

Feed the Future Learning Agenda Annotated Bibliography: Improved Nutrition and Dietary Quality

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Contact:

Detra Robinson, Chief of Party
Westat
1600 Research Boulevard
Rockville, MD 20850
Tel: 301-738-3653
Email: DetraRobinson@westat.com

This annotated bibliography is a compilation of studies that relate to the following questions from the Feed the Future Learning Agenda on Improved Nutrition and Dietary Quality:

- 1) What have been the impacts of different approaches linking Agriculture, Nutrition and Health (ANH) on dietary diversity and nutritional status (i.e. geographic co-location of programs, integration of interventions, what combination of A, N, and H)? Have programs to increase farmers' incomes resulted in improved nutrition when not coupled with nutrition programming?
- 2) What activities have enabled value chain investments to lead to improved consumption of diverse diets?
- 3) Which agriculture technology interventions have improved diets and nutrition outcomes?
- 4) What investments in human and institutional capacity development have effectively generated large scale nutrition outcomes?

2012

Bhagowalia, P., Headey, D., & Kadiyala, S. (2012). *Agriculture, income, and nutrition linkages in India: Insights from a nationally representative survey*. IFPRI Discussion Paper No. 01195. Washington, DC: International Food Policy Research Institute.

The authors use data from the 2004/2005 India Human and Development Survey to estimate the effects of variables including income and agricultural production techniques on stunting, wasting, and dietary diversity. They find that the association between income and stunting and wasting is small except for in the high or highest income quintiles, where the association is more pronounced. In agricultural households, the relationship between income and stunting and wasting is even weaker than in nonagricultural households. Women's secondary education is positively associated with children's height-for-age z scores (HAZ) and the proportion of the household budget allocated to fruits. The authors highlight that specific components of the farming system are important especially for small-scale farm households, with irrigation and ownership of milking animals and poultry positively associated with improved diets. As noted by the authors, a weakness of the study and the data is that information is not available about intra-household allocation of food, which could be important to consider in any resulting interventions.

Bouis, H., & Islam, Y. (2012). Biofortification: Leveraging agriculture to reduce hidden hunger. In S. Fan and R. Pandya-Lorch (Eds.), *Reshaping agriculture for nutrition and health: An IFPRI 2020 book* (83-92). Washington, DC: International Food Policy Research Institute.

Bouis and Islam describe biofortification as the scientific process of increasing the nutrient profile of staple foods using conventional or transgenic plant breeding. The authors discuss the advantages of biofortification, particularly in terms of the ability of biofortification to reach the rural poor whose caloric consumption is dominated by staple foods. They also describe the challenges and limitations of biofortification. The authors offer a summary of the evidence from the introduction of orange sweet potato in Uganda and Mozambique, which studies have shown to improve the Vitamin A status of children in targeted groups.

Ecker, O. & Nene, M. (2012). *Nutrition policies in developing countries: Challenges and highlights*. IFPRI Policy Note. Washington, DC: International Food Policy Research Institute.

Ecker and Nene define nutrition-specific and nutrition-sensitive policies, the latter of which address the root causes of malnutrition and often involve various sectors, including agriculture and health. The authors then provide from the literature three case studies where multisectoral approaches have successfully addressed malnutrition. Between 1996 and 2007, Brazil experienced a fifty percent reduction in the prevalence of stunting in children under 5, which was due in large part to poverty reduction including a conditional cash transfer program and maternal education, as well as improvements in healthcare coverage and sanitation. In Nepal, the Female Community Health Volunteer (FCHV) Program was launched in 1988. Volunteers provided

nutritional education to parents as well as vitamin A supplements to over 90 percent of Nepalese pre-school children. Reductions in the prevalence of stunting and xerophthalmia were reported. In Uganda, a program promoting orange-fleshed sweet potatoes (OFSP) was associated with a near 10 percent reduction in vitamin A deficiency amongst preschool children.

Headey, D. (2012). Turning economic growth into nutrition-sensitive growth. In S. Fan and R. Pandya-Lorch (Eds.), *Reshaping agriculture for nutrition and health: An IFPRI 2020 book* (39-46). Washington, DC: International Food Policy Research Institute.

Headey performs a cross-country, econometric analysis using data from several sources, including the Demographic and Health Surveys (DHS), the World Bank's World Development Index, and Agrostat (from the Food and Agriculture Organization of the United Nations). He finds that GDP growth is associated with a decrease in the prevalence of stunting and that in agrarian economies agricultural growth is more strongly related to the decline in stunting than nonagricultural growth with the exception of India. He also develops a nutrition-sensitive social development index (NUSSDI) comprised of four variables: "(1) a poverty proxy (ownership of at least one asset), (2) a health proxy (medically attended births), (3) a female education proxy (women's secondary and tertiary education), and (4) a family planning proxy (fertility rates)." He demonstrates that the association between an increase in the NUSSDI index and lower stunting rates is stronger than the association between GDP growth and lower stunting rates, and that the variables in the index are themselves associated with GDP growth. Finally, he provides a summary of the countries/state that have experienced long-term "proven" success reducing malnutrition (Bangladesh, Brazil, Honduras, Tamil Nadu of India, Thailand, and Vietnam) as well as successful Green Revolution countries and countries with shorter-term "unproven" success. The success stories confirm the importance of GDP growth, agricultural growth, and the aforementioned socioeconomic variables. While Headey does not describe the success stories in detail, he nonetheless provides a useful starting point for exploring the factors that contribute to success at a large scale.

Henson, S., Humphrey, J., McClafferty, B., & Waweru, A. (2012). *Assessing the integration of agriculture and nutrition in USAID target programs: Findings from a rapid assessment in Kenya*. Retrieved from:
[http://kenya.usaid.gov/sites/default/files/u17/GAIN%20Kenya%20report%2015%20February%202012%20draft%20to%20mission%20\(1\).pdf](http://kenya.usaid.gov/sites/default/files/u17/GAIN%20Kenya%20report%2015%20February%202012%20draft%20to%20mission%20(1).pdf)

The authors provide background from the literature to demonstrate the recent emphasis on including nutritional improvements in agriculture interventions, as well as the focus on taking a value chain approach to achieve nutritional goals. They describe the Rapid Assessment Design Tool, which is used to apply a "nutritional lens" to pre-existing agricultural interventions, incorporating value chain mapping in the process of analyzing existing projects or programs. From USAID's commodity-based projects in Kenya, the authors selected two projects to which they fully applied the Rapid Design Assessment Tool: milk and dairy products from the Kenya Dairy Sector

Competitiveness Program (KDSCP) and Orange-Fleshed Sweet Potatoes from the Kenya Horticulture Competitiveness Program (KHCP). Both of these programs take a value chain approach to agriculture, but not nutrition. The KDSCP did not measure baseline nutritional indicators and the KHCP measured limited baseline nutritional indicators in target beneficiary households but not wider consumer groups. The authors report that there was anecdotal evidence of increased consumption of nutritious foods as a result of the Orange-Fleshed Sweet Potato project, but that this has not been studied quantitatively. The authors identify opportunities for strengthening the agriculture/nutrition linkages in these projects.

Hotz, C., Loechl, C., Lubowa, A., Tumwine, J. K., Ndeezi, G., Masawi, A. N., ... & Gilligan, D. O. (2012). Introduction of β -carotene-rich orange sweet potato in rural Uganda resulted in increased vitamin A intakes among children and women and improved vitamin A status among children. *The Journal of Nutrition*, 142(10), 1871-1880.

