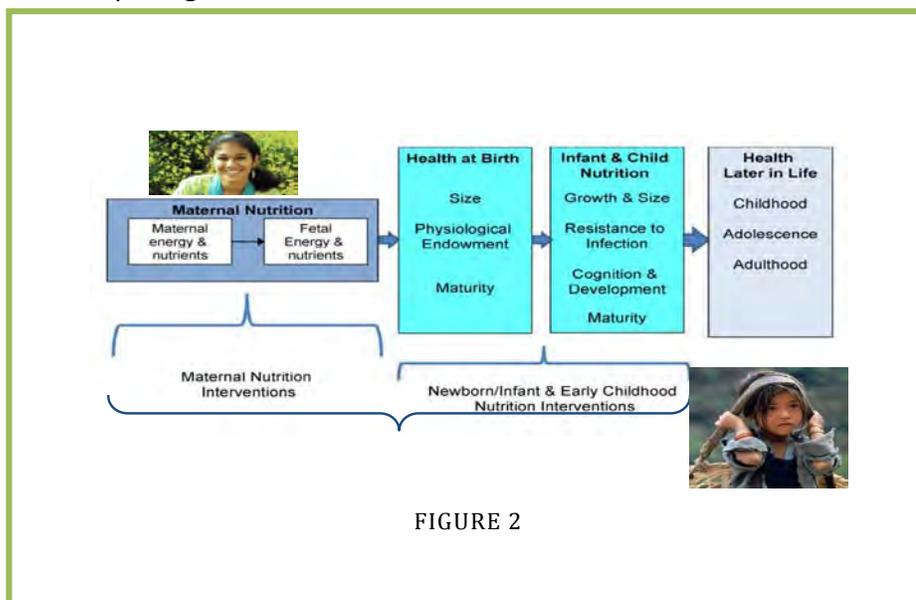
permanent small size in adulthood, and increases a woman's risk of complications during childbirth and delivering a small baby, thus perpetuating poor growth into the next generation. Among undernourished women, risks for obstetric morbidity and delivery complications are higher, as is infection, anemia and risk of death.

Early life nutrition—Influence on lifelong health

The effects of early life nutrition are known to have lifelong influences on health (Figure 2). A woman's nutritional status at the start of and during her pregnancy influences the nutrients available to be transferred to her fetus and fetal growth. It is well known that deficiency in



iodine and consequent thyroid hormone production during critical periods of organogenesis can damage the brain and nervous tissue of the developing fetus, causing irreversible mental retardation and other developmental abnormalities. Inadequate weight gain during pregnancy can influence the baby's size at birth and other deficiencies compromise the physiologic endowment and maturity of the infant at birth. During early infancy and childhood, inadequate dietary intakes of the mother and infant affect the young child's growth, ability to resist and fight infection and cognitive development. Each of these, in turn, can affect the child into his school years and adult life. The period from conception through an infant's first two years of life represents a critical window of opportunity to prevent the lifelong consequences of malnutrition. This period is known as the "First 1000 days" and evidence suggests that once this window of opportunity closes, it is difficult, if not impossible, to reverse the negative consequences of poor growth and nutrition.



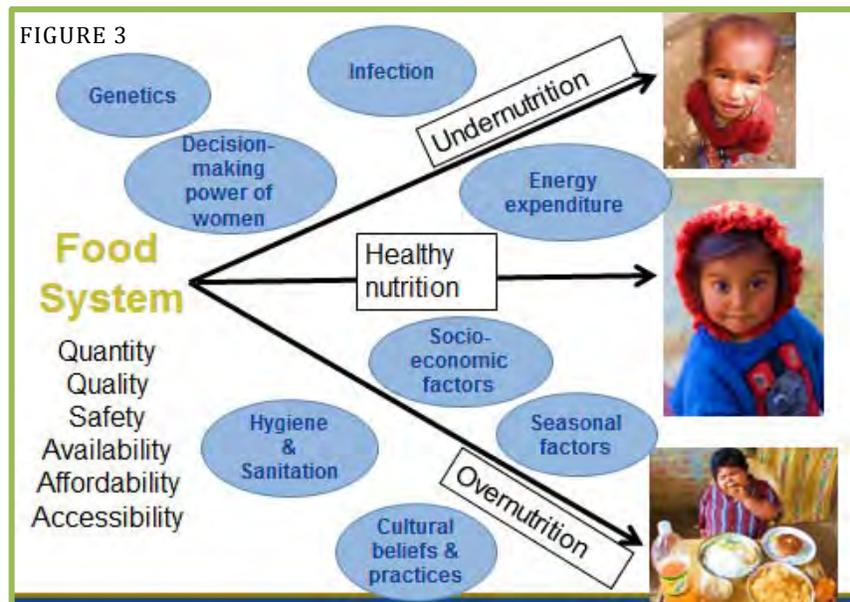
Essential Nutrient Facts

Much has been learned about essential nutrients since the first vitamin was identified almost 100 years ago, but this knowledge is often underappreciated. Micronutrients, such as vitamin A, iron, zinc, iodine and others, cannot be produced by the body, so they must be provided through the diet. These nutrients perform millions of functions in the trillions of cells in the human body. They serve as co-enzymes, regulate metabolism, are involved with oxygen transport and cellular respiration, play an active role in the immune system, and are critical for functions in virtually all cells, all of the trillions of cells that make up the human body.

Alignment of the Food System with Nutritional Outcomes

Agriculture, nutrition and health are interrelated. Producing and consuming adequate amounts and kinds of food promote healthy nutrition. In reality, however, food production and consumption patterns vary widely, and are often not well aligned and can work at cross-purposes. When food systems are aligned with nutritional needs in terms of the amount, quality, safety, availability, affordability and accessibility, they can

contribute significantly to the production of a nutritionally healthy population (Figure 3). When food systems are misaligned with nutritional needs of a population they can significantly influence the rates of under and overnutrition. Of course, the food system operates in a context where cultural, socioeconomic and other factors also influence health and nutrition, and where these factors can positively or negatively interact with the food system to influence the population's nutrition and health. So understanding both the food system and the context in which it operates is vital for understanding what parts of the food system should be reshaped to better improve nutritional well-being.



Nepal: The Agriculture-Nutrition Connection

In Nepal, considerable progress has been made in reducing poverty, increasing productivity, and reducing stunting in children in the past 5 to 10 years. However, wasting prevalence or abnormal thinness among children has increased. Disaggregating national estimates reveal important and impressive reductions in childhood stunting—that is, children being abnormally short for their age—across all ecological zones, ranging from a low of 14.7% in mountain districts to a high of 17.2% in the Terai (Figure 4). But stunting prevalence remains at high levels in all three ecological zones. A different picture emerges with respect to wasting prevalence. The Terai has shown major reductions in childhood wasting; but wasting has significantly increased in the hills and mountain districts. Large disparities in both stunting and wasting rates remain by wealth quintile. Poor children are almost twice as likely to be stunted and wasted compared with their wealthier counterparts.

Much less is known about the changes that have occurred with respect to micronutrient deficiencies in Nepal over the past 5 to 10 years. The latest DHS shows little overall change in anemia prevalence among pregnant women and children, with steep increases among women in the hills and mountains. Research published by NNIPS in Sarlahi reveals that micronutrient

deficiencies are common, concurrent and vary by season among rural Nepalese pregnant women (Jiang T et al, J Nutr. 2005).

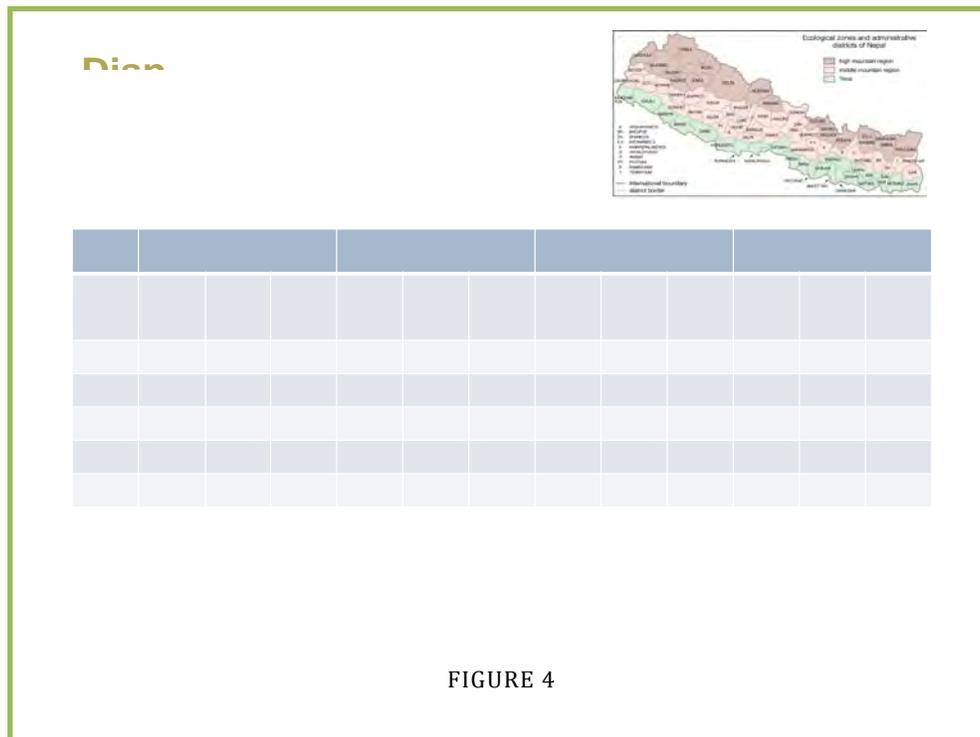


FIGURE 4

New opportunities to refocus agriculture to achieve better nutrition and health outcomes

While Nepal's progress has been commendable, it still faces enormous challenges related to food security and malnutrition. It also faces many opportunities with the resurgence of interest and investment in agriculture and start of new programs like USAID's Suaahara project which is, by design, attempting to integrate nutrition and agriculture interventions.

A major question is how to use these new opportunities to refocus and realign agriculture to improve nutrition and health among women and young children. Several broad steps are needed:

- identify and fill knowledge gaps
- ensure that agriculture, health and nutrition sectors do not work at cross-purposes
- proactively find and scale up innovative approaches within appropriate contexts, and
- create an enabling environment for cross-disciplinary collaboration and cooperation

Pathways of impact of agricultural interventions on nutrition

Agriculture can work through several key pathways to impact nutritional outcomes (Figure 5). The most direct pathway is producing food for household consumption. The second is through increased household income through the sale of food produced or wages from farm labor. A third pathway is through agricultural policies that affect food prices. A fourth pathway is how income obtained from agricultural production or labor is spent. And a final pathway is through the implications that the increasing role of women as agricultural laborers has on: (i) their

ability to influence decision-making regarding nutrition and health in the home; (ii) time to care for their children; and (iii) impact on their own health.

