Final Technical Report

Project Title:
From Field to Fork: Nutrition and Food Security in Uplands of Vietnam and Thailand
IDRC Project Number: 107324

Research Organizations involved in the study:

- Center for Agricultural research and Ecological studies, Hanoi University of Agriculture (CARES-HUA)
- Center for Agriculture Forestry Research and Development (CARD) – Hue University of Agriculture and Forestry
- Knowledge Support Center-Greater Mekong Sub-region (KSC-GMS), Faculty of Social Sciences, Chiang Mai University
- HealthBridge Foundation of Canada

Location of Study:

- Yen Chau district, Son La province, Vietnam
- A Luoi district, Thua Thien Hue, Vietnam
- Mae Chaem district, Chiang Mai, Thailand

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Abbreviations

AFS	Agriculture and Food Security
CARD	Center for Agriculture Forestry Research and Development
CARES	Center for Agricultural Research and Ecological Studies
CMU	Chiang Mai University
DD	Dietary Diversity
FGD	Focus Group Discussion
FS	Food Security
HB	HealthBridge Foundation of Canada
HBV	HealthBridge Foundation of Canada, Vietnam Office
HH	Household
HUA	Hanoi University of Agriculture
HUAF	Hue University of Agriculture and Forestry
IDI	In-depth Interview
IDRC	International Development Research Centre
IRB	Institutional Ethical Review Board
KII	Key Informant Interview
KSC-GMS	Knowledge Support Center-Greater Mekong Sub-region
MPH	Master of Public Health
NGOs	Non-Government Organization
NIA	National Institute of Agriculture
RC	Research Coordinator
RO	Research Officer
SRI	System of Rice Intensification

Executive Summary:

Nutrition-sensitive agriculture (NSA) interventions are of increasing interest to those working in global health and nutrition. However NSA is a broad concept, and there are numerous candidate NSA interventions that could be implemented in any given setting. While most agriculture interventions can be made "nutrition-sensitive", there are no explicit guidelines for helping to decide what agriculture component should be tried in an NSA intervention. Based on previous models, we developed a framework with explicit questions about community factors (agricultural production, diets, power and gender), project factors (team capacity, budget, timelines) and external factors that helped our team of agriculture scientists, nutritionists and local officials identify NSA interventions that may be feasibly implemented with a reasonable chance of having positive agriculture and nutrition impacts.

We applied this framework in two settings in upland Vietnam (Yen Chau and A Luoi district), and one setting in upland Thailand (Mae Chaem district). From an initial list of nineteen interventions that have been tried elsewhere, or may reasonably be expected to be appropriate for NSA, five or six candidate interventions were considered per site. Based on the criteria, three to four interventions were selected and implemented per site. Poultry rearing and home gardening were selected in each site complemented by nutrition education to maximize the use of these nutrient-rich food sources. They, and the other selected interventions, hold promise for capitalizing on underused agricultural potential to improve diets, while working with (or improving) existing gender relationships and power structures. The interventions have been trialed in three sites for 13 to 18 months from May 2014 to December 2015.

Chicken raising was applied in all three sites. However, after about 6 to 15 months of implementation in the three research sites, only in A Luoi did the intervention participants maintain a high percentage (97%) of chickens provided by the project and had higher consumption of eggs and chicken meat compared to control group. In Mae Chaem and Yen Chau, only 6% and 24% chicken survived, respectively. Though farmers expressed their desire to continue chicken raising, they may need much more support if they are to have chickens survive and produce eggs and meat for eating.

Growing vegetables in home gardens brought positive changes, though the farmers faced difficult conditions. There was a lack of water in Mae Chaem and heavy rain in A Luoi. In Mae Chaem, 74% to 91% of intervention households (HHs) grew each of the 5 promoted varieties in their garden. The intervention vegetables were consumed by 48% to 83% of the intervention HHs in Mae Chaem. In A Luoi, 60% of the HHs maintained the vegetable cultivation during the intervention period. Among the intervention HHs, 30% produced vegetables in excess of the needs for their family's diet. As a result, the percentage of households who consume vegetables and the amount that they consume is significantly higher in the intervention group than in control group among both children under 5 years and their parents. In Yen Chau, intervention HHs grew more types of vegetables compared to control HHs at endline ($p<0.05$). The percentage consuming various nutrient-rich vegetables is higher in intervention HHs than control HHs (except for papaya). In addition, intervention HHs sold more produce in the market than control HHs.