Vitamin A deficiency has persisted in Uganda and consumption of β -carotene-rich, orange sweet potato (OSP) may help to alleviate it. A large-scale, 2 year intervention was implemented among Ugandan farmer group member households to promote the production and consumption of OSP. Two models of intervention differed in duration of exposure to farmer-group level inputs; Model 1 gave 2 years of exposure, while Model 2 gave only 1 year. A randomized, controlled effectiveness study compared impact of Models 1 and 2 versus a control group on the intake of OSP and Vitamin A among children aged 6 to 35 months, 3 to 5 years of age, and women of childbearing age. It also examined the impact of Model 1 versus the control on VA status of 3 to 5 year old children and women with serum retinol below 1.05 $\mu\text{mol/L}$ at baseline (or clinically moderately deficient or worse). Net OSP intake increased in both intervention groups accounting for 44 to 60 percent of total Vitamin A intake at follow up. Prevalence of inadequate Vitamin A intakes was reduced in both intervention groups versus the Control, among children 6 to 35 months age and women (>30 and >25 percentage point reductions, respectively), with no difference between Models 1 and 2. There was no overall impact of Model 1 on Vitamin A status, but there was a 9.5 percentage point reduction in prevalence of serum retinol <1.05 $\mu\text{mol/L}$ among children with complete data on confounders and, at follow up. The authors conclude that Vitamin A intake from OSP was positively associated with serum retinol. Introduction of OSP to Ugandan farming households substantially increased Vitamin A intakes among children and women and led to improved Vitamin A status among children.

International Food Policy Research Institute. (2012). *Unleashing agriculture's potential for improved nutrition and health in Malawi*. Conference Report, 26-27 September 2011, Lilongwe, Malawi.

The report summarizes conference proceedings from the 2011 conference, "Unleashing Agriculture's Potential for Improved Nutrition and Health in Malawi." Presenters describe the nutrition challenges facing Malawi, praise Malawi's commitment to improved nutrition, and explain the various interactions between agriculture, nutrition, and health. Examples of successful multi-sectoral programs linking agriculture, nutrition,

and health include Malawi's MICA program with positive impacts on nutrition reported; an ongoing orange-fleshed sweet potato biofortification program with anecdotal examples of success; and two World Vision Malawi programs that utilize an integrated Area Development Program approach, both of which demonstrated improvements in children's anthropometrics. The presenters do not discuss the quality of the study designs, yet the need for better-designed studies is a recurrent theme in the literature and is important to consider.

Masset, E., Haddad, L., Cornelius, A., & Isaza-Castro, J. (2012). Effectiveness of agricultural interventions that aim to improve nutritional status of children: Systematic review. *BMJ* 2012; 344: d8222.

The authors perform a systematic review to identify studies that analyze the effects of agricultural interventions such as home gardening and biofortification on the nutritional status of children in developing countries. After excluding studies that did not meet the criteria for inclusion, twenty-three studies remained. Sources include, "Published and unpublished reports (after 1990) in English identified by searching 10 databases (Agris, Econlit, Eldis, IBSS, IDEAS, IFPRI, Jolis, PubMed, Web of Science, and World Bank), websites, previous systematic reviews, and reference lists and by contacting experts." The authors find several examples of studies that demonstrate an increase in consumption of protein and micronutrients, but they find limited examples of agricultural interventions that successfully increase micronutrient absorption or that have a "positive effect on the prevalence of stunting, wasting, and underweight among children aged under 5." As noted by the authors, there are problems with many of the studies' designs, which makes it difficult to ascertain whether or not the interventions have been successful.

Webb, P., & Kennedy, E. (2012). *Impacts of agriculture on nutrition: Nature of the evidence and research gaps*. Nutrition CRSP Brief Number 4. Retrieved from http://www.fsnnetwork.org/sites/default/files/ncrsp_research_brief_no._4_impacts_of_agriculture_on_nutrition_-_review_of_evidence_oct_2012_v3.pdf

Webb and Kennedy synthesize nine previous reviews published since 2000 of the effects of agricultural interventions on nutrition. The authors find several consistent themes throughout all of the reviews. The evidence base demonstrating the impacts of agricultural interventions on nutrition is "weak and mixed at best." There are some examples of statistically significant improvements in the indicators of individual micronutrients but there is no evidence for improvements in comprehensive sets of micronutrients. Common elements in interventions with evidence of increased child growth are the inclusion of a behavior change component; the combination of increased income, improved overall diet, and consumption of a targeted micronutrient-rich food; women's empowerment; and attention to the "net effects" of interventions, such that unintended negative effects do not offset the positive effects of the interventions. The authors also note that the lack of evidence is a major obstacle to policy advocacy and investment. Finally, the authors summarize one review (Hawkes et al. 2012) focused on the gaps in the evidence base and future research priorities for agriculture and nutrition.

Aphane, J. M., Pilime, N., & Saronga, N. J. (2011). Food-based, low-cost strategies to combat micronutrient deficiencies: Evidence-based interventions in Lesotho and Malawi. In B. Thompson & L. Amoroso (Eds.), *Combating micronutrient deficiencies: Food-based approaches*. CABI Publishing.

The authors describe a project entitled, 'Protecting and Improving Food and Nutrition Security of Orphans and HIV/AIDS Affected Children in Lesotho and Malawi.' In Lesotho, the targeted population consisted of nearly 7,000 households in one district. An initial assessment showed high levels of stunting in children and a lack of dietary diversity. The project as implemented in Lesotho included the promotion of keyhole gardening, which allows production of diverse vegetables year-around. In Malawi, the targeted population was nearly 3,000 households within two districts, where the diet consisted nearly exclusively of maize. The situation in the targeted areas of Malawi was particularly extreme as the initial program assessment showed that due in part to drought, approximately 50% of households had used their entire food stocks six months before the next harvest. As a result, the project intervention included training and dissemination of inputs for the production of drought-resistant crops. A community-led innovation included the building of two dams to provide water for farming in the dry season. Targeted households in both countries received education on animal husbandry and some received a chicken or goat. In both countries the project included nutrition education, training of community volunteers to provide basic health care services, promotion of improved sanitation and hygiene, promotion of increased school attendance, vocational training, and community-wide education about the rights of women and children. The program emphasized local participation and capacity-building, from the planning stage through implementation, with support at higher levels of government. The authors report increased availability and consumption of micronutrient-rich foods in both countries. The project is a complex, holistic, multi-sectoral endeavor. The study is lacking extensive quantitative data on nutritional outcomes or a cost-benefit analysis, yet it appears to have been largely successful in improving food security.

Arimond, M., Hawkes, C., Ruel, M. T., Sifri, Z., Berti, P. R., Leroy, J., ... & Amoroso, L. (2011). Agricultural interventions and nutrition: Lessons from the past and new evidence. In B. Thompson & L. Amoroso (Eds.), *Combating micronutrient deficiencies: Food-based approaches*. CABI Publishing.

The authors drew evidence from existing reviews and performed an original systematic review to identify agricultural interventions that have demonstrated an impact on dietary diversity and/or nutritional indicators. The authors' summary of existing reviews of agricultural commercialization showed the following trends: agricultural commercialization programs did not specifically include improved nutrition as a goal nor did they include nutrition education; household income generally increased; trends

showed an increase in household dietary energy intakes but not evidence for improvements in micronutrient intakes or status; and agricultural commercialization did not significantly impact children's nutritional status. The authors' summary of the literature regarding home-gardening projects showed that projects that included nutrition education and gender considerations were successful in impacting dietary diversity and/or nutritional status. The authors drew upon Leroy and Frongillo (2007) in considering the impact of livestock and aquaculture interventions on diet and nutrition, and report that while results of the reviewed projects were mixed, nutrition education and inclusion of gender considerations were important factors for success. Finally, the authors reviewed two recent case studies. First, they summarized a program that incorporated agricultural extension, nutrition education, and market development to promote biofortified orange-fleshed sweet potatoes in approximately 1,000 households in Mozambique (Low et al 2005, Low et al 2007). Research showed that the intervention resulted in improved dietary quality and nutritional status. The second case study is of the large-scale 'NGO Gardening and Nutrition Education Surveillance Project' in Bangladesh, that incorporated promotion of home gardening with nutrition education by building upon a network of local NGOs and incorporating women's issues into the project design. Results showed that the program beneficiaries produced more fruits and vegetables, had higher incomes, had more diverse/higher quality diets than non-beneficiaries, and that there were indications of sustainability over time. A limitation of the paper is that while the authors discuss the importance of strengthening the studies of future interventions and give a brief description of the study designs of each of the case studies in the pre-existing reviews, they do not discuss in detail the methodological strengths and weakness of these cases.