Over the past 40 to 50 years, much has been learned about how agricultural interventions do or do not influence nutrition. The Green Revolution of the 1960s and 70s focused on increasing food production and agricultural productivity through improved seed varieties, agricultural

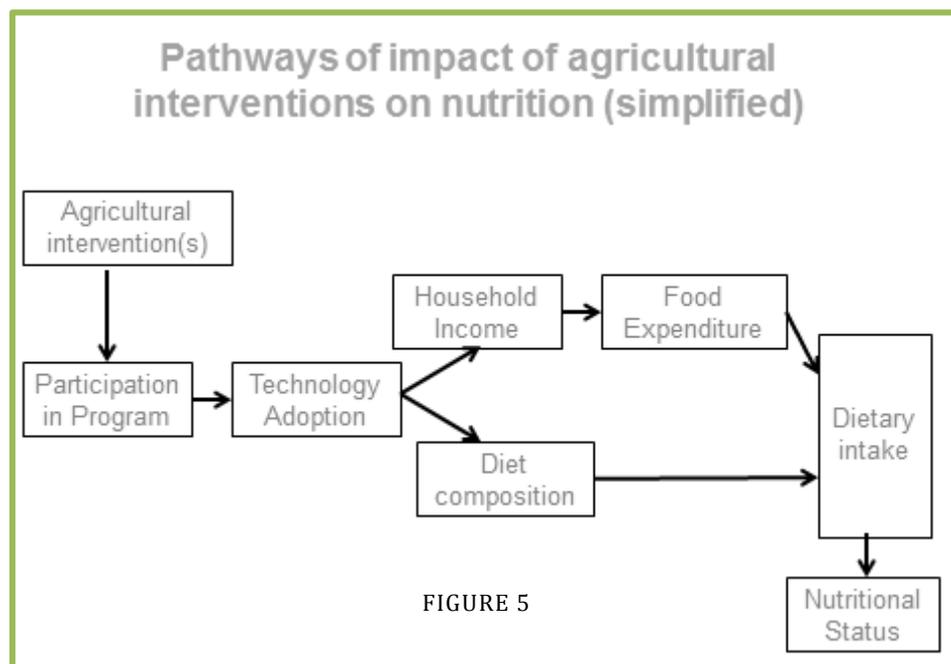
extension and irrigation projects.

While these efforts increased cereal production, they ignored distributional issues and non-cereal crops, and therefore were insufficient to eliminate undernutrition because the poorest did not have access to both an adequate quantity and quality of food. From the late 1970's, especially after Amartya Sen's work on causes of famine in 1981, malnutrition was linked to food security, and the focus shifted toward increasing incomes and livelihoods rather than food production. But increases in income did not immediately translate to increased caloric consumption or improved dietary quality. This realization inspired a new wave of research that aimed to address both issues at the same time. Projects such as dairy development, and the promotion of vegetable gardens, fisheries and livestock, aimed to increase incomes of the poor and increase availability and access to nutritious foods. These interventions were the focus of a recently completed systematic review.

Department for International Development (DFID) Systematic review

DFID commissioned a systematic review of agricultural interventions that assessed the impact of potential "win-win" agricultural interventions that aimed to improve children's nutritional status by improving BOTH the incomes AND diets of the rural poor. Previous reviews on the same subject found mixed results or no impact of agricultural interventions on nutritional status. This review built on and expanded previous reviews by covering the period of 1990 to 2010.

The key conclusion offered by the authors of this review stated, "We attribute the lack of impact of agricultural interventions on child nutrition to methodological weaknesses of the studies reviewed rather than specific characteristics of these interventions." In other words, the



authors concluded that weak study designs and measurement issues were responsible for the inconclusive evidence. Thus, the question of whether agricultural interventions have a positive impact on the nutritional status of children remains unanswered.

The review highlighted four methodological weaknesses of studies linking agriculture to child nutrition status: (1) the lack of a credible counterfactual; (2) the use of inadequate and often incomparable metrics; (3) the lack of data on participation rates or characteristics of participants of agricultural interventions; and (4) the lack of statistical power to determine an impact on child nutritional status. These weaknesses are briefly discussed below:

1. **Lack of a credible counterfactual.** A major methodological weakness which led to 90% of studies being excluded from the review was the lack of a credible counterfactual. A counterfactual enables the estimation of effects that would have occurred if the intervention had not been implemented. Credible comparison groups are necessary to estimate effects that can be attributed to an intervention. Thus, when measuring the impact of an agricultural program on a nutritional (or other) outcome, an appropriate counterfactual is needed so that the observed impact can be attributed to the intervention, and one can rule out other factors that might have had an independent effect on the outcome.

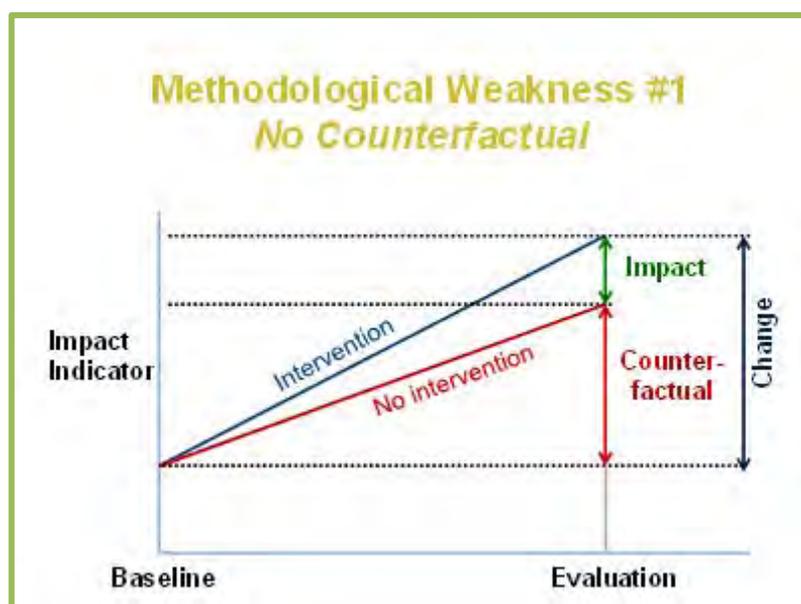


FIGURE 6

2. **Inadequate and non-comparable metrics.** A second methodological weakness cited by the review is related to the measurements taken or not taken, their validity and their comparability across studies—particularly measurement of changes in income and diet related to agricultural interventions. For example, studies may capture income from home

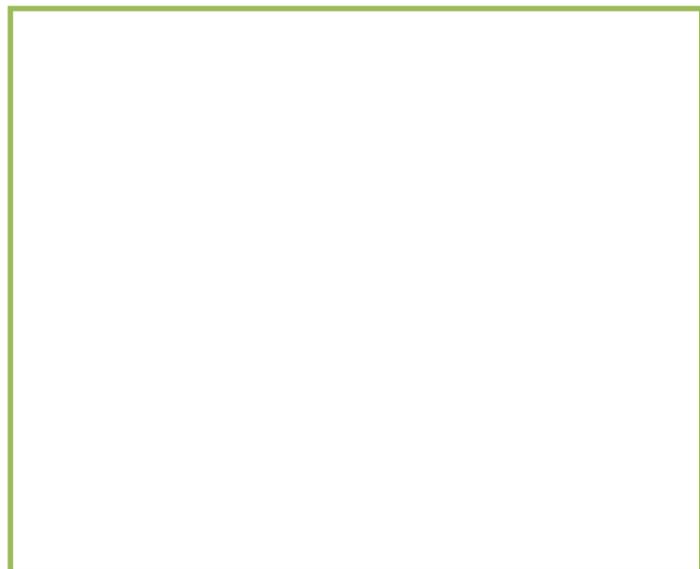
gardening or on cash income from sales of food items promoted by the agricultural intervention. But these can be very imprecise measures of income because people may invest more time and labor in this income stream, while decreasing income from another source. Thus, without measuring total household income, one cannot estimate the overall impact of the intervention on household income and food expenditure.

Similarly, programs measure impact on diet differently. Some use consumption of food items specifically promoted by the intervention, but this also ignores the potential of a “substitution effect.” So it is important that studies focus on indicators of dietary consumption that look at the whole diet. In addition, some programs measure household expenditure on food and still others measure the quantity of foods consumed although they may use different methods (24 hour food recall, semi-quantitative food frequencies), different recall periods (past day, past week, past month), and report consumption frequency differently (e.g. yes/no, consumption compared to a cut-off, or by using a dietary diversity index).

Valid and comparable indicators are needed in order to assess the impact of agricultural interventions on nutritional outcomes across studies.

3. **Data lacking on participant rates and characteristics.** The review also cited the lack of data on participation rates or characteristics of participants in the agricultural interventions as a weakness. Agricultural interventions are often targeted at specific population groups or attract individuals with specific characteristics—typically, the poor or the very poor participate in these programs, or those with access to land and perhaps water. Because these groups have baseline or pre-intervention characteristics, including nutritional status, which differ from those in the general population, they cannot be compared to the general population. The lack of data on participation rates and characteristics of participants compromises our ability to: (1) assess the impact of interventions on specific vulnerable groups; (2) assess the targeting efficiency of interventions; (3) understand who does and who does not participate in the intervention; and (4) whether the intervention impact depends on or is modified by the characteristics of the participants.

Studies should make an effort to collect data on both participants and non-participants in the intervention and comparison groups to assess selection and participant bias and to investigate the determinants of participation and the impact of the intervention across vulnerable



groups.

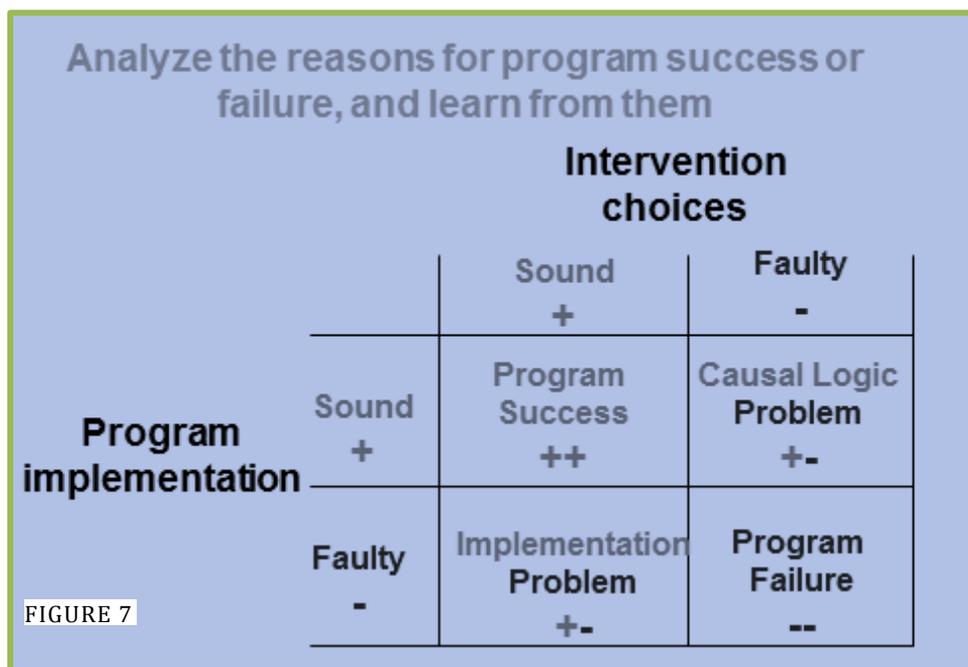
4. **Studies were underpowered.** Another methodological weakness identified by the review was the lack of power—in a statistical sense—to detect a nutritional impact if one existed. Statistical power is largely determined by sample size and the size of the impact one hopes to detect. Among the studies reviewed, the average power to detect small (i.e. 2%), medium (i.e. 10%) and large (i.e. 30%) differences in stunting prevalence was only 4%, 15% and 51%, respectively. Therefore, future studies should be designed to be sufficiently powered to detect nutritional impact of agricultural interventions.

A way forward?