In A Luoi, the proportion of food secure households increased from 2% of at baseline to 8% at endline ($\chi 2$ test, $p<0.001$), and Severely Food Insecure households reduced from 61% at baseline to 26% at end-line ($\chi 2$ test, $p<0.001$). Food security in Mae Chaem and Yen Chau, however, was reduced from 26% to 17% and 45% to 40%, respectively ($\chi 2$ test, $p<0.05$).

In intervention groups, Dietary Diversity (DD) and Minimal Adequate Diet (MAD) scores improved in children 6-23 months in Mae Chaem and A Luoi. The average number of food groups consumed increased in Mae Chaem from 2.7 to 4.8 ($\chi 2$ test, $p <0.001$) and in A Luoi from 2.3 to 4.3 ($\chi 2$ test, $p <0.001$), but did not change in Yen Chau (3.0 at baseline and 4.5 at end-line, t-test, $p>0.05$). The percentage of children who received ≥4 food groups per day increased in Mae Chaem from 39% to 93% ($\chi 2$ test, $p <0.001$) and in A Luoi from 27% to 94% ($\chi 2$ test, $p <0.001$), but did not change in Yen Chau (30% baseline, 75% at end-line, Fisher' exact $p>0.05$).

The proportion of children meeting MAD increased in A Luoi from 9% to 48% ($\chi 2$ test, $p <0.001$) and in Yen Chau from 4% to 75% (Fisher's exact test, $p <0.001$), but did not change in Mae Chaem (3% baseline, 14% end-line, $\chi 2$ test $p>0.05$).

The percentage of children who consumed iron-rich or iron-fortified foods increased in Mae Chaem from 36% to 93% (Fisher's exact test, $p<0.001$) and in A Luoi from 52% to 84% ($\chi 2$ test, $p<0.01$) but did not change in Yen Chau (52% at baseline, 100% at end-line, Fisher's exact test, $p>0.05$). However, age of the children and not the interventions may have influenced this in that as the children become older, their diet generally become more diverse.

Gender roles were positively changed in all three sites in terms of sharing of childcare and domestic tasks between the wife and husband and decision-making (in Mae Chaem mainly in decision of vegetable selection, selling and use of revenues).

Barriers that limited the success of the interventions were poultry diseases, challenging weather and drought conditions. They negatively influenced the farming and maintenance of chickens and vegetables. Therefore additional interventions should be researched and tested for year-round productivity of NSAs.

The Thailand team suggested to sub-district level authorities in Mae Chaem that they integrate in their annual and multi-year policies and action plans NSAs that incorporate nutrition into agricultural promotions, as well as to ensure food and nutrition security. Vietnamese teams recommended to local authorities in A Luoi and Yen Chau that they ensure technical support for chicken raising, especially efforts to increase coverage of high quality vaccines for disease prevention of poultry. They also recommended providing regular training on nutrition with practicum for parents and caretakers of young children, focusing on the use of local nutrient-rich foods.

The research problem:

Malnutrition and food security remain serious problems in both Vietnam and Thailand, particularly among ethnic minorities living in remote, upland areas (Baulch et al. 2007; GSO

(General Statistical Office of Vietnam) 2011). The national prevalence of underweight and stunting is 11.7% and 22.7%, respectively, in Vietnam, and 9.2% and 16.3%, respectively, in Thailand. Rates in both countries are higher in the poverty-stricken highland-minority communities (GSO (General Statistical Office of Vietnam) 2011; National Statistical Office of Thailand 2013).

The current study was carried out in three locations: Mae Chaem district of Chiang Mai province in northern Thailand (with Lua and Karen ethnic groups), A Luoi district of Thua Thien Hue province in central Vietnam (with Cotu, Taoi, Paco, Van Kieu and Kinh ethnic groups), and Yen Chau district of Son La province in north Vietnam (with Kinh, Thai, Kho Mu, and H'mong ethnic groups). Specific villages were selected based on accessibility by the research team, perceived potential for change, and representativeness of major ethnic groups. The three sites have broadly similar climates, with temperatures hitting lows of 15 to 20 °C in December and highs of 25 to 35 °C in May through July, and the monthly rainfalls ranging from close to 0 mm in December to as much as 250 to 300 mm in August in Yen Chau and Mae Chaem, or 1000 mm in A Luoi in October. Agriculture practiced in these communities is predominantly subsistence agriculture (or semi-subsistence in the case of Yen Chau district in northern Vietnam with 60% of farmers producing their own rice and nearly all producing their own vegetables).