Burchi, F., Fanzo, J., & Frison, E. (2011). The role of food and nutrition system approaches in tackling hidden hunger. *International Journal of Environmental Research and Public Health*, 8(2), 358-373.

Burchi et al. provide a historical summary of agricultural policies, from the focus in the 1970s on agricultural productivity to the more recent acknowledgment of agriculture as a means to address micronutrient deficiencies. They also describe the recent history of nutritional policy, which evolved from focusing on protein and caloric needs to emphasizing the importance of micronutrients and relying on food fortification and supplements. The authors point to weaknesses that have been identified in the literature with the aforementioned strategies and suggest that a more sustainable and holistic approach to nutrition is warranted. They provide examples of programs with a combined agriculture/nutrition approach which have been successful in improving nutritional outcomes, such as biofortification, home-gardening, and animal husbandry projects. They do not evaluate the methodology of the agriculture/nutrition studies, but the overview is a valuable starting point nonetheless.

Ecker, O., Mabiso, A., Kennedy, A., & Diao, X. (2011). *Making agriculture pro-nutrition: Opportunities for Tanzania*. IFPRI discussion paper 01124. Retrieved from <http://www.ifpri.org/sites/default/files/publications/ifpridp01124.pdf>

The authors conduct a systematic review of all nutrition programs implemented in Tanzania between 2000 and 2010. The authors report that agricultural interventions specifically aimed to improve nutrition were limited in Tanzania in that period and describe the food-based programs that were implemented. They use a dynamic computable general equilibrium (DCGE) model to predict economy-wide growth rates and levels of stunting in children with and without a package of investments for agriculture. Results suggest that by implementing the Tanzania Agriculture and Food Security Investment Plan, agricultural growth in Tanzania would increase and stimulate annual GDP per capital growth of 1.6 % above the rate expected in the absence of the plan. In addition, the model predicts that in this scenario the prevalence of child stunting would decline by 0.3 % when compared to the baseline scenario. Finally, the authors emphasize that the nutrition and agricultural challenges specific to each region should be taken into account, and that including nutrition-specific interventions and nutrition education further improves the predicted results.

Fanzo, J., Remans, R., Pronyk, P. M., Negin, J., Wariero, J., Mutuo, P., ... & Sachs, J. D. (2011). A 3-year cohort study to assess the impact of an integrated food- and livelihood-based model on undernutrition in rural western Kenya. In B. Thompson & L. Amoroso (Eds.), *Combating micronutrient deficiencies: Food-based approaches*. CABI Publishing.

The authors conduct a three year prospective cohort study to evaluate the impact of the Millennium Villages Project (MVP) in Kenya on household food security, dietary diversity, Vitamin A levels, and anthropometric indicators in children. According to the authors, “The project implements a concurrent package of scientifically proven interventions in agriculture, health, education, water and sanitation, and infrastructure at an annual cost of US\$110 per person per year sustained over a 5- to 10-year period.” Statistical comparisons with the baseline data showed that in year-three there was a decrease in the average Food Insecurity Score, higher average Diet Diversity Scores and Food Variety Scores, lower proportions of underweight and stunted children under age 2, and a roughly 50% reduction in the proportion of vitamin A deficient children under age. A weakness of the study design is the lack of a control group for comparison. The authors acknowledge this and discuss factors separate from the program interventions that could have negatively or positively influenced the results.

Hawkes, C., & Ruel, M. T. (2011). *Value chains for nutrition*. IFPRI 2020 Conference Paper 4. Washington, DC: International Food Policy Research Institute.

Hawkes and Ruel present a summary of the literature on value chains and provide case studies to illustrate the concept of utilizing value chains to enhance nutrition. They make the case that food production is a multi-step, complex process with nutritional implications all along the way, and suggest that value-chain concepts are potentially useful for improving nutrition outcomes. They define value chains and describe different applications of value chain analysis as currently used in business, agriculture, and development. They then discuss the ways in which value chain approaches could increase the supply of and demand for nutritious foods. They list the advantages and disadvantages of using a value chain approach to nutrition. The authors’ extensive

search of the literature for projects which incorporated value chain concepts and some element of nutrition or health yielded only eight case studies, which illustrates that the idea of using value chains for nutrition is new and largely untested. Of the eight case studies, some are only in the planning stages and have not yet been evaluated and others report increased sales of nutritious foods and/or an increase in dietary diversity, but none report improvements in nutritional indicators. Clearly more examples are needed before the usefulness of this approach can be evaluated. An important question is whether or not the disadvantages that Hawkes and Ruel describe do in fact lead to unintended negative consequences.

Hotz, C., Loechl, C., de Brauw, A., Eozenou, P., Gilligan, D., Moursi, M., ... & Meenakshi, J. V. (2011). A large-scale intervention to introduce orange sweet potato in rural Mozambique increases vitamin A intakes among children and women. *British Journal of Nutrition*, 1(1), 1-14.

β -carotene-rich orange sweet potato (OSP) has been shown to improve vitamin A status of infants and young children in controlled efficacy trials and in a small-scale effectiveness study with intensive exposure to project inputs. However, the potential of this important food crop to reduce risk of vitamin A deficiency in deficient populations will depend on the ability to distribute OSP vines and promote its household production and consumption on a large scale. In rural Mozambique, we conducted a randomized, controlled effectiveness study of a large-scale intervention to promote household-level OSP production and consumption using integrated agricultural, demand creation/behaviour change, and marketing components. Two intervention models were compared: a high intensity training model (Model 1) and a low intensity training model (Model 2). The primary nutrition outcomes were OSP and vitamin A intakes by children 6-35 months and 3-5.5 years of age, and women. The intervention resulted in significant net increases in OSP and vitamin A intakes among all three groups, during the harvest period. OSP accounted for 47 to 60 percent of all sweet potato consumed, and, among reference children, provided 80 percent of total vitamin A intakes. A similar magnitude of impact was observed for both models suggesting that group-level trainings in nutrition and agriculture could be limited to the first project year without compromising impact. The authors conclude that the introduction of OSP to rural, sweet potato-producing communities in Mozambique is an effective way to improve vitamin A intakes.

MacDonald, A. C., Main, B. J., Namarika, R. H., Yiannakis, M. E., & Mildon, A. M. (2011). Small-animal revolving funds: An innovative programming model to increase access to and consumption of animal-source foods by rural households in Malawi. In B. Thompson & L. Amoroso (Eds.), *Combating micronutrient deficiencies: Food-based approaches*. CABI Publishing.