- *Fill information gaps.* For Nepal and other countries to design the most effective policies and programs, more needs to be learned about how much and what are the types or mixes of agricultural interventions are best for nutrition and health. For example, should Nepal invest in staple crops, high-value crops or livestock? What types of agricultural interventions will improve the consumption of a diverse and adequate diet, especially among vulnerable groups? What conditional factors, such as land ownership, caste, education, women's status, market structures, and rural infrastructure, do the most to leverage agricultural growth for better nutrition and health of women and children? There is an urgent need to fill this gap in knowledge.
- *Prioritize researchable questions.* Filling every gap in knowledge immediately is not possible; thus, there is a need to prioritize researchable questions that will have the greatest potential to inform policies and programs, especially in the hill and mountain districts where child undernutrition rates are the highest.
- *Create an enabling environment for “integrated” cross-disciplinary research.* Models for successful research that bridge single sector perspectives are needed. Researchers across sectors need to become conversant in each other's professional language, and incentives may be needed to foster cross-sectoral research.
- *Identify and or create metrics that bridge the ag-nut pathway.* There is a need to identify, create and use valid measures that have utility across the domains and sectors along the agriculture-to-nutrition continuum. For example, in public health the outcomes we are concerned with are nutritional status, morbidity, mortality and increasingly child development. Important agricultural outcomes include productivity, agricultural growth, income and returns on investments. Are there ways to bridge these two paradigms, and
- *Identify a set of indicators that are both valid and feasible to collect under field conditions?*
- *Disseminate results and lessons learned across disciplines so that innovative approaches can be taken to scale in appropriate contexts.* Ways to disseminate results quickly and broadly across disciplines and sectors are needed. Mechanisms need to be created to do this. Public health nutrition symposia rarely attract agriculturalists or economists and vice versa. New

platforms and forums for information and idea exchange and collaboration are needed.

- *Embrace failure and success and learn from them.* Finally, as cross-disciplinary research that aims to illuminate the pathways by which agriculture impacts on nutritional outcomes is conducted, there is a need to embrace both failure and success. Program successes and failures need a post-mortem to understand why, among whom and in what conditions the interventions succeeded or failed (Figure 7). If the choice of agricultural interventions addresses the major causes of inadequate dietary intake and if they are implemented well, one would expect to see improvements in nutritional status. If the desired outcomes are not achieved, the basis for intervention choices as well as the adequacy of program implementation must be reviewed. Was the implementation choice correct? Was implementation adequate in terms of coverage, quality and reaching those at greatest risk? Were the study designs used to measure program implementation and outcomes adequate? Did the intervention choices truly address an important underlying determinant of maternal and/or child undernutrition. Adequate and robust study designs and implementation are needed to assess if, and what kinds of, investments in agriculture and food-based strategies effectively achieve significant and accelerated reductions in maternal and child undernutrition at scale, over and above nutrition and health interventions.



Session 1

Agriculture to Market

Session 1 focused on research that explored the link between ‘agriculture to market’ and factors that influenced agricultural production and market availability. Although agricultural (food) production is considered a direct pathway for household consumption, there exist

several key intermediate pathways or factors that impact nutritional outcomes at the household level. One intermediate pathway is through increased food production, which may increase household income through the sale of food produced or wages from farm labor. Findings addressing this intermediate pathway presented in Session 1 were:

- increased homestead and off-season food production and the use of improved technology increased food availability and household food consumption;
- health and nutrition training when linked with agriculture results increased household nutrition in terms of calorie and protein intake and change in health behavior;
- improved nutritional outcomes through agriculture are possible when interventions from multiple sectors are integrated such as a coordinated approach of nutrition; awareness and behavior-change training with agricultural production and/or income generation activities ;
- research that measures the effects of each these interventions alone versus in combination on nutrition outcomes over a significant period of time is limited.

Dr. Gauchan, from the Nepal Agricultural Research Council (NARC), presented an overview of Nepal's agro-economy and insights on the role of agriculture in food security and nutrition in Nepal in his session-specific keynote talk. He stated that Nepal's rural agrarian economy makes agriculture the main source of income and employment, and thus is a primary contributor to the livelihood of Nepali people. It is a key driver of food consumption patterns in both rural and urban areas and an essential factor for food security and nutrition by virtue of being both a

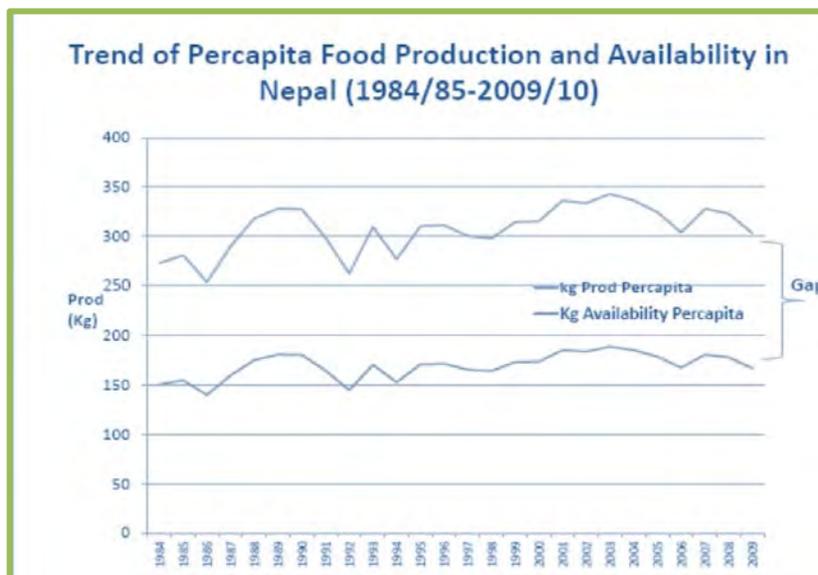


FIGURE 8

despite the linkages between food production and food availability, gaps in this pathway exist. Agricultural productivity in Nepal is lower than the country's potential productivity as indicated by a report on pulse production presented by Mr. Neupane. The report states that the national average of pulse production is less than half of pulse production potential.

source of food and income. Agricultural production also influences the fluctuations in food prices which influences household food security. In theory, increased food production may increase market supply and, in turn, increase home consumption. But in practice, significant amounts of food and/or the nutrient value of those foods are displaced by the time it is available for individual consumption. Therefore,

A major reason for food insecurity in Nepal is the limited investment in agriculture and agricultural research. Also, small land plots and the use of non-commercialized farming methods, especially among poorer farmers, contribute to low food production. Households



often sell their produce for income instead of consuming it; however, a major portion of farmers' incomes are ultimately spent on food purchases. Other constraints of optimal production are poor access to improved seeds and a lack of farmers' knowledge on utilization of improved technologies, limited land area with minimal output, crop diseases, pests, poor post-harvests as well as limited market options.

Due to the geographical diversity in Nepal, seasonality is an important factor influencing food availability and market prices. During lean months (i.e. May to September) poor households are most vulnerable and suffer from higher rates of undernutrition. Climate changes (rainfall variability, temperature and increased incidence of diseases and pests) further drive up rates of undernutrition among vulnerable groups in this times window. Interventions such as homestead food production, the promotion and use of improved technology, commercial farming and infrastructure development (all of which were discussed during Session 1) have been shown to stabilize market variability and price. Dr. Gauchan recommended strengthening efforts to ensure year-round availability of nutrient rich foods, and the need for expanding the use of technologies such as off-season food production of vegetables, breeding nutrient-rich crop varieties, fortification during food processing, technology for detecting food contaminants, improving the shelf life of processed food products, technology for reducing drudgery and post-harvest handling losses. However, he acknowledged the lack of data definitively linking these approaches to improvements in agriculture production and food availability at the household levels.

Ram Krishna Neupane, from FORWARD Nepal, reported on a study showing that legume production and household legume consumption can be increased using interventions that combine wilt resistant/tolerant varieties of legumes, crop rotation, seed dressing with fungicide along with capacity building of legume growers (through training, regular visits, workshops and awareness raising). He suggested that access to improved seeds and knowledge at the local level is important to contribute to increased productivity. Although his research findings showed an increase in pulse consumption, the overall impact on total household diet or nutritional status of household members was not measured. He noted that most of the income generated by increased pulse production was spent on improving soil quality and the household's personal health expenses. He also speculated that nutritional status might be improved if the increased pulse consumption added to the overall diet of household members and/or replaced foods of lesser nutritional value.

Dr. Luke Covalito presented findings from the Smallholder Irrigation Market Initiative (SIMI). He noted that this project increased small landholder incomes, health and nutrition through training and the creation of value chains. Key features of SIMI included access to micro irrigation, improved technologies, multiple-use piped water systems, and the development of smallholder commercial pockets. The use of training methodology called the Participatory Learning Approach (PLA), which includes literacy embedded with health nutrition training, was considered especially important in improving participants' health and nutrition. The project reported that 15% of vegetables produced by households were consumed by the household members, although further research is warranted to establish if and to what extent minimum nutrient requirements are met given such consumption levels. Dr. Covalito noted the cost benefits of combining agriculture, health and nutrition training, and recommended further research to better understand how behavior changes due to income generation impact on food and nutrition. He noted that targeting interventions to clusters of the poorest households is likely to achieve better results.



Joe Sanders from USAID's Nepal Flood Recovery Program explained that integrated interventions across sectors like commercial agriculture, nutrition, and infrastructure can have an impact on the food security of rural people. In his presentation, he stated that without understanding targeted farmers' economic situations, landholding size, and potential as producers, food security programmatic interventions may not be very effective. In addition to traditional farming practices, a side-by-side investment in improved technologies, inputs and agronomic practices are required to increase output, farmers' capital base and longer term sustainability of such outcomes, stated Sanders. Such investments would also affect local value chains, and the incorporation of nutrition education and behavior change training could have impacts on household food security overall. He noted that the majority of food insecure households are small landholders so, these would be appropriate target groups. The impact of commercial farming on household food security is not well studied in Nepal.

During Session 1, in general, barriers to link agriculture to market were identified and suggestions were made. Poor road connectivity and infrastructure, inefficient small-scale and scattered production, lack of market information, and high post-harvest losses are many of the barriers that exist between food production and availability. Valid testing is required to identify whether those barriers specifically lie in the pathway contributing to poor nutritional outcomes. It was reported that targeted investments in productive infrastructure should be made in order to achieve substantial improvements in agricultural production and commercialization. Potential actors in the pathway of agriculture to market such as retailers, local traders, agro-processors, exporters and others should be carefully examined for their contribution to farmers' economy, food availability and food market stability. It is still not clear whether

Nepal's current agricultural policies support the sustainability of approaches to improve production and whether they facilitate farmer/market linkages. International trade and liberalization of food markets as well as expansion of food retail, food processing and marketing industries are believed to help link agriculture to market, therefore, should be considerations while designing studies.

There are still many knowledge gaps in our understanding of how to reshape agriculture to improve nutritional outcomes. There are not valid reports to describe how income from agriculture production is being spent and how and to what extent this impacts household consumption of nutritious foods. Relationships between increased production and increased market availability and improved household food security and nutrition need to be validated.



Time was allocated for questions and answers between the audience and presenters following Session 1. The audience challenged the panel by asking whether increased production and consumption of legumes potentially displaces consumption of other staple foods and what truly was the cost-effectiveness of linking agriculture to nutrition. Given Nepal's limited resources, the panel urged the audience to think of how to best apply limited resources for optimal returns. Studies need to focus on the comparison between grow-to-eat versus grow-to-market to see which one is more contributory to improved food production and nutritional health. It is also important to identify demand versus supply patterns as well as what is actually consumption versus market availability. In terms of nutrition, farmers tend to sell produce not consume what they grow which needs to be explored in a standard design for its impact on nutrition.

It was suggested during the discussion to explore whether nutrition education to mothers best associated with changes in behavior actually have an impact on nutrition outcomes. Post-harvest nutrient losses are another area that the audience probed. At the end of Session 1, the speakers and audiences expressed their thoughts on crop protection from insects, post-harvest food preservation, anti-nutrient factors, development of rural markets to improve food security and nutrition, a strategy of multi-sectoral and inter-disciplinary intervention combining

agriculture, nutrition and health, and the need for more inclusive agricultural growth targeted with nutrition interventions that empower women and target disadvantaged groups.