The authors describe the results of the MICA program, which was implemented in Malawi from 1996 through 2005 and included nutrition and health interventions and a small-animal revolving fund scheme (SARF) to promote animal husbandry. The goal of the SARF program was to improve the nutrition and health status of women and children, particularly regarding iron and iodine deficiencies. Along with the SARF

program, the MICA program included the following elements: “iron supplementation (weekly to women of childbearing age and children under 5 years old, daily to pregnant women); fortification of staple foods with iron, zinc, vitamin A, B vitamins and folate; malaria prevention and treatment; hookworm control; latrine construction; and capacity building and advocacy for improved anaemia programmes at all government levels.” Roughly 45,000 households at 16 different project sites participated in the program. The authors’ evaluation is based on data that were collected in cross-sectional surveys of beneficiaries and non-beneficiaries in 1996 (baseline) and in 2004. Results show that consumption of animal products was higher amongst beneficiary households compared to non-beneficiary households. Also, the prevalence of anemia amongst women in the target group was lower than that for women in the non-target group, although for children, there was a similar reduction of the prevalence of anemia in the target and non-target groups. The authors noted that it was not possible to disentangle the effects of the various components of the program. They also note that there were concurrent programs such a malaria reduction campaign happening nationally that could have contributed to the improvements in both the target and non-target groups. The authors do not address the question of whether the redundancy of the MICA program with national programs was unnecessary or cost ineffective, but that question is worthy of examination.

2010

Babatunde, R. O., & Qaim, M. (2010). Impact of off-farm income on food security and nutrition in Nigeria. *Food Policy*, 35(4), 303-311.

The authors analyze data from a survey conducted in 2006, which covered 220 households in Kwara state, Nigeria, selected by multi-stage random sampling. Summary statistics show that the average farm size of surveyed households is relatively small, 1.9 ha (SD 0.58). While the focus of the study is off-farm income, the authors find that off-farm income and farm income both have a positive effect on household calorie supply and that the magnitude of the effect for both is the same. They also find that increased off-farm and farm income have a positive effect on dietary quality, estimated by measuring the percentage of calories within the household from fruits, vegetables and animal sources, and that again the magnitude is the same. Estimates of the effects of off-farm income on anthropometric measures are positive but not statistically robust (the relationship with weight-for-age is statistically insignificant and with height-for-age is only significant at the 10% level). Further econometric analysis reveals that off-farm income is associated with higher farm income and larger plots farmed, and the authors suggest that the off-farm income may be used to ease liquidity constraints and purchase inputs needed for farming. The authors do not have data on intra-household allocation of food, yet it would be valuable to learn how vulnerable members of the households are affected by these trends.

Humphrey, J., & Navas-Alemán, L. (2010). *Value chains, donor interventions and poverty reduction: A review of donor practice*. IDS Research Reports, 2010(63), 1-106.

The authors conduct a review of the research on value chain initiatives aimed at poverty reduction and provide thirty case studies, two of which report changes in diet and/or nutrition. The first program was funded by the Inter-American Development Bank (IADB), which provided funds to support the inclusion of micro-producers in Central America into the global market for handicrafts. “The objective of the project was to increase the incomes of micro-enterprises by supporting a buyer-driven approach to value chain development.” According to the authors, the project evaluation was based on comparison of baseline and endline data, but did not include a control group. Amongst other results including increased income, it is reported that “project participants had improved their diets.” The second project was undertaken by ACDI/VOCA and was funded by USAID. The project included the promotion of agricultural cooperatives in Ethiopia as well as the establishment of connections between the cooperatives and traders and processors in Ethiopia and beyond. The project evaluation indicated that compared to non-cooperative members, cooperative members had higher incomes, which they used in part to “improve their diets.” Neither of the case studies includes any level of detail or quantitative information regarding diets or nutrition, however it is worth noting that this suggests a positive impact on diet in value-chain type projects, even when not specifically included in the design.

Kalimbira, A. A., MacDonald, C., & Simpson, J. R. (2010). The impact of an integrated community-based micronutrient and health programme on stunting in Malawian preschool children. *Public Health Nutrition*, 13(05), 720-729.

Authors describe and evaluate the MICA program in Malawi, an integrated health and nutrition program which had approximately 270,000 direct beneficiaries and ran from 1996 through 2005. They estimated the rates of stunting for pre-school children based on cross-sectional survey data from the years 1996 (the baseline), 2000 (four years into program implementation with MICA beneficiaries compared to the control group), and 2004 (eight years into the program also comparing beneficiaries to the control). The authors find that the prevalence of stunting in the baseline year was 60.2%. In 2000, rates of stunting declined to 50.6% for the beneficiaries and 56.0% for the control group. In 2004, there was no longer a significant difference in the prevalence of stunting between the beneficiary group (43.0%) and the control group (45.1%) ($P=0.3$). The authors do not offer a definitive explanation for why the control group and beneficiaries display similar results in 2004. A weakness in the study that the authors explain is that the respondents in the control group did in fact participate in the program from 1996 until 1999, but were discontinued from all interventions in 1999 for logistical reasons. As the authors suggest, this could explain the similar results for beneficiaries and the control group in 2004, but it also raises the question of what influence, if any, program participation had had on the control group in 2000, and why the difference between the beneficiaries and the control group is more pronounced in the short-term than the long-term.

Kerr, R. B., Berti, P. R., & Shumba, L. (2010). Effects of a participatory agriculture and nutrition education project on child growth in northern Malawi. *Public Health Nutrition*, 14(8), 1466-1472.

The authors evaluate a project in Malawi, the goal of which was “*improving child nutritional status with smallholder farmers in a rural area in northern Malawi*.” The project interventions included agricultural extension regarding the intercropping of legumes and other crops such as maize and nutrition education regarding breastfeeding and early childhood feeding. Evaluation was based on a quasi-experimental prospective study, with intervention households randomly chosen from the pool of self-selecting project participants and control households chosen from similar villages that matched the age and food security status of intervention households. Surveys were conducted repeatedly throughout the project. There was evidence that farmers in the control village also obtained the legume seeds and were shown to substantially increase legume consumption, so households from these villages were incorporated into the program as intervention villages and data were kept on how long they were considered program participants. This allowed for analysis of length of time in the study. Villages were also ranked relative to how actively the village participated in the project. Results indicated that all groups showed an increase in WAZ scores regardless of how long they participated in the project, but that the groups that had participated longer showed greater improvement in child growth. Also, an increase in the village’s participation level during the survey was associated with improved child growth, whereas a decrease in the participation ranking was associated with decreased child growth. The authors do not discuss sustainability of the project or perform a cost-benefit analysis, however unplanned spread of seeds to the control village suggests that the project could have substantial spill-over effects.

2009

Gibson, R. S., & Anderson, V. P. (2009). A review of interventions based on dietary diversification or modification strategies with the potential to enhance intakes of total and absorbable zinc. *Food & Nutrition Bulletin*, 30(Supplement 1), 108S-143S.

The authors perform a systematic review of the published and gray literature of “*interventions employing dietary changes—diversification or modification strategies at the community or household level that have the potential to increase the intake of total and/or absorbable zinc*.” In reviewing the literature on agricultural interventions, the authors identify ten interventions that measured changes in consumption, however, most of the studies were focused on vitamin A, and none measured zinc consumption. The authors note the importance of including nutrition education in the interventions. Because most interventions promoted production of fruits and vegetables, which are not high in zinc, the potential impact on zinc consumption was limited, although vitamin A can improve zinc absorption. The authors identify eleven interventions to promote production of animal-source foods (ASF), some of which also promoted consumption of ASF. The potential for increased zinc consumption depended on the type of meat targeted. These

interventions were also more successful when paired with nutrition education, but authors note considerable problems with many study designs. The authors evaluate the evidence regarding other non-agricultural interventions to improve zinc consumption. Finally, the authors call for inclusion of measures of zinc consumption and serum levels in future research.