Session 2

Linking Food Markets and/or Home Production to Household Access

The main focus of Session 2 was household access to foods through market availability or home food production and approaches to improve linkages between agriculture and nutrition through market dynamics. The rural poor's access to foods rich in essential micronutrients such as fruits and vegetables, meat, fish, dairy products, and bio-fortified staple foods is restricted because of limited availability, economic constraints, lack of knowledge and information, and a related lack of demand for nutritious foods.

Agricultural production may help at-risk groups generate more income and help make nutritious foods more available, affordable, acceptable, and of higher quality. On its way from farm to mouth, food undergoes storage, distribution, processing and preparation processes that affect the availability, affordability, acceptability, and nutritional quality of these foods to the consumer. It is critical to analyze what happens between production and consumption because it affects the economic and nutritional value of the food product.

Session 2 started with a key note speech from Dr. Marie Ruel, who presented material on the concept of a nutrition-sensitive value chain to improve access to nutritious foods in rural markets. This type of value chain is believed to have the potential to positively impact nutrition, but the concept is in its preliminary stage and is not yet widely used. Dr. Ruel noted that micronutrient deficiency is a global problem and the poor are often the most vulnerable to these deficiencies because they lack access to diverse, nutrient-rich foods. Dr. Ruel, based on work done in Africa and Honduras, stated that using the concept of a “nutrition-sensitive value chain” can provide clues for strengthening agriculture-nutrition linkages and increasing the potential for added nutritional value along the food chain, by maximizing, conserving, or adding nutrients at key points. Identifying where the nutritive and economic values can be created in the supply side, value chain for nutrition approach can be used to increase the availability, affordability, and quality of nutritious foods. It could enhance the perception, supply and demand of nutritious foods to the poor and create the economic benefits to at-risk producers (see Figure 9). In addition to improving nutrition, this concept provides solutions to development challenges in other sectors such as in agriculture. In addition, the concept can be used to identify the problems and to design and implement solutions to increase the availability, affordability, and quality of nutritious foods.



FIGURE 10



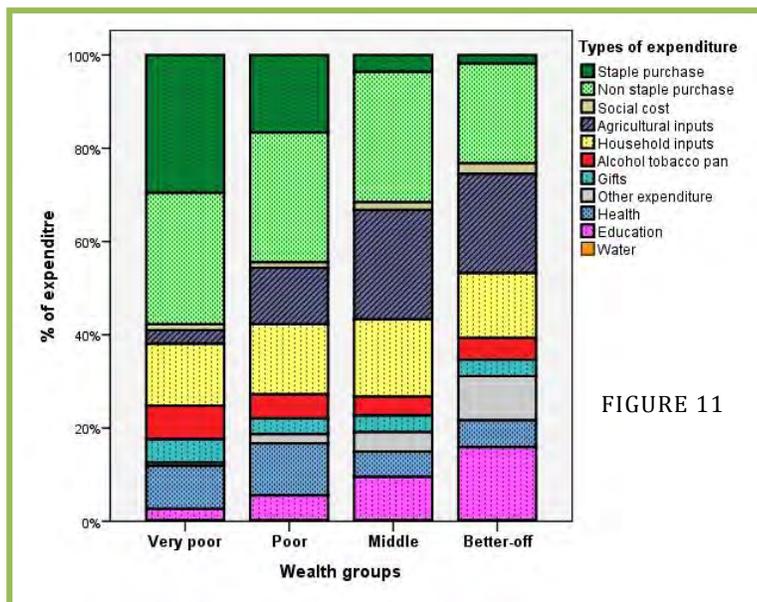


FIGURE 11

among these groups. Since women are predominantly in charge of household food preparation and distribution, targeted intervention to women’s groups could impact household behavioral changes associated with nutrition outcomes. Dr. Naomi Saville used the Household Economy Approach (HEA) to study food security and livelihood situation of different wealth

groups in Terai. Interviews and market surveys completed in this study indicated that household expenditure increases with wealth groups, and the poor spend more in food and less in

agriculture inputs and education. Staple crop production contributes more towards the source of food consumption to the higher wealth groups (Figure 10, Figure 11). The poor depend on labor exchange to fulfill their calorie requirement. Thus the poor are more likely to work to afford food and their lack of agricultural out is either due to the lack of knowledge or resources leading to limited food production and food security.

In addition to social and cultural diversity, diverse ecological variability in Nepal affects food production, availability and consumption patterns among various population groups in different regions. This causes more variability in food security and makes food security monitoring complex and challenging. Mariko Kawabata from the World Food Programme illustrated two different data collection methods to assess food security monitoring in Nepal in order to provide reliable and timely information for appropriate action to prevent human suffering from food insecurity. Data collection (especially information obtained seasonally at the village level) using the phase classification approach (which was developed based on the principles of global Integrated Food Security Phase Classification (IPC) methodology pioneered by FAO in Somalia) by the District Food Security Networks (DFSNs) was compared and validated against cross country household surveys designed to monitor food security by ecological belt or sub-region by season and year. Key food security indicators from the household data confirmed the degree of



food insecurity reported by the DFSNs providing valid tools for food security monitoring.

BP Shrestha, from Mother and Infant Research Activities (MIRA), on the other hand applied different food insecurity measurement tools in his study, namely the Household Dietary Diversity Score (HDDS), Months of Adequate Household Food Provisioning (MAHFP) and Household Food Insecurity Access Scale (HFIAS). These tools indicated that poor and Dalit (defined as lower caste) suffered the most from food insecurity. This study demonstrated that income generation either by agriculture or other means improves food security.

Community development programs like Action Against Malnutrition Through Agriculture (AAMA) have shown positive results in

terms of income generation, micronutrient-rich food availability and knowledge of health and nutrition that have improved mothers' and young children's nutritional status. Essential Nutrition Actions (breastfeeding, complementary feeding, maternal nutrition, nutrition for sick child, micronutrient deficiencies), homestead food production (Village Model Farms, home gardens and poultry), behavior change communication (counseling



and negotiations skill, IEC(flip chart, counseling card, poster, etc.) are some of the strategies that AAMA implemented in the Far Western regions of the country. Debendra Adhikari reported that these strategies have improved home food production and increased knowledge of appropriate infant feeding requirements leading to improved infant feeding practices.

Poverty appears to be a key determinant of household food access. Upon income generation, people tend to spend more on nutritious foods. However, during the question/answer session, participants expressed their concern about maintenance of food quality throughout the supply chain. The audience noted that people prefer to eat what they have traditionally been eating and changing dietary habits can be challenging. People in Nepal seem to be more receptive to eating more nutritious raw food preparations rather than processed foods. However, it is important to generate evidence to determine which aspects of behavior change are effective in improving dietary habits. The farmer's instinct is to grow to sell. No or limited landholdings of the poor is an issue for the creation of home gardens. The most food insecure households are often those with no or little land or other resources required for agricultural production; thus, promoting only agricultural interventions is not adequate. Nonetheless, agriculture is the main mechanism to increase income as there are no other job opportunities in the rural areas.

Session 3

Household Availability, Access and Use to Dietary Intake and Nutrition and Health Outcomes of Women and Young Children

The important part of the agriculture-to-nutrition pathway is to explore how downstream processes, such as agricultural production, market access and affordability, and household food availability, influence dietary intake and nutrition and health outcomes in women and young children. Understanding the food supply system—from production to consumption—enables one to explore the points in the system that influence the amount, quality, safety, availability, affordability and accessibility of foods, and ultimately, the nutritional health of a specific target group. Of course, a food system operates within a context of cultural, socioeconomic and other factors that also influence health and nutrition. These factors can positively or negatively interact with the food system to influence the population's nutrition and health. Thus, understanding the context in which it operates is vital for understanding what elements of the food system should be reshaped to better improve nutritional well-being.

Dr. RK Adhikari in his keynote speech highlighted the double burden of the nutritional problems in Nepal reflected by indicators of undernutrition (i.e. low birth weight, stunting, underweight, wasting and iron deficiency anemia) and also overnutrition (i.e. overweight and obesity). The 2011 DHS shows an improvement in maternal nutrition and a slight decline in the prevalence of stunting and underweight in children, however, wasting rates remained almost static since 2006. Despite improvements in several maternal and child nutrition status indicators, rates of undernutrition remain alarmingly high in Nepal. For example, the prevalence of anemia in women and children is still 35% and 46% respectively. Iodine deficiency in high mountain areas persists although households using iodized salt in other parts of the country have low levels of iodine deficiency. Breastfeeding is universal and breastfeeding practices have improved significantly. But poor maternal nutrition status and inappropriate complementary feeding practices continue to contribute to poor growth and development in Nepali children. Moreover, seasonality, work load of mothers, gastrointestinal infection, intra-household food distribution and food given to children also influence the nutritional status of mothers and children.

As mentioned earlier, dietary habits also play a major role of dietary intake and risk of undernutrition. Feeding practices differ across communities due to differences in culture, knowledge level and socio-economic status. Over-dependence on cereal foods, without nutrient-dense foods, can lead to high rates of micronutrient deficiencies. For example, Dr. Peter Anderson mentioned that pulse consumption contributes less than 3% to total calorie intake while rice consumption contributes more than 63%. Pulses are a good source of micronutrients like vitamin B2, folate, calcium, potassium and iron; declines in pulse consumption may be contributing to low intakes of foods rich in essential minerals and



vitamins. Dr. Anderson's presented data showing a decline in pulse consumption in South Asia, and modeled the impact of increasing pulse consumption on improving nutrient intake. The models showed that adding 30 g of rice-bean intake to the diet would substantially increase folate intake, as well as lysine, Ca, K, Fe and other B-vitamins. Dr. Anderson recommended promoting pulse intake, along with fortification of staples, to improve the micronutrient intake of the population.

Neena Joshi, of Heifer International (HI), provided preliminary evidence showing that community development interventions can improve the livelihood of poor and undernourished communities. HI uses a comprehensive approach that provides households with small animals, mentors them to increase income and asset ownership, trains them on saving and lending schemes, and provides health and nutrition education. Preliminary results from an HI study showed improvements in children's weight and height in the Terai but not in the hills. However, the study design and duration were not adequate to evoke causal attribution to the program. HI is currently conducting a long term follow-up of the project's beneficiaries, and will report on their findings in the future.

Dr. Keith West, from Johns Hopkins School of Public Health, summarized an extensive body of evidence on nutrition status and interventions contributed by the Nepal Nutrition Intervention Project Sarlahi (NNIPS), which has been operating in Nepal since 1987. NNIPS has completed numerous randomized controlled trials (RCT) to evaluate the impact of nutritional interventions. The first of these, NNIPS-1, showed that preschool vitamin A supplementation reduced child mortality by 30%. This was followed by NNIPS-2, which showed that weekly vitamin A or β -carotene reduced maternal mortality by ~40%. NNIPS-3 showed that maternal iron and folic acid supplementation improved birth, anemia, and infant and child survival. NNIPS-4 evaluated the effects of daily iron/folic acid and/or zinc on mortality. Finally, the NNIPS cohort follow-ups assessed the long-term health effects of micronutrient interventions. These studies also provided data showing that multiple micronutrient deficiencies co-exist among women in rural Nepal and the supplementation trials improved health, function and survival among the most vulnerable groups such as infants, children and women. The NNIPS studies also revealed important household behavior and economic influences on diets and health risks of children. Women's employment and access to cash was found to be a critical factor in raising effective demand for a more nutritious diet. NNIPS studies have also shown that early initiation of breastfeeding reduce infant mortality, that dietary adequacy in children depend on with whom they eat meals and, this in turn, can markedly influence diet and nutritional status. NNIPS findings confirmed that providing an income accompanied with health and nutrition education can improve household nutrition. The NNIPS studies have provided a wealth of evidence-based results that have and can continue to inform nutrition and public health policy and program decisions in Nepal.