Iannotti, L., Cunningham, K., & Ruel, M. (2009). *Improving diet quality and micronutrient nutrition: Homestead food production in Bangladesh*. IFPRI Discussion Paper 00928. Washington, DC: International Food Policy Research Institute.

The authors describe a home gardening program, the Homestead Food Production (HFP) program, begun by Helen Keller International (HKI) in Bangladesh in 1988. To analyze the impacts of the HFP program, the authors rely on results from nine previous studies of the program, only two of which used control groups for comparison. The authors' analysis reveals that the program has led to: "increased production and consumption of micronutrient-rich foods; increased income from gardens and expenditures on micronutrient-rich foods; women's empowerment; enhanced partner capacity; and community development." To describe the impact of the HFP program on food access, the authors report survey results that show that participants do generate income from sale of produce grown through the HFP program and that participants spend a portion of that income on food. However, as the authors admit, a survey of participants' overall household income has not been conducted. The authors also describe the increased consumption of nutritious foods on the part of participants relative to the control groups. However, they admit that rigorous studies of the anthropometric effects and nutritional indicators of participants are still needed.

Olney, D. K., Talukder, A., Iannotti, L. L., Ruel, M. T., & Quinn, V. (2009). Assessing impact and impact pathways of a homestead food production program on household and child nutrition in Cambodia. *Food & Nutrition Bulletin*, 30(4), 355-369.

Olney and colleagues analyze a homestead gardening project that included 1,400 households in Cambodia sponsored by Helen Keller International. The goals of the project were to: "increase the diversity and year-round production of fruits and vegetables, meat, and eggs; improve consumption of fruits and vegetables and animal-source foods through increased production, nutrition-related education, and increased income; and improve health and nutrition outcomes in participating women and children." The project includes the development of village model farms and the training of local volunteer leaders who provide agricultural training and inputs as well as nutrition education to project participants at the model farm sites. Evaluation is based on cross-sectional surveys at baseline (October 2005) and endline (May 2007), each including 300 intervention and 200 control households. Selection of households was done by local people of importance to the project (e.g. NGO staff, volunteers) who looked for households that met a set of predetermined criteria. The differences in the following variables from baseline to endline were greater in the intervention group than the control: household vegetable production, household dietary diversity scores, the frequency of mothers' consumption of micronutrient-rich foods, children's egg consumption, and reduction in

children's frequency of fevers. There were no significant differences in children's health (other than reduced fevers) and nutrition outcomes from baseline to endline. The authors discuss the apparently weak link between dietary diversity and children's health and anthropometrics. As noted by the authors, there were significant problems in the program design, e.g. household selection for the surveys was not randomized and the baseline and endline surveys were conducted in different seasons.

Spielman, D. J., & Pandya-Lorch, R. (2009). *Millions fed: Proven successes in agricultural development*. Washington, DC: International Food Policy Research Institute.

The objective of the book, edited by Spielman and Pandya-Lorch, is to “*identify and describe successes in agricultural development that have made substantial contributions to reducing hunger and malnutrition.*” The editors initiated a call for nominations and undertook a literature review to identify agricultural policies, programs, or investments that met the following criteria: importance, scale, time and duration, proven impact, and sustainability. From 250 success stories, 20 were chosen and developed into case studies, which were prepared via literature reviews and analyses of available evidence. The editors note that the success stories fit into the following categories: *intensifying staple food production; integrating people and the environment; expanding the role of markets; diversifying out of major cereals; reforming economy-wide policies; and improving food quality and human nutrition.* Of particular relevance are the case studies that promote micronutrient consumption and dietary diversity, including the Asian mungbean project and the homestead gardening in Bangladesh.

Swanson, R. (2009). *Final Evaluation of Land O'Lakes Zambia Title II Development Assistance Program, Dairy Development FFP DAP for Vulnerable Populations in Zambia*. Retrieved from: http://www.fsnnetwork.org/sites/default/files/final_evaluation_of_zambia_title_ii.pdf

The report is the final evaluation of a project carried out by Land O'Lakes (LOL) with the majority of funding from USAID in rural Zambia. The project was begun in 2004 and was expected to end in 2009. The goal of the project was “*reducing food insecurity among its targeted vulnerable populations in Zambia through increased incomes generated from the sale of milk and other dairy related products.*” Over 1,000 Zambian households considered to be food insecure were given an “in calf” or “pass on” cow. Based on a value chain analysis, the intervention included provision of technical and marketing assistance. Nutrition education was not part of this particular project, although LOL does contribute to dairy/nutrition campaigns in Zambia. Project evaluation was based on results from a baseline survey conducted in 2004 and a 2006 mid-term survey, quantitative time series data from a sample of beneficiary households, quantitative data from a randomized cross-sectional survey of beneficiaries and non-beneficiaries conducted in 2008, and qualitative data from interviews of relevant individuals. The author shows that net household income for project beneficiaries in 2008 was \$872, compared to \$578 at baseline and \$554 for non-beneficiaries. Household dietary diversity scores (HDDS) also showed improvement, from a 2006 baseline of 6.05 to 6.4 in 2008 for beneficiaries who had received cows, compared to HDDS of 4.6 for non-beneficiaries. The findings have not been subjected to an independent peer review,

however this seems to be an example of a value chain project with positive dietary implications.

2008

Bhutta, Z. A., Ahmed, T., Black, R. E., Cousens, S., Dewey, K., Giugliani, E., ... & Kirkwood, B. (2008). What works? Interventions for maternal and child undernutrition and survival. *The Lancet*, 371, 417-40.

The authors conducted literature reviews and performed meta-analyses for each of several types of nutrition interventions. Based on the available evidence, they formulated a list of core interventions for which there was sufficient evidence to recommend implementation in the 36 countries that have been identified as being where 90% of the world's stunted children live. The interventions that they identified as proven successes included breastfeeding counseling, vitamin A and zinc supplementation or fortification, and hand-washing or hygiene interventions. It should be noted that the authors identified several types of interventions for which there was insufficient evidence of impact, including dietary diversification strategies, small animal husbandry, and home gardening. They then utilized a cohort model to estimate the impact on children's mortality, stunting, and disability-adjusted life-years (DALYs) of each of these interventions if implemented at 70%, 90%, and 99% coverage levels in the 36 targeted countries. They estimated that if the eight proven interventions were implemented in all 36 countries at 99% coverage rates, the prevalence of stunting at 36 months would be reduced by 36%, death before 36 months would be reduced by 25%, and the proportion of lost DALYs would be reduced by 25%. They also show that universal supplementation during pregnancy could reduce maternal deaths by 24%. The authors noted that to achieve progress beyond these levels, it would be necessary to address the underlying causes of undernutrition such as poverty, disease, women's inequality, and inadequate education.

Bryce, J., Coitinho, D., Darnton-Hill, I., Pelletier, D., & Pinstrup-Andersen, P. (2008). Maternal and child undernutrition: Effective action at national level. *The Lancet* 371: 510–26.

The focus of the paper is providing guidance to the twenty countries with the highest burden of undernutrition regarding national-scale nutrition strategies. The authors describe seven important themes that are critical to success: “getting nutrition on the list of priorities, and keeping it there; doing the right things; not doing the wrong things; acting at scale; reaching those in need; data-based decisionmaking; and building strategic and operational capacity.” Agricultural research initiatives to improve the nutritional quality of crops and programs to increase agricultural productivity, such as use of fertilizers and irrigation systems are included in the section on “doing things right.” While the authors point to the importance of building in-country capacity to design and implement nutrition strategies, including human and institutional capacity, they do not provide useful examples of successful capacity-building processes that have had positive effects on nutrition.

Dillon, A. (2008). *Access to irrigation and the escape from poverty: Evidence from northern Mali*. IPFRI Discussion Paper 782. Washington, DC: International Food Policy Research Institute.

The object of the paper is to test “the impact of irrigation investments on agricultural production, consumption, and nutrient intakes” as well as the allocation of surplus to savings and/or intravillage sharing and the potential for irrigation to increase usage of child labor. Data are from two surveys conducted in 2006 by the author of 2,658 households, including 245 households that had participated in a similar survey in 1997-98. Questions covered agricultural production as well as demographic characteristics and economic activities. In the study area, irrigation has become more prevalent since 1997, reflected in an additional 30% of households with access to irrigation. This is due in large part to NGO support. The area is also characterized by low expenditures on agricultural inputs. The authors show that farmers in villages with access to irrigation have higher mean production levels, higher mean consumption levels, and higher caloric intake levels than farmers who rely on rainfed agriculture or a lake-recession system, and that despite the higher variability of production for those using irrigation, this risk is offset by the higher average production levels. The authors also show that the gains from irrigation are put into household savings and intravillage sharing, and that there is not an increase in child labor associated with irrigation.

Semba, R. D., de Pee, S., Sun, K., Sari, M., Akhter, N., & Bloem, M. W. (2008). Effect of parental formal education on risk of child stunting in Indonesia and Bangladesh: A cross-sectional study. *The Lancet*, 371(9609), 322-328.

Increased education is a very fundamental example of human capacity development, and thus this study of parental education and child stunting is included even though it does not address a nutrition-oriented capacity development program per se. The authors use cross-sectional data from the Nutritional Surveillance System in Indonesia and the Nutritional Surveillance Project in Bangladesh and perform econometric analyses including multivariate logistic regression models. Results show that in both Indonesia and Bangladesh, higher levels of both maternal and paternal education were associated with higher height-for-age Z scores of children and a reduced risk of stunting, although in Indonesia maternal education was more strongly associated with reduced stunting than paternal education and in Bangladesh the opposite was the case. The authors cite examples in the literature that also show differences in the relative importance of maternal versus paternal education regarding nutrition outcomes, which supports their findings. An important point that the authors make is that even in households with high levels of education for both the mother and father, rates of stunting are still high, which suggests that parental education is important but not sufficient to combat stunting. One must look beyond this study to understand how education impacts the success of nutrition programs and nutrition-sensitive capacity development projects, but it is possible that education has a multiplier effect.

Tontisirin, K., & Bhattacharjee, L. (2008). Community based approaches to prevent and control malnutrition. *Asia Pac J Clin Nutr*, 17(S1), 106-110.

Tontisirin and Bhattacharjee provide an overview of the important components of community based nutrition programs (CBNP), including the involvement of the community from the planning stages of the program through implementation, as well as the inclusion of diverse sectors such as agriculture and health. The authors then summarize CBNPs from the literature. Giving the example of the CBNP in Thailand, the authors describe volunteers who work with approximately ten households each and are given training in the important elements of the program including health and nutrition interventions. The program has grown to include 700,000 volunteers with broad reach throughout Thailand, which has experienced long-term and impressive reductions in malnutrition in recent decades. A home-gardening project in Lao PDR, combined agricultural training with nutrition education and capacity development and was associated with improvements in nutrition indicators, although the project was implemented on a small-scale (four villages). The cases presented by the authors are valuable examples of success. An issue they do not address is whether there are underlying social preconditions that are necessary for successful community based nutrition programs, such as literacy and female empowerment, yet the examples are valuable nonetheless.

2007

Leroy, J. L., & Frongillo, E. A. (2007). Can interventions to promote animal production ameliorate undernutrition?. *The Journal of Nutrition*, 137(10), 2311-2316.

Leroy and Frongillo perform a review of the literature regarding the impact of interventions to promote animal production on nutrition as well as the following intermediate outcomes: production, household income and expenditure, caregiver income, caregiver time and workload, zoonosis, and dietary intake. They found fourteen relevant studies, including projects involving aquaculture, dairy, poultry, and mixed horticulture/animal husbandry projects. The objectives of the projects varied, and included income generation, increased consumption of animal-sourced foods, and/or improved nutrition. Nutrition-specific programming and/or gender-specific components were included in some but not all projects. Based on the evidence available from the studies, the authors found that the interventions showed positive effects on animal production and income; mixed results regarding women's income levels and control of income; mixed results for caregiver time and workload; mixed but generally positive results for dietary intake of animal-sourced foods; and generally positive results regarding nutritional status (although this was based on only four studies with relevant data). The authors note that the inclusion of nutrition education and consideration of women's roles were important factors for success regarding diet and nutrition. The authors note several weaknesses in the study designs. One issue that they do not address is the possibility of publication bias, whereby more successful interventions would be more likely to be reported in the literature.

Low, J. W., Arimond, M., Osman, N., Cunguara, B., Zano, F., & Tschirley, D. (2007). A food-based approach introducing orange-fleshed sweet potatoes increased vitamin A intake and serum retinol concentrations in young children in rural Mozambique. *The Journal of Nutrition*, 137(5), 1320-1327.

The authors evaluate a two-year project in rural Mozambique with the objective of assessing “the effectiveness of introducing orange-fleshed sweet potato (OFSP) in an integrated agriculture and nutrition intervention aimed at increasing vitamin A intake and serum retinol concentrations in young children.” Data were gathered in longitudinal surveys of households in randomly selected villages from one control district and two intervention districts. The intervention included three elements: agricultural extension to distribute OFSP vines and information regarding OFSP production techniques, nutrition education regarding vitamin A and OFSP, and marketing assistance to promote and enable marketing of OFSP. Statistical analysis of the data revealed the following at the project’s end: the prevalence of wasting and low weight-for-age were lower in the intervention area than in the control area, whereas they were the same at baseline; nutritional knowledge was higher for men and women both compared with the control group and compared with the baseline; households in the intervention group dramatically increased OFSP production compared to the control group and baseline; consumption of OFSP increased much more amongst the intervention group than the control group from baseline to the final evaluation; and at the final survey, intake of Vitamin A and adjusted mean serum retinol concentrations were higher amongst children in the intervention group than amongst children in the control group. This was a small-scale intervention and the authors acknowledge that more work needs to be done to determine whether projects of this sort are feasible at larger-scale, whether and how future projects could be done more cost-effectively, and whether such interventions have long-term impact and sustainability.

The World Bank, Agriculture and Rural Development Department. (2007). The impact of agriculture interventions on nutrition outcomes (Ch. 3). In *Agriculture to nutrition: Pathways, synergies and outcomes*. Washington, DC: World Bank.

The report reviews agricultural interventions that affect nutrition through three pathways: “increased consumption from increased food production, increased income from the sale of agricultural commodities, and empowerment of women agriculturists.” A review of the literature regarding agricultural commercialization found that in most instances conversion to cash-cropping led to increased income and higher food expenditures, but not improvements in child nutrition. A review of the literature regarding homestead gardening interventions that promote the production of fruits and vegetables concludes that these agricultural interventions are most effective when coupled with nutrition education, but alone are less likely to lead to improvements in nutrition. The review of the literature regarding interventions to promote animal source foods including aquaculture, dairy, and poultry found that most interventions with relevant data showed an increase in income and/or expenditures, but mixed results regarding nutrition. The authors point to results from Leroy and Frongillo that indicate

that the animal food source interventions that include nutrition education or a focus on the role of women were the most successful in increasing nutrition. The specific interventions drawn upon from the literature are listed, and for many the authors point to weaknesses in the design of the studies, including a lack of randomization or control for selection bias.

The World Bank, Agriculture and Rural Development Department. (2007). Case Studies (ch. 4). In *Agriculture to nutrition: Pathways, synergies and outcomes*. Washington, DC: World Bank.