The discussion following Session 3 presentations noted the lack of randomized trials using foods rather than supplements to evaluate food-based interventions on nutritional outcomes. Recommendations from the discussion were to evaluate the role of bio-fortification on nutrient intake and status, the effects of household behavior change on nutrition, and the risks of the environmental exposures (such as aflatoxin and pollution) on growth and nutritional well-being.

Participants recommended future research in Nepal should use only validated data collection and measurement tools, identify a set of common indicators that could be used in both agriculture and nutritional surveys to facilitate linkages, enable inter-sectoral “cross-talk” and improve food security monitoring. Production of staples and institutionalization of the marketing was also suggested to be an approach to fight food insecurity in Nepal. In addition, the discussion highlighted the need for research on post-harvest processes to minimize food and nutrient losses, and on feasible ways to measure indicators of household income and consumption.



Session 4

Identifying, Defining, Measuring Linkages and Evidence Gaps

Day 2 of the Symposium was a participatory discussion to elicit and prioritize research gaps, identify study design and variable measurement issues, and identify research capacity building priorities.

Priority research domains focused on:

- Improving the dietary intake (quality & quantity) of poor/malnourished women & children
- Nutritional goals in the home
- Dietary factors in the home that improve nutritional conditions
- Contextual factors that influence dietary adequacy
- Home food production, storage and processing factors that affect dietary adequacy
- Market factors that affect home food security
- Agricultural factors that affect market prices, availability, and household access

The discussion, led by Dr. Sharad Onta and Dr. Keith West, drew on national experts including NPC Member, Athmaram Pandey, Dr. Chet Raj Uprety, Dr. Hari K. Upadhyaya, Dr. Indira Sharma, Dr. Kedar P. Baral, Dr. Lucia Russo, Dr. Robin Houston, Dr. Shubh Narayan Mahato, Joe Sanders, Dr. Kirk Deardern, M.R. Maharjan, Shabnam Shivakoti, Dr. Naomi Saville, Pooja Pandey, Saba Mebrathu, Sophiya Uprety, Dr. Subarna Khatri, Dr. Y.B. Thapa and Dr. Ram Chandra Bhusal.



Research gaps were identified under each research domain. Under the first research area, ***‘improving dietary intake of poor and malnourished women and children’***, discussants identified the need for a more broad and distilled understanding of the underlying determinants of linear growth among infant and young children. While maternal nutrition, the quality and quantity of a child’s diet and infection are known to influence

linear growth, interventions addressing these factors have produced less than optimal child growth, suggesting other factors such as environmental enteropathies might mitigate the growth-enhancing effects of diet on child growth. Non-Nepal specific literature supports correlations between stunting and factors such as maternal education, improved access to healthcare, maternal health and optimal feeding behaviors [5]. But further research is needed particularly focusing on mycotoxin and other environmental exposures on gut health and their association with child growth. DHS 2011 data shows that stunting rates have decreased from 49% to 41%, and suggest that it is worth exploring these data further to identify potential factors associated with this decline. However, inequalities persist across agro-ecological zones in Nepal, where stunting prevalence rates among children residing in mountain and hill areas are 15% to 43% higher than those living in the Terai[1].

There was agreement that research efforts should focus on populations in the lower wealth quintiles, which harbor the highest rates of undernutrition. There was also agreement about the need to better understand the determinants of the high rates of anemia in women and children, and the role that food-based approaches and fortification should play in bringing down these rates. Research conducted in India has shown that iron-fortified dried milk significantly lowered the proportion of anemic children relative to controls (19.8% versus 50%) among 24 to 36 month old children[6]. Research is required to determine if a similar effect can be achieved in Nepalese children. Nepal, however, has firm evidence on the benefits of maternal iron-folic acid supplementation in decreasing overall anemia prevalence in women, improving birth weights and child cognitive function and improving child survival through 7 years of age [7-11]. These findings have been translated into policy and national programs are now in place in Nepal. Nevertheless, despite significant reduction in anemia among women, rates have stagnated over the past year and the prevalence of anemia remains at 35%. Nearly half of children under 5 (46%) are anemic despite deworming efforts and the scale up of micronutrient powder programs warranting further research.

Finally, the determinants of severe acute malnutrition (SAM), the causes of severe protein energy malnutrition (PEM) and micronutrient deficiencies among this age group were all identified as areas of focus that warranted a better understanding.

Another pertinent point of discussion under this research domain was the need for further examination of the interplay between nutrition and infection (including enteropathies). Animal and human research suggests that when confronted by incessant microbial challenge, nutrients may be channeled to mobilize a near-continuous immune response at the expense of growth. Further research is needed in this area.

In addition to the immediate consequences of undernutrition and specific micronutrient deficiencies, more work is needed to understand the long-term effects of these conditions on cognition, school outcomes and adult health. Finally, investigating intergenerational effects of poor maternal nutrition is an important research priority, especially as it relates to birth size, and subsequent infant and child malnutrition.

Under the ***‘nutritional goals in the home’*** research domain, a priority research area is defined as how communities understand and apply (or not) nutrition information and messaging at the household level. Such research requires studying the components of behavior change communication, and how each affects food-purchasing decisions and dietary behavior. Another important research gap is identifying how to overcome household information gaps in nutrition across different socio-economic, gender, ethnicity and caste groups. Similar research gaps on hygiene behavior messaging also require attention.

Discussions on the third research area—***‘Dietary factors in the home that improve nutritional conditions’***—identified the need for improving our understanding of determinants of intra-household food allocation and its relationship with dietary intake. Studies published more than 10 years ago provide evidence that eating from a shared plate and who a child shares food with, can influence the amount and quality of food a young child consumes. In addition, much remains to be learned about how commonly-used cooking and food preparation methods influence the nutrient content of cooked food. Both of these areas warrant more research [12, 13].

The importance of understanding the gender gap and discriminatory practices that exist at the household and community level that ultimately have bearing on nutrition outcomes was highlighted under the ***‘contextual factors that influence dietary adequacy’*** research domain. To unpack this



relationship, questions such as “how does income generation among women influence dietary adequacy and purchasing patterns?” were posed as potential areas for further research. Other marginalized groups such as indigenous peoples were identified as populations whose dietary intake and dietary patterns needed to be studied. Groups such as the Madheshis and Dalits, especially those in the mountains and high hills, have not been studied at great length and perhaps lessons can be learned from these groups with regard to special, nutritious, indigenous foods and food preparation methods used. The role of alleviating poverty in improving nutrition was also recognized as a broad area of research that would inform the agriculture-to-nutrition pathway as one of the primary aims of agricultural investments and interventions is to improve economic returns from agricultural production.

A growing area within programmatic work is the investment in programs that provide home and kitchen garden interventions to contribute to meeting the households’ daily dietary (and dietary diversity) needs. These interventions often target women and provide education on gardening techniques and occasionally provide seeds to promote home production of foods. This emerging programmatic focus with an aim to improve nutrition status established the next research domain: ***‘home food production, storage and processing factors that affect dietary adequacy’***. An important point of discussion within this domain was the need to determine micronutrient content of locally available crops, vegetables and fruits grown at home. Commonly promoted foods for home and kitchen gardens include green leafy vegetables like spinach and orange flesh vegetables. Poultry-raising for eggs as well as goat-raising, as sources of animal protein, are also frequently-promoted practices. While evidence supports improved intake of micronutrient rich foods and dietary diversity of participants in home food production programs, rigorous evaluations that study the impact of such programs on nutrition status in women and children is still lacking[14]. Soil quality of these home gardens was also determined to be a research topic of interest. Soil quality can affect both soil productivity and nutrient content and nutrient bioavailability of crops. It has been shown that in subsistence farming where soil quality is low, the content of protein and anti-nutrients is lower than in medium to high productivity soil. [15, 16]

Market dynamics and their effects on access of household to food continue to be an important link across the agriculture-to-nutrition pathway. Discussions on the domain, ***‘market factors that affect home food security’***, captured opportunities for further study including topics such as how to engage the private sector to contribute to changes in household consumption and dietary practices, determinants of food purchase and consumption, documenting incentives for agricultural production of indigenous food crop and whether this provides adequate motivation of farmers to produce these crops, household purchasing power and patterns, the cost-effectiveness of growing and marketing certain nutritious crops and lastly market demand for high-value crops. Finally, Symposium participants discussed the research domain: ***‘agricultural factors that affect market prices, availability, and household access.’*** Knowledge gaps identified included the role of livestock and fishery versus typical agricultural interventions in potentially improving nutrition within households, what market outlets exist and the perfusion of agricultural produce in markets. Additional gaps included the need to explore how to improve production of staple crops across ecological zones, how the redesign of some

agricultural tools have impacted time constraints and workload of farmers, how to improve production of specialized crops across eco zones, whether technologies and certain seed varieties can be used across ecological zones and if so, whether these agricultural approaches can be scaled up. A crucial contributor to improved and sustained agricultural production is water. Issues surrounding sustained water management approaches to support agricultural production and practices were discussed and identified as areas for further research. Given the Symposium's focus on ultimately improving nutrition status of women and children, the role of medicinal herbs and oil were discussed as potential alternative crop interventions that could potentially contribute or detract from diet quality. The role of bio-fortification of crops was raised—its potential and feasibility in Nepal and its efficacy for improving nutrition status. Beyond agricultural production, issues focused on homestead postharvest food loss and food preservation methods to maintain the nutrient integrity of foods. These areas require further study. A unique topic that emerged out of this discussion was the possibility of defining, creating and measuring the nutritional effects of a “nutrition friendly” farming system.

The use of appropriate research designs and methods surfaced as an overarching discussion area throughout Day 2. A call was made for the use of mixed methods to study the agriculture-to-nutrition pathway and to quantify long-term gains (or losses) of agricultural investments to



accelerate improved nutrition outcomes. Several participants urged researchers to focus on program and implementation research—the “how” of programs and the also the true impact of programs. Questions raised included: ‘How are programs effective in improving nutrition?’ and ‘How is research translated into effective programming?’ Leroy et al. states, “the main constraints limiting the effectiveness of these programs include problems of design and integration of their different

components (especially of their nutrition package); the lack of conceptualization, framework of analysis, and documentation of their pathways of impact; the lack of measurement and understanding of facilitating factors and constraints to implementation and success; and their often weak monitoring and evaluation designs” [4]. The use of quantitative methods to accurately measure results, as well as qualitative methods to explain why certain behavior-change communication methods work or why households consume more of a certain crop, for example were strongly encouraged. Moreover, deconstructing nutrition-specific or nutrition-sensitive interventions was brought up as an important consideration given the high use of such terminology in development circles.

Taking this discussion one step further, questions that had policy level implications were raised. What are the problems in translation and implementation at the policy level? Gap analyses conducted on the identification of the knowledge of policy makers themselves on the agriculture-nutrition pathway was put forth as a way to facilitate translation of research. This lack of information was expressed by the symposium attendees as not specific to policy makers alone but also a gap that



existed for smallholder farmers and mechanisms for effective communication of technological advances within agriculture, market dynamic and nutrition research itself was suggested. Concerns were raised about limited government support to research. One participant pointed out that currently only 3% of the country's GDP goes to agriculture, thus it may not be realistic to think that much research can be produced with such a budget. However, representatives from the National Planning Commission (NPC) stated that they have indeed begun to prioritize research that informs this pathway through their efforts in considering a technical assistance group to review research that would contribute to the implementation of the multi-sectoral nutrition plan.

Government representatives requested researchers to simplify research findings and, in turn, researchers called for a forum where they could interact with government representatives to share Nepal-specific and/or Nepal-relevant research. To this end, a suggestion made was for such a quarterly or half-yearly meeting to be held between researchers and the concerned policy makers. Additionally, it was suggested that local research be published in international, but especially Nepali, journals to establish a reliable database to draw from that can help inform policy and implementation decisions. The creation of monitoring and evaluation systems at the policy level to oversee implementation of multi-sectoral policies seeking to address nutrition and research findings being tested in smaller pilot studies prior to going to scale was also suggested.

Ultimately, capacity building—the measure through which national research agenda on this topic could be achieved—was addressed. It was acknowledged that there are constraints with regard to the number of trained nutritionists and/or researchers with strong methodological training in Nepal. A trained multi-disciplinary team that had been recommended by the opening speakers on Day 1 of the Symposium and by the audience on Day 2 requires investment by donors and GON as well as academic institutions to research. Audience members stressed the need for rigorous research designs and methodologies that policy and programming decisions are firmly based on evidence and not on speculation and untested assumptions. Therefore, priority capacity-building areas should be research methodologies, survey methods, data

management and analysis. It was also thought that such a trained workforce could assist in setting up and monitoring surveillance systems. Another area for capacity strengthening is training policy makers on the use of evidence in policy formation, program design and the evaluation of government programs.

NEXT STEPS

The Nutrition CRSP “Agriculture, Food Security and Nutrition in Nepal—Taking Stock and Defining Priorities” symposium, co-hosted by Johns Hopkins Bloomberg School of Public Health and the Department of Community Medicine and Public Health, IOM was one of the first events of its kind to bring together the research community primarily, as well as government officials and program implementers to take stock of the research that exists in Nepal currently across the agriculture-to-nutrition pathway. The presentations and posters showcased during the event were by no means representative of all research conducted in Nepal that would inform this pathway. However, based on the presentations provided during Day 1, the more glaring gap that surfaced was that there was little research that linked across all three domains. Even the research that addressed more than one domain did not always capture strong linkages based on methods used or outcomes measured (Figure 12).

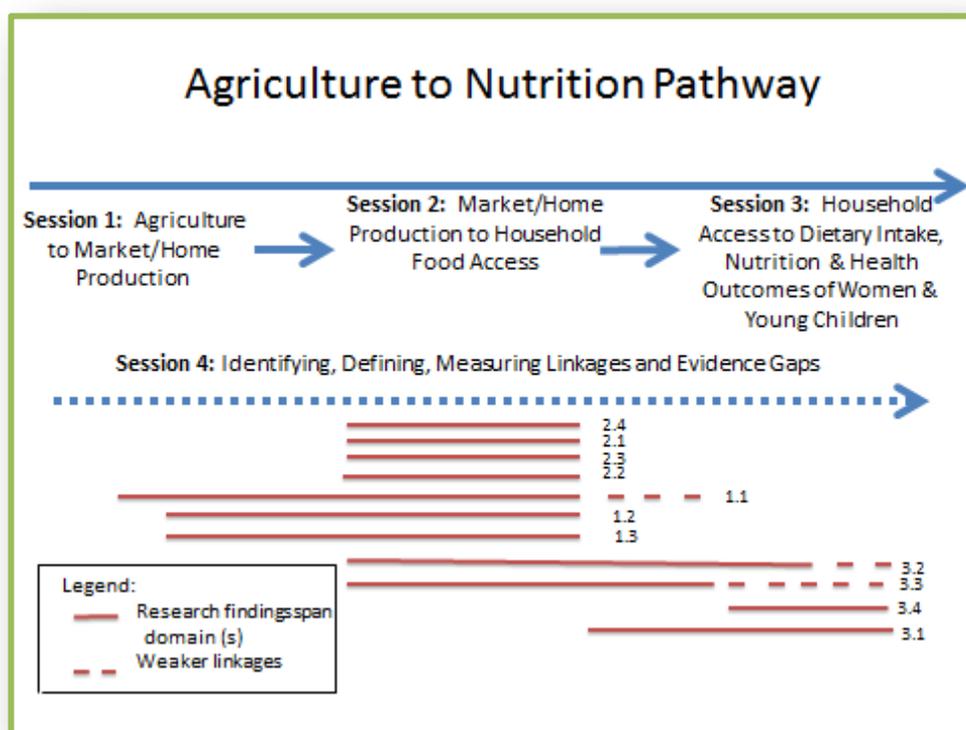


FIGURE 12

Based on discussions that transpired throughout the Symposium, the Symposium Organizing Committee identified the following priority actions as recommended “next steps” for the Nepal research community:

- ❖ Form a cross-disciplinary working group composed of established researchers from each relevant sector—agriculture, economics, marketing, food security, dietary intake, public health and nutrition—to identify the key research questions that need to be addressed

in the next 3, 5 and 10 years to inform the agriculture-to-nutrition causal pathway. Each sectoral expert could prioritize research in his/her domain, but consensus should be achieved on cross-disciplinary research and research that addresses linkage points across sectors. Securing donor support for both this initial process, but also for funding the research priorities recommended by the working group, should be prioritized.

- ❖ Conduct efficacy (i.e. under optimal conditions) and effectiveness (under real-life and programmatic conditions) research on promising and relevant interventions. In addition, a research agenda for understanding intervention delivery, reach and uptake is needed. This is sometimes referred to as “implementation research” or understanding the conditions necessary for effective large-scale program implementation.
- ❖ Establish community-based surveillance sites in the major agro-ecological zones in Nepal to: (i) provide longitudinal measures of trends and changes over time in food availability, access and utilization, and relate them to household food security, dietary intake and nutrition and health status; and (ii) generate empirical evidence about integrated agriculture and other food and nutrition program interventions that have an effect on nutrition and health outcomes. This should be a priority area for the Nutrition CRSP.
- ❖ Organize a bi-annual or annual forum for policy makers from the NPC, MoAC and MoHP and researchers to discuss and translate research findings that pertain to improvement of nutrition status through a multi-sectoral approach.
- ❖ Organize an annual scientific symposium or “evidence summit” to facilitate the rapid sharing of findings and innovative solutions.

APPENDIX

SESSION 1 - ABSTRACTS

1.1 HOUSEHOLD CONSUMPTION OF GRAIN LEGUMES IN NEPAL TERAI: A STUDY ON IMPACT OF IMPROVED TECHNOLOGIES. RK Neupane, NS Thakur, P Jha, DN Pokharel, BP Mahato and RA Sah. FORWARD Nepal, Bharatpur Chitwan, and NARC Singhdurbar Plaza Kathmandu, Nepal.

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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. However, against a steady declining trend, daily dietary intake of pulses varies across rural households, and little to date has been documented on the impact technology interventions, such as wilt resistant/tolerant varieties of pulses, crop rotation and seed treatment have had on household legume consumption.

Aims: To estimate the changes in daily dietary intake of pulses by rural Terai households as a result of technology interventions.

Methods: Household dietary intake surveys were conducted before and 36 months after a project intervention that introduced wilt tolerant/resistant varieties of lentil (*Lens culinaris Medic*), chickpea (*Cicer arietinum* L) and pigeonpea (*Cajanus cajan* L. Millsp) along with crop rotation and fungicidal seed dressing options into four districts—Banke, Bardia, Dang and Kanchanpur, located in the mid and far western Terai. A total of 30 households were randomly selected from each project area of the four districts (total N=~120). A semi-structured questionnaire was developed, pretested and used, and a check list was prepared for focus group discussions (FGD). Secondary data on area and productivity of pulses in project districts were obtained from published reports of line agencies. Data were analyzed using SPSS.

Results: The average productivity of lentil, chickpea and pigeonpea increased by about 15%, 59% and 48% respectively over the base year. Household consumption of pulses was higher after project intervention in all four districts. Average consumption of pulses before project intervention was only 2kg/capita/annum and the consumption level increased to 13.5 kg/capita/annum after project intervention. The level of consumption varied by land holdings. Households with more than 2 ha of land showed an average consumption of 19.7 kg/capita/annum, while only 7.5 kg/capita /annum were reported from households owning less than 0.5 ha. After project intervention, productivity increases of pulses were higher in smaller than in larger farms. However, the cash needs of smaller farmers compelled them to sell the produce in market, resulting in lower household consumption.

Conclusion: Technology intervention is likely to improve pulse productivity at the household level. Increases in dietary intake of pulses have been recorded irrespective of household sizes, although farmers with larger holdings tended to include more pulses in their daily diets.

1.2 EFFICIENCIES IN LINKING AGRICULTURAL DEVELOPMENT WITH HEALTH AND NUTRITION TRAINING IN NEPAL. L. Colavito and M. Pariyar.

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Background: USAID supported a pilot program for health and nutrition training for pregnant women and mothers with children less than 5 years old (2006-2009) that were from 14,161 targeted households from the Smallholder Irrigation Market Initiative.

Aims: To assess the benefits of linking health and nutrition training in improvements in health and nutritional indicators and cost effectiveness.

Methods: Comparison from randomized baseline and annual impact surveys were conducted for targeted HHs and for control group households. Control groups included both SIMI project targeted households that did not receive the health and nutrition training and control households that did not benefit from SIMI or similar projects.

Results: The program showed strong statistically significant benefits from linking agriculture training and health and nutrition training for a variety of measures for improved health and nutrition. Results included increased calories consumed (329 per day), increased protein consumption (7.5g per week), more meals (2.5 per week), and substantial decreases in the incidences of diarrhea and pneumonia. The program achieved these results at an additional cost of about \$50 per HHs.

Conclusions: The results show strong benefits to linking agriculture development and health and nutrition training programs. Benefits include the ability to change behavior as households are increasing income, increased consumption through increased incomes and agricultural productivity of nutritious foods, and households investing more for better health care. The program also showed the cost effectiveness of adding health and nutrition training to an ongoing program that had already socially mobilized communities for agricultural development.

1.3 HIGH IMPACT. INTEGRATED APPROACHES FOR IMPROVED FOOD SECURITY AND NUTRITION OF RURAL POOR. Joe Sanders, COP, USAID/Nepal Flood Recovery Program.

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Problem: Food insecurity and malnutrition are highest in the Far West region of Nepal, where 82% of households in program worksites are subsistence farmers with high food insecurity.

Objective: Improve the affordability, accessibility, and availability of nutritious food to rural households through integrated commercial agriculture, nutrition, and infrastructure interventions.

Conceptual framework: The multifaceted causes of poverty, food insecurity, and malnutrition must be addressed by approaches that recognize the interrelationship between income generation, food productivity, and consumption. Improved agricultural productivity and commercialization can dramatically increase incomes, but complementary investments in other sectors are also required to sustain impact and address overall food security priorities.

Description of implementation: Commercial agriculture participants contribute small plots of land to a demonstration farming program that provides training and cost-shared financial assistance to promote high-value vegetable production and improved agricultural technologies. Nutrition and hygiene participants' focus is on nutritious food production through home gardening. Both components provide training at the household level in enhanced nutrition actions, hygiene, and sanitation. Nutritional impact is measured both in terms of changes in food consumption and by indicators such as body mass index, prevalence of breastfeeding, and diet diversity. Productive infrastructure projects that provide direct benefits to program participants are also supported.

Outcome: *Commercial Agriculture:* 7,536 farmers (35% women) assisted on 1,780 hectares; 843 shallow tube wells installed; 800% increase in land's economic productivity; 320% increase in household incomes; 225,000 person-days of surplus employment generated. *Nutrition and Hygiene:* 5,960 farmers (75% women) assisted on 147 hectares of home gardens; 240 model latrines and 1,715 improved cooking stoves installed. *Productive Infrastructure:* 131 infrastructures benefiting 837,726 people; improved transportation access for 128,881 households; 165,106 person-days of temporary employment generated.