The chapter provides four case studies of agricultural interventions with nutrition components: “*an orange-fleshed sweet potato intervention to improve vitamin A intake in Mozambique, a legume systems and child nutrition program in Malawi, a homestead gardening project integrated with primary health care activities in South Africa, and an integrated homestead gardening and livestock program in Asia.*” Analysis of the four case studies revealed the following commonalities: inclusion of nutrition education, consideration of women’s roles, meaningful incorporation of local community members into the projects, and consideration of local contexts in program design and implementation. The case studies all demonstrated increased intakes of micronutrient-rich foods and the two studies that measured vitamin-A deficiency (VAD) showed reductions in the prevalence of VAD.

2006

Hawkes, C., & Ruel, M. T. (2006). *Understanding the links between agriculture and health. Agriculture and nutrition linkages: Old lessons and new paradigms*. (Focus 13, Brief 4 of 16). Washington, DC: International Food Policy Research Institute.

Hawkes and Ruel provide a summary of the linkages between agriculture and nutrition, including the challenges of undernutrition and overnutrition. They describe four main paths through which agriculture can help achieve improved nutrition: *increasing the availability and affordability of staple foods, raising incomes in households engaged in agricultural work, increasing access to micro-nutrient rich foods, and empowering women*. The authors provide brief examples of successful activities in each category. They also describe three ways in which trends in recent decades towards globalization and urbanization have affected the agriculture/nutrition relationship: *creating environments conducive to obesity and diet-related chronic diseases, elevating the role of agricultural marketing in nutrition linkages, and increasing the impacts of food and nutritional demands on agriculture*.

Mason, J., Soekirman-Galloway, R., Martinez, J., Musgrove, P., & Sanders, D. (2006). Community health and nutrition programmes. In: D. Jamison, J.G. Breman, A.R. Measham, G. Alleyne, & M. Claeson, (eds.) *Disease control priorities in developing countries*. Washington DC: World Bank.

The authors define Community Health and Nutrition Programs (CHNP) and give examples of large-scale CHNPs that have been implemented in recent decades. They describe various factors for success for CHNPs. They point to the consensus in the literature which emphasizes the importance of addressing both health and nutrition concerns in order to improve children's survival and development. They also describe the "S-shaped dose response curve" which suggests that there is a minimum level of resources that must be invested before generating improvements in indicators such as the prevalence of underweight. To analyze the impact of CHNPs, they draw upon ad-hoc surveys and program and administrative data, but admit that they do not have ideal control groups. The authors' analysis suggests that implementation of a CHNP is associated with a rapid decrease in the prevalence of underweight, followed by maintained decrease of 1-2% points per year. The majority of cases they look at are from Asia and Latin America, but the authors do not examine what role if any concomitant agricultural growth played in improving nutrition.

The World Bank. (2006). *Repositioning nutrition as central to development: A strategy for large scale action*. World Bank Publications.

The report references data and publications from various sources to explain the significance and causes of malnutrition, to describe successful actions that have been taken towards improving nutrition, and to discuss strategies for scaling up nutrition programs and moving to next steps. In a review of the evidence regarding successful nutrition programs and policies, the report distinguishes between "*the long route via birth spacing, food policies, and women's education, and the shorter route via health and nutrition services, micronutrient supplementation, conditional cash transfers, and nutrition education.*" The report discusses community-based growth promotion programs, and lists countries and one state that have successfully implemented such programs on a large scale: Tamil Nadu (India), Indonesia, Thailand, Bangladesh, Honduras, Madagascar, and Senegal. It is noted that these programs tend to combine nutrition with other health care components and that training of the workers/volunteers is an essential step in the process. This speaks to human capacity development, but the report notes that, "The literature on strengthening management and implementation capacity in nutrition is limited," and points to the need for greater emphasis on the implementation and research of capacity development.

2004

Berti, P. R., Krasevec, J., & FitzGerald, S. (2004). A review of the effectiveness of agriculture interventions in improving nutrition outcomes. *Public Health Nutrition*, 7(05), 599-609.

The authors performed a systematic review of the literature regarding agricultural interventions that evaluated nutritional outcomes between 1985 and 2001. They identified twenty-four peer-reviewed papers (two of which were from before 1985 but deemed relevant) and ten papers from the grey literature, resulting in a total of thirty projects excluding overlap. The projects were evaluated to determine whether they

included investments in each of the five types of capital as defined by the Sustainable Livelihoods Framework: natural, physical, human, social, and financial, and they were also ranked according to the author's confidence in the methodology of the study. They found that "broad-based" interventions that invested in three or more types of capital were more successful than interventions only addressing two or fewer types of capital. Their analysis also indicated that home gardening interventions were "somewhat" more successful than other interventions in terms of nutritional outcomes, but the authors note that these projects all had nutrition improvements as explicit goals and included nutrition education in the intervention, making attribution of the success difficult. The authors do not consider in this paper the cost-benefit analysis of broad-based versus narrow interventions, yet this is an important consideration for future research.

2003

Faber, M., & Benade, A. J. S. (2003). Integrated home-gardening and community-based growth monitoring activities to alleviate vitamin A deficiency in a rural village in South Africa. *Food Nutrition and Agriculture*, (32), 24-32.

The authors report on the results of a pilot study conducted in a village in Kwa-Zulu Natal, South Africa, that combined community-based growth monitoring (begun in 1995) with nutrition education regarding the importance of Vitamin A consumption and agricultural training in the production of beta carotene-rich vegetables. Growth monitoring and agricultural training were combined both in location (demonstration gardens were located at each growth-monitoring site) and time (trainings were given to mothers on the growth-monitoring day). Members of the community were actively involved in the project from its design through the implementation, and local individuals were trained to conduct growth-monitoring and to support the home-gardening initiatives. Evaluation was based on cross-sectional surveys (at baseline and twenty months later) in the community that received the home-gardening and nutrition education interventions and a nearby village that had the growth-monitoring program but not the agricultural or educational components. Results showed that serum retinol concentrations of pre-school children in the experimental village whose families had project gardens averaged 23.9 µg/dl, which was an increase from the baseline in the experimental village (20.9 µg/dl) and higher than the average levels for children in the experimental village without project gardens (20.6 µg/dl). In the control village, the average serum retinol concentration for pre-school children at baseline was 22.9 µg/dl versus 20.8 µg/dl at follow-up. While the results of this study are promising, the scale of the project was very small and the prospects of scaling up the intervention are not explored in detail.

Ismail, S., Immink, M., & Nantel, G. (2003). *Improving nutrition programmes: an assessment tool for action*. Rome, Italy: FAO.

The authors describe the components of community based nutrition programs and provide in-depth case studies of nutrition programs in the following countries: Kenya,

Madagascar, Zimbabwe, Bangladesh, Philippines, Sri Lanka, Brazil, Honduras, and Mexico, as well as desk reviews of programs in Thailand, Vietnam and Zambia. The Bangladesh Integrated Nutrition Program stands out as a program that was implemented on a large scale, demonstrated some degree of measurable improvement of nutrition indicators, and included community participation. The authors do not explicitly evaluate the programs in terms of investments in human and institutional capacity development, however, as described by Gillespie (2001) community participation is often an important component of capacity development.

2002

Iannotti, L., & Gillespie, S. (2002). *Successful community nutrition programming: Lessons from Kenya, Tanzania, and Uganda*. Washington, DC: The Linkages Project.