Program's implications: Integrated interventions across sectors deepen impact and strengthen sustainability. Understanding farmers' economic situations, landholding size, and potential as producers is crucial to designing appropriate food security interventions. Co-investing in improved technologies, inputs, and agronomic practices helps maximize outputs and establishes a strong capital base for farmers. Demonstration farming models ensure strong commitments from farmers, facilitate planning, and provide a firm basis for estimating project outcomes and effects on the local value chain. Substantial improvements in agricultural production and commercialization cannot be achieved without targeted investments in productive infrastructure. Nutrition awareness and behavior change training is less effective without coordinated assistance in agricultural production and income generation activities. Adoption of improved agricultural technologies and nutrition practices requires an intensive training program with frequent and consistent message delivery.

SESSION 2 - ABSTRACTS**2.1 APPLICATION OF THE HOUSEHOLD ECONOMY APPROACH FOR ASSESSING FOOD SECURITY AND DESCRIBING LIVELIHOODS IN NEPAL. Saville NM1, Akhter N1, Shrestha BP2, Manandhar DS2, Osrin D1, Costello A1**

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Background: Improvement of nutritional status through behavior change is only possible if nutrient-rich foods are available and households are able to access them. In the plains district of Dhanusha, Nepal during 2006, a Household Economy Approach (HEA) study was conducted as formative research.

Aim: To understand the food security and livelihood situation of different wealth groups in the district so as to design behavior change strategies that could be promoted through community mobilization through women's groups.

Methods: Sixty community representative interviews were conducted as well as 210 in-depth interviews with disaggregated wealth group representatives. For each of the 60 Village Development Committee clusters, detailed information on food produced, market and other linkages, commodity prices, resource maps, historical timelines and seasonality of production, migration, labor and market prices were obtained. Each wealth group was described in terms of asset scores and livelihood activities. Wealth group interviews provided estimates of income, expenditure and food sources for a 'typical household' in that group. From annual estimates of kilos of food from different sources, kilocalorie access per person per household in that wealth group was estimated.

Results: Food production in the district is high and micronutrient-rich vegetables, fruit and animal foods are available year round except in the monsoon season. 'Hungry seasons' precede rice harvests (Sep/Oct and March/April). The landless poorest rely on food purchase and agricultural labor exchange to meet their basic food needs, making them vulnerable to food price and labor availability shocks. Middle/better-off groups grow staple and non-staple foods for consumption and sale, and are vulnerable to shocks affecting production. Poorer groups rely on migratory labor to India, plus daily-waged labor, whereas middle/better-off run businesses have regular jobs and remittances from Arab countries and Malaysia for cash income. The poor borrow on unfavorable terms in order to access jobs overseas. Quantitative income estimates were difficult to standardize between interviews and did not match expenditure.

Conclusion: The HEA provides rich detail on livelihood patterns that may help design appropriate nutritional interventions. However, in diverse agricultural economies quantitative estimates of kilocalorie intake and household income may be less reliable.

2.2 HOMESTEAD FOOD PRODUCTION CONTRIBUTES TO DIETARY INTAKE AMONG CHILDREN 6-23 MONTHS OLD IN KALIALI DISTRICT, FAR WEST TERAII. DP Adhikari¹, P PandeyRana¹, D Davis¹, N Sharma¹, HB Chand², RK Neupane¹. ¹ Helen Keller International, Nepal Country Office, Chakupat-Patan, Lalitpur, P.O. Box 3752, Nepal; ² Helen Keller International, Nepal Field Office, Dhangadi, Kailali, Nepal
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Issues: Limited production and variety of foods and knowledge about timely introduction of complementary food and age appropriate feeding practices are the key issues affecting the nutritional status of children and mothers in Far-Western Nepal.

Objectives: To improve nutritional status of pregnant and lactating women and children less than two years of age by addressing a key determinant of malnutrition and increasing household food production in the project districts.

Conceptual framework: Knowledge, skills, technical and material inputs, and community mobilization lead to improved availability and increased consumption of nutritious foods.

Program design and description: The USAID supported *Action Against Malnutrition through Agriculture (AAMA) Project*, was designed to increase food availability and diversification through homestead food production (HFP) in 4,632 households with pregnant women and mothers with children under two. Beneficiaries received training in HFP, seeds/seedlings and poultry chicks.

Process evaluation methods: A community-based, bi-annual *lot quality assurance sampling survey* was conducted using a 24-hour recall questionnaire (WHO, 2010) for assessing the infant and young child feeding practices using the seven recommended food groups; recorded by age group and consumption. SPSS version 18.0 was used to analyze data. Cross tabulation and bivariate analysis were used to assess the minimum dietary diversity in relation to the HFP exposure status, and mothers who knew timely introduction of complementary food, age appropriate amount and frequency of feeding.

Results: Vegetable varieties increased (3.8±1.9 in January 2009, 4±2.3 in August 2010, 8±3.6 in February 2011 and 7±3.1 in August 2011) and the average vegetable production within the previous two months increased from 74kg/HH at baseline (January 2009) to 175kg/HH (February 2011). In August 2011, mid-monsoon, the production dropped to 123kg/HH. The mean egg production HH/week increased from 2.4 eggs per household in August 2010 to 5.7 in August 2011. Dietary diversity, including consumption of vitamin A and iron-rich plant sources and eggs, was significantly higher among children 6-23 months from HFP intervention households ($p<0.001$). Dietary diversity of children age 6-23 months was significantly higher among those whose mothers knew when to introduce complementary feeding (71.7%) than those mothers who didn't know (36.7%). Dietary diversity of children age 6-23 months was significantly higher among those whose mothers knew about age appropriate feeding frequency (82.0%) versus among those whose mother didn't know (42.7%) ($p<0.001$).

Program implications: These findings demonstrate that improved HFP and knowledge may lead to improved infant feeding practices and additional demonstration study sites are warranted.

2.3 FOOD SECURITY, FOOD PRICE AND INCOME TRENDS IN DHANUSHA DISTRICT, NEPAL BETWEEN 2005 AND 2011. Shrestha BP2, Akhter N1, Manandhar DS2, Osrin D1, Costello A1, Saville NM1.¹Centre for International Health and Development, Institute of Child Health, University College London, UK.²Mother and Infant Research Activities (MIRA), GPO box 921, Kathmandu, Nepal.

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Background: Household food security is determined by availability, access and utilization of food. Although the Terai is Nepal's 'bread basket,' the poor lack access to foods. Hence, in Dhanusha district, MIRA/UCL monitored food security and related factors between 2005-2006 and 2011 as part of prospective surveillance of households with recently-delivered women.

Aims: Objectives were to understand: a) how household food insecurity was experienced in relation to anxiety about insufficient quality of and insufficient quantity of food; b) who was affected by food insecurity; and c) whether the food price crisis affected food security.

Methods: Three standardized monitoring tools were used with recently delivered women between September 2006 and June 2011. 'Household Dietary Diversity Score' (HDDS)--and 'Months of Adequate Household Food Provisioning' (MAHFP)--data were collected from September 2006 to June 2011 in >35,000 households. 'Household Food Insecurity Access Scale' (HFIAS) data were collected in 4,084 households September 2006 to May 2007 and in 11,039 households November 2009 to June 2011. Food prices were monitored for 66 items in 48-53 markets in Dhanusha in 2005-2006, 2008, 2009 and compared 2006 and 2008 rates for different incomes.

Results: All food insecurity measures improve steeply with asset quintile and Dalits suffer worst. Comparing November-June 2005-2006, 2009-2010 and 2010-2011 food insecurity indicators improved for as follows: HFIAS 3.8, 2.4, 1.9; anxiety about food access 63%, 41%, 34%; insufficient food quality 52%, 36%, 31%; insufficient food intake 24%, 15%, 11%; HDDS 4.3, 4.5, 4.8 food groups; MAHFP 10.2, 10.4, 10.5 months; moderately/severely food insecure 39%, 24%, 19% and in the poorest quintile 70%, 53%, 48%. Households with access to remittance incomes increased on average 36%, 48%, 52% and in the poorest quintile 16%, 31%, 32%. Income rates increased by 33% for labor, 26% for salaried jobs and 22% from businesses 2006-2008. Food prices increased 32.6% 2005-2008 and 25.2% 2008-2009.

Conclusion: Although 48% of poorest households in Dhanusha still suffer food insecurity, food security has improved despite the food price crisis. Effects of price increases seem to have been buffered by salary increases and increasing access to remittance incomes.

2.4 VALIDATING DISTRICT-LEVEL ASSESSMENT WITH SURVEY DATA: EXAMPLE FROM THE NEKASP, World Food Programme

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Background: Food security in Nepal is characterized by a high variability: notable disparity is found within respective regions and districts, as well as among different population groups, which makes the food security monitoring complex and challenging. The Nepal Food Security Monitoring System (NeKSAP) employs different data collection methods to assess and monitor the food security situation, delivering reliable and timely information. The presentation illustrates how the different data collection methods complement each other to achieve the best result under practical limitations involved in food security monitoring in Nepal.

Methods: The NeKSAP employs two key data collection methods: phase classification approach by the District Food Security Networks (DFSNs); and repeated cross-sectional surveys. The DFSNs, formed by staff and representatives from district-based organizations and institutions, assess and monitor the food security situation in their respective districts based on standardized food security phase classification approach. The information is disaggregated to VDC-level and updated by season (quarterly/bi-annually). Household survey is conducted across the country, designed to monitor the food security situation by ecological belt or sub-region by season and year. Information gathered by the DFSNs is validated using the NeKSAP household survey data through examining the degree of household food security by respective food security phase as classified by the DFSNs.

Results: Evidence shows that key food security indicators from the household data confirm the degree of food insecurity reported by the DFSNs.

SESSION 3 - ABSTRACTS

3.1 NUTRITION INTERVENTIONS THAT IMPROVE CHILD AND MATERNAL HEALTH AND SURVIVAL: FINDINGS FROM TRIALS IN THE TERAJ OF NEPAL (EXPANDED ABSTRACT)

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Background: Nutritional deficiencies stem from a diet chronically insufficient to support health and development, including host defenses to infection and other environmental stresses. Pregnancy, infancy and early childhood are periods of greatest risk of deficiency with potential short and long term health consequences. Community research can reveal the health impact of supplementing or improving the diet in a population and provide a basis for preventive programs and policies.

Methods: The Nepal Nutrition Intervention Project-Sarlahi (NNIPS) was launched in 1988 by Johns Hopkins University and the Nepal Netra Jyoti Sangh, with USAID support, to conduct micronutrient deficiency prevention research that would inform health policies and programs in Nepal. Sarlahi District was chosen based on its comparability with numerous features in the Terai. Key findings from the following field trials and associated studies are summarized: NNIPS-1 (1989-92, n=28,630) assessed the efficacy of periodic, high-dose vitamin A in reducing preschool child mortality; NNIPS-2 (1994-7, n=44,646 women/22,189 pregnancies) assessed the impact of providing a recommended dietary allowance (RDA) of vitamin A, either preformed or as beta-carotene, to women on a weekly basis before, during and after pregnancy on maternal and infant mortality; NNIPS-3 (2000-1, n=4926 pregnant women) evaluated against a control the effects of antenatal supplementation with iron, iron+folic acid, iron+folic acid+zinc or a 14-nutrient supplement on birth size (all groups receiving an RDA of vitamin A); a follow-up study of these three cohorts, funded by the Gates Foundation, in 2006-2008 (n=~55,000 children and mothers) examined long-term effects of early life interventions on children; and, NNIPS-4 (2001-6, n=41,276) studied the efficacy of daily zinc, iron or both in reducing morbidity and mortality in children 1 to 35 months of age.

Results: NNIPS-1 revealed that vitamin A could reduce preschool child mortality by 30%[17] which, with similar findings from a trial in Jumla[18], provided evidence for Nepal's vitamin A program which has prevented at least 120,000 child deaths in the past dozen years. The NNIPS follow-up study also found, by ages 15-23 years, that vitamin A had reduced hearing loss associated with middle ear infection by 42%[19], attributed to a reduction in severity of infection. Vitamin A given at birth may also reduce infant mortality. In Bangladesh[20], India[21] and Indonesia[22], newborn vitamin A has been shown to lower mortality < 6 months of age by ~20%, an intervention being piloted in Nepal.

NNIPS-2 reduced mortality related to pregnancy by an average of 44% with either maternal vitamin A or beta-carotene supplementation[23]. Maternal supplementation also reduced night blindness[24] and maternal morbidity[25] but had no overall effect on infant mortality[26]. At 9-12 years of age, however, the follow-up study revealed greater lung

capacity (by spirometry) among children born to vitamin A supplemented mothers[27], likely by improving fetal lung development[28]. There were no effects on blood pressure or cognition of offspring. Epidemiological findings revealed maternal night blindness to be a major risk factor for maternal vitamin A deficiency, undernutrition, morbidity and mortality during and long after the end of pregnancy[29, 30].

During NNIPS-3, mothers were found to be low-to-deficient in multiple micronutrients¹⁵, raising concern that multi-nutrient supplements may be needed during pregnancy or lactation in the absence of dietary adequacy. However, the trial showed varied effects: folic acid alone had no effect on birth weight[31] but significantly reduced preterm infant mortality[9]. Adding iron reduced anemia in this iron-deficient setting, and reduced risk of low birth weight by 16%[32]. Adding zinc to the supplement reversed effects of iron. The multiple micronutrient supplement also reduced risk of low birth weight, by 14%, comparable to that seen with folic acid-iron alone[9], but conveyed no survival advantage for infants[32]. Longer follow-up strengthened the case for antenatal folic acid-iron supplement use: by 6 to 8 years of age, children born to folic acid supplemented mothers were ~40% less likely to have abnormal kidney function (by micro albumin to creatinine ratio) and early biomarker indications of metabolic syndrome[33]. More strikingly, children born to mothers receiving iron with folic acid in pregnancy were more likely to survive the preschool years[10] and perform better on cognitive tests[34]. These effects were not seen with a multiple micronutrient supplement. It is unlikely that food-based approaches will, in the near future, assure adequate dietary intakes of bioavailable iron, indicating that antenatal folic acid-iron supplementation remain a standard of care for achieving maternal adequacy in these nutrients in Nepal.

NNIPS-4 stands as one of two community based trials (the other in Zanzibar) that assessed effects of daily zinc or iron supplementation on child survival. In Nepal, daily zinc supplement use had no effect on infant mortality but exerted a non-significant 20% reduction in mortality >12 months of age[35]. However, because both trials in Nepal and Zanzibar were comparable in design, underlying risks and effect estimates, data from both were pooled to reveal a significant overall mortality reduction of 18%[35]. While the evidence is marginal to promote universal, daily zinc supplementation for child survival, the findings are consistent with known effects of zinc in reducing prevalence, severity and subsequent incidence of diarrhea, and emphasize its importance in treating diarrhea[36].

Two epidemiological studies reveal likely benefits of (a) early exclusive breastfeeding and (b) the importance of guiding meal consumption patterns to assure adequate intakes by children at home. In the first, a dose-response relationship was observed between the number of hours in which breastfeeding was delayed and risk of neonatal mortality, suggesting that 19% of all neonatal deaths in rural Nepal could be averted by initiating breastfeeding within the first hour of life[37]. In the second, an anthropological study showed that the odds of toddlers consuming a variety of nutritious foods was 1.5 to 12 times higher if the child had shared a plate with an older sibling rather than eat alone[38]. Sharing a plate at mealtime with an older female was more advantageous to the child than with an older male.

Conclusions: Community research can provide evidence for nutrition program decisions: Preschool vitamin A supplementation continues to protect lives, sight and health of children.

Supplementation should continue until such time that adequate dietary vitamin A intake and status in the population is assured. A maternal diet adequate in vitamin A will likely help reduce risk of maternal mortality in Nepal, help control risk of night blindness. Pregnant and lactating women should be asked about night blindness, provided low dose vitamin A if positive, and offered general dietary and health care guidance. Among other nutrients, antenatal folic acid and iron assures a substantial public health impact for both mother and child in Nepal, for which there is presently no adequate dietary alternative. A multiple micronutrient supplement may not add further public health benefit, for which more research may be needed. Zinc supplementation is a critical adjunct treatment (with oral rehydration) for diarrhea, and could reduce under-five mortality if intake is increased universally, preferably through food based strategies. Immediate and exclusive breastfeeding can likely reduce neonatal mortality. And, food based strategies will need to also guide intrahousehold meal practices to assure dietary adequacy in young children.

3.2 GROWTH AND HEALTH OF RURAL CHILDREN IN 3 DISTRICTS OF NEPAL: EFFECT OF A COMMUNITY DEVELOPMENT INTERVENTION. LC Miller*#, R Shrestha^, M Lohani#, P Singh#, P Subba^, D Thapa^, SN Mahato#, N Joshi# *Tufts Univ Sch of Medicine, Boston, MA USA; ^Nepal Technical Assistance Group, Kathmandu, Nepal; #Heifer International, Kathmandu, Nepal

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Background: More than 50% of children in Nepal are malnourished. Economic growth and poverty reduction are not always sufficient to improve the health and nutritional status of children. Because child health/nutrition are vital cornerstones of community development, Heifer Nepal conducted a longitudinal randomized controlled trial to evaluate the effects of its programs on these important outcomes.

Aims: (1) Systematically assess effects of Heifer activities on child health and nutritional status; (2) delineate characteristics of families and children affecting these (and other) outcomes.

Study design: Six communities in 3 districts of Nepal [Chitwan/Nawalparasi (Terai), Nuwakot (hills)], were pair-matched for specific characteristics and then randomly assigned to receive Heifer community development activities at baseline (INT) or at 1 year (CON). At baseline, 6, 12, 18, and 24 months, a 125- item questionnaire addressing family demographics, SES, diet, and child health/nutrition was completed in each household, along with child growth monitoring.

Results: By 12 months, 2,903 individuals in 430 households were enrolled, including 528 children 6 months to 8 years. INT and CON communities were equivalent for baseline and 12 months SES, household size, land/animal ownership, and child nutrition/health, but there were marked differences between Terai and hill districts. At 12 months, Terai INT group had improved child weight ($p=.04$), height ($p=.05$), and reduced sick days ($p=.01$), as well as increased household income ($p=.004$), animal ($p=.04$) and land ownership ($p=.04$) compared to CON. Significant improvements were noted in sanitation practices in INT group at 12 months ($p<.01$). Child health and nutrition strongly correlated with age.

Conclusions: Significant improvements at 12 months in many indicators were noted in Terai but not hills INT vs. CON. Family clustering and other household characteristics likely affect outcomes of community development interventions. Extended follow-up will be important to further understand factors affecting child outcomes and identify specific targets for improvement.

3.3 IMPACT OF CHANGES IN GRAIN PULSE (LEGUME) CONSUMPTION ON MICRONUTRIENT SUPPLY OF RURAL WOMEN IN NEPAL AND NORTH INDIA. P Andersen, Department of Geography and RK Chandyo, Centre for International Health, University of Bergen, Norway.

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Background: An important food system change in South Asia, is the reduction of pulses (legumes) in the diet over the last four to five decades, due to stagnant agricultural production. The reasons for stagnant pulse availability include low priority in research and development and agricultural incentives, and depletion of soil micronutrients and rhizobium due to agricultural intensification. The per capita consumption of pulses has declined by more than half. For rural and poor people, pulses have primarily been replaced by staple grains, not by animal source foods, leading to reduced micronutrient density. The paper is based on the FOSRIN project which studied ricebean (*Vigna umbellata*) in particular.

Aims: Pulses are often seen as a source protein for poor and/or vegetarian populations. We investigate the role of pulses in prevention of micronutrient sufficiency –“hidden hunger.”

Methods: Dietary recalls of 800 rural women of reproductive age in Nepal and North India, were analyzed using the WorldFood2 program. The dietary intakes were compared to recommended intake values to predict general deficiency problems. Contributions of different food groups were assessed.

Results: Staple grains provided about 80% of the energy, rice alone 62%. Major deficiencies predicted were lysine, Ca, K, Fe, vitamins A, C, D, folate and B12; the intakes of Fe and folate were particularly inadequate for pregnant women. The predicted deficiencies, combined with the nutrient density of pulses compared to staple grains, defines the window of opportunity for pulses. The major contributions of pulses were lysine, Ca, K, Fe and B vitamins other than B12.

Conclusion: Pulses have a central but not sufficient role in prevention of hidden hunger. The policy implications of the study includes if interventions should be enrichment of rice, substitution with other staples, supplementation or complementary food items, including pulses.

3.4 CORRELATES OF INFANT AND YOUNG CHILD FEEDING PRACTICES IN CHEPANG

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Background: Infant and young child feeding (IYCF) practices differs in communities due to difference in knowledge, health service utilization, culture, and other socio-economic factors. The objective of this study was to explore knowledge and practice of Chepang mothers on IYCF and their correlates.

Methods: A cross-sectional descriptive study was conducted in the Chepang community of the Makawanpur district. Quantitative methodology was used in which 360 mothers of children under two year age were selected randomly. Logistic regression analysis of selected child feeding indicators was done to find their association with socio-economic and health related factors.

Results: Feeding practices of mothers were found better than their knowledge level. About 35% had knowledge about early initiation of breastfeeding. Exclusive breastfeeding and introduction of complementary foods at the age of 6 months were 81% and 90% respectively. Literate mothers were found initiating breastfeeding earlier than the illiterate (OR=2.61, 95% CI, 1.59-4.27). Growth monitoring service utilization was found to have significant association with exclusive breastfeeding practices (OR= 2.75; 95% CI, 1.30-5.78). Feeding diverse complementary foods was found to be associated with average monthly family income and duration of food sufficiency.

Conclusions: Feeding practices in Chepang community were associated with health and socioeconomic determinants. Some of the feeding practices were found to be good, however, meal frequency for the children 9 to 23 months of age and feeding diverse foods for children 6 to 23 months were found to be lower, which needs to be improved through nutrition awareness programs. Qualitative studies are needed further to explore the cultural factors.

TITLE Listings for Poster Presentations

- **IMPROVEMENT OF WOMEN'S LIVELIHOODS, INCOME AND NUTRITION THROUGH CARP-SIS-PRAWN POLY CULTURE IN TERA I, NEPAL.** Sunila Rai, Madhav K. Shrestha, Naba Raj Devkota. Institute of Agriculture and Animal Science, Rampur, Chitwan, Nepal
Email address of corresponding author: madhavshrestha1954@gmail.com
- **RICE SEED BUSINESS MODELING AND FOOD SECURITY: A CASE STUDY OF KAVREPALANCHOK AND RAUTAHAT DISTRICTS OF NEPAL.** Megh Bahadur Nepali^{1,*}, Sudeep Gautam², Sabita Mohini Amatya Shrestha² and Sanjeev Adhikari²
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- **HEALTH AND HUMAN DEVELOPMENT NEXUS IN NEPAL.** Mukesh Kumar Mishra*, Vinod Mishra¹, Farhat N. Siddiquie². *Bhopal NIMS College, Lalitpur, Nepal, ¹Department of sociology, Tribhuvan University Nepal ²Department Of Clinical Nutrition and Dietetics,
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