The authors present a compilation of ten studies that analyze community-based nutrition programs in Kenya, Tanzania, and Uganda. The programs are multi-sectoral and most include a combination of agriculture, health, and education components. In a section on capacity development and training, the authors explain that training is a part of all the programs evaluated, and they emphasize the importance of capacity development “at all levels” - staff, volunteers, and community members. Participatory approaches such as the Triple-A approach (assessment, analysis, and action) and the Participatory Rural Appraisal (PRA) are described with examples given from the case studies. The authors make the case that strong community involvement and capacity development are important factors for success and sustainability of nutrition programs. The authors suggest various lessons learned and recommendations for future programs, drawn from the case studies, although they have not performed a statistical meta-analysis to capture general trends. They acknowledge the need for more rigorous studies to link nutritional outcomes to program interventions.

Lipton, M., Sinha, S., & Blackman, R. (2002). Reconnecting agricultural technology to human development. *Journal of Human Development*, 3(1), 123-152.

Lipton et al. begin with a historical description of the major impacts of agricultural technology on human development, up to and including the Green Revolution which was characterized by large increases in food production, decreasing poverty, and gains in human development in Asia and Central America. However, the authors argue that since 1990 agricultural research has focused on the private sector rather than the needs of the rural poor, which has decreased the role of agricultural technology in the human development process. The central thesis of the paper is that “Agrotechnical processes of research, invention and adoption can improve human development by raising average consumption, nutrition, education or health, but can also affect their spread, stability, and sustainability.” They describe the progress in the spread of irrigation technology in recent years (at time of writing) as painfully slow, particularly in Africa where only 3-5% of cropland benefits from water management techniques. They also describe the need for new plant varieties and increased adoption of Integrated Pest Management to deal

with the threat of pests. While the authors do not describe nutritional benefits of recent agrotechnical programs, the implication is that these and other benefits have been limited as of late.

2001

Gillespie, S. R. (2001). *Strengthening capacity to improve nutrition*. FCND Discussion Paper. Washington, DC: International Food Policy Research Institute.

The author provides a thorough explanation of capacity development as it pertains to nutrition. He explains that a human-rights based approach to nutrition inherently examines the capacity of individuals to meet their nutrition needs. He describes decentralization of nutrition programming as an essential part of the process because this allows individuals and communities to develop capacity to meet their own needs from a bottom-up rather than top-down approach. He then provides a list of capacity development steps that can be taken: “*adding staff, adding physical and financial inputs, providing training and technical assistance, introducing new technologies, changing coordination mechanisms, giving particular stakeholders increased voice in planning and implementation, altering the balance between public and private sectors in service delivery, reforming specific organizational systems, changing or enforcing laws, rules or regulations, changing attitudes, values, organizational cultures, changing incentives, providing information, and increasing accountability.*” (Heaver 2000). However, few examples of successful capacity development programs are provided. The author acknowledges this gap and points to a lack of evaluation and the need for case studies that can be used as models for capacity development for nutrition.

Ruel, M. T. (2001). *Can food-based strategies help reduce vitamin A and iron deficiencies?: A review of recent evidence* (Vol. 5). Washington, DC: International Food Policy Research Institute.

The author reviews the literature regarding “food-based interventions for reducing vitamin A and iron deficiencies in the developing world”. The author describes the primary types of food-based strategies, including interventions to increase production and consumption of relevant foods, improve the bioavailability of nutrients, and plant-breeding strategies to increase nutrient levels and bioavailability of food. Ruel cites several studies, mostly of home-gardening interventions, that indicate an increase in consumption of Vitamin A-rich foods, but few demonstrate improvements in nutritional status. Evidence of the impact of interventions to increase the production and consumption of plant- or animal-based iron is even more limited. An important theme that the author identifies is the importance of including nutrition education as part of the intervention. The lack of rigorous research into the efficacy and effectiveness of food-based strategies is also noted.

2000

Kidala, D., Greiner, T., & Gebre-Medhin, M. (2000). Five-year follow-up of a food-based vitamin A intervention in Tanzania. *Public Health Nutrition*, 3(4), 425-432.

The authors conducted a quasi-experimental post-test study of a project that was undertaken in 1992 and 1993 in five villages of the Illongero District of Tanzania. The goals of the original project were: “*promoting increased production and consumption of vitamin A-rich foods and enhancing proper preparation of these foods.*” Project activities included the training of village leaders and Project Implementation Committees, who then conducted seminars for villagers on the importance and sources of vitamin-A rich foods, gardening techniques, distribution of seedlings to households and primary schools, food storage and preparation, breastfeeding and weaning foods, etc. A survey was conducted in 1991 of the target villages and villages in a control district, from which a summary of findings but not the data were available to Kidala et al. A second survey was conducted in 1998 (five years after the conclusion of the program) of randomly selected households and subjects in five intervention villages and five control villages. Results showed that in the intervention group, knowledge of solar driers, prevalence of home gardens, and frequency of consumption of vitamin A-rich foods were higher than in the control group. Contrary to expectations, the children in the control group had significantly higher mean serum retinol levels than children in the intervention group. Also, 79% of children in the intervention group were shown to be infested with helminths (worms), compared to 49% in the control group. After taking into account helminth infestation, the difference between serum retinol levels in the control and experimental groups was no longer statistically significant. A weakness in the study was the unavailability of data on the baseline variables, although the initial report gave some indication of comparability.

1999

Tontisirin, K., & Gillespie, S. (1999). Linking community-based programs and service delivery for improving maternal and child nutrition. *Asian Development Review*, 17(1/2), 33-65.

Tontisirin and Gillespie describe the best-practices for the development and implementation of community-based nutrition programs, drawing largely upon a detailed description of the example of Thailand. In the 1980s and 1990s, Thailand experienced a very successful reduction in malnutrition at the national level, which was possible in part because of wide-spread support throughout the government. A multi-faceted approach was taken, with integration of nutrition, health, agriculture, and education components. Growth monitoring of children was conducted by the community volunteers at the same time and place as other health checks. Training/empowerment of community volunteers and higher-level program managers was extensive, which constitutes a significant example of human and institutional capacity development. From the literature on community-based nutrition programs, the authors describe the social conditions that should either be in place or developed within the program to help

ensure success. However, in regard to whether this model is replicable, the authors emphasize that there is no one-size-fits-all solution, but rather that the bottom-up process, particularly as developed through the Triple-A approach of assessment, analysis, and action, should be applied. The authors make a compelling case for the community-based nutrition programs, however they do not clearly present statistical evidence linking the success in Thailand or elsewhere to these programs, which is likely made difficult by the nearly universal coverage of the programs (in Thailand) and the tightly entangled, holistic nature of the approach.

1989

Von Braun, J., Puetz, D., & Webb, P. (1989). *Irrigation technology and commercialization of rice in The Gambia, effects on income and nutrition* (Vol. 75). Washington, DC: International Food Policy Research Institute.

The authors analyzed the effects of a project that promoted pump irrigation of rice fields in rural areas of The Gambia. The project included the participation of approximately 7,500 households, and data were gathered from surveys of 900 households including participants and non-participants selected by two-stage random sampling. The authors' analysis of the data indicates that farmer households in the intervention group had higher rice production levels than did households in the control group. The authors also found that households with access to pump irrigation had a lower prevalence of calorie deficiency in the wet (hungry) season than non-participants. However, in the dry season, participant households were more likely to face calorie deficiencies than non-participants, which the authors noted was a topic for further research. The project attempted to direct more control of irrigated land to women by giving women land titles, however the authors found that women controlled land fed by rainwater and partial irrigation rather than the pump irrigated land. Analysis of the factors influencing nutrition show that the positive effects on nutrition are through the income-consumption pathway, which was shown to have substantially improved nutrition of children in the intervention group (measured with anthropometrics). Access to the irrigated rice land was also associated with reduced weight loss amongst mothers in the wet season relative to the control.