There is a need in all three locations to identify long-term, sustainable solutions to increase local food availability in these vulnerable areas. The populations in these areas are food insecure with high rates of malnutrition (Minot et al. 2006; GSO (General Statistical Office of Vietnam) 2011; Tienboon and Wangpakapattanawong 2007). Their food security is threatened further by transitions taking place in the local farming systems. Traditionally, farmers in highland areas (more than 600 metres above sea level) have practiced "shifting agriculture", also known as swidden or slash-and-burn agriculture. The burning of the trees by farmers provided a nutrient-rich layer of ash that allowed for a season or two of high levels of crop production. Farmers would then move to new areas to repeat the cycle, while the burnt area was left to regenerate (Rambo and Cuc 1996). There is now intense pressure to transition away from shifting agriculture, in both Vietnam (where it is now illegal) and northern Thailand as alternative methods of farming are now being sought because there is insufficient land for the number of people farming to leave land fallow long enough to regenerate (Sikor and Nguyen 2011; Thomas et al. 2004). There is tension between farmers' needs for high levels of production in the short term, which makes increasing levels of agriculture inputs (especially synthetic pesticides and fertilizers) attractive to the farmers, and the longer term degradation of the environment caused by this industrialization of agriculture (Dung et al. 2008; Tuan et al. 2014).

Progress towards milestones:

The research has progressed well as planned for all milestones as specified in the Grant Agreement.

Milestones in first reporting period: From March to August 2013, the project achieved the following:

1.1 Effective team work established; collaborative agreements and sub-contracts formalized with

third party organizations; and recruitment of key personnel completed. HealthBridge (HB) signed contracts with its three research partners in March 2013. These third party organizations are: 1) the Center for Agricultural Research and Ecological studies, Hanoi University of Agriculture (CARES-HUA); 2) Center for Agriculture Forestry Research and Development (CARD) – Hue University of Agriculture and Forestry; and 3) Knowledge Support Center-Greater Mekong Sub-region (KSC-GMS), Chiang Mai University. These institutions established research teams lead by the Co-Principle Investigators for the period from March 2013 till February 2016. HB Vietnam recruited a Research Coordinator (RC) and a Research Officer to coordinate the three research teams and monitor the research progress.

1.2 Project inception workshop held and report finalized. Project inception workshop was held from April 29-May 3, 2013 in Chiang Mai, Thailand. The inception workshop report covered common team vision, coordination and communication mechanisms, and implementation plan including monitoring and evaluation.

1.3 Study design, methods, sampling strategy, data collection tools and gender strategy finalized. Research protocol was developed and discussed amongst the teams. Research methods including design, sampling, tools for data collection, database and guidelines for data entry and analysis were finalized. Tools for data collection were tested and finalized. Lists of target villages with ethnic groups were created for sampling. The protocol was reviewed and approved by the Institutional Ethical Review Board (IRB) of Hanoi School of Public Health for Vietnam sites, and provisionally approved by the Human Experimental Committee of Chiang Mai University for the Thailand site.

1.4 Relevant stakeholders identified and stakeholder engagement strategy developed for each site. List of stake holders and stake holder engagement strategies was developed by each team and submitted.

Milestones in second reporting period: September 2013 – February 2014, the project achieved the following:

2.1 Completed commencement workshops conducted in Vietnam sites in September 2013 (workshop in Chiang Mai was done in August 2013). In September 2013, the CARES and CARD teams conducted workshops with local community representatives and relevant officials in health and agricultural sectors prior to the data collection for the baseline survey. In the workshops, the research teams discussed the site selection, project implementation plan, and called for support and coordination from local authorities and communities.

2.2 Completed institutional ethical procedures. The research ethical application of the CMU was approved by the Human Experimentation Committee of the Research Institute for Health Sciences, Chiang Mai University in early November 2013.

2.3 Research team trained on gender, nutrition intervention design, advocacy & policy formulation, tracking affordability of interventions, data management and analyses. Research teams in all three sites were involved in developing the research protocol and data collection tools. Rather than formal training on data management and analyses, HealthBridge developed

detailed guidelines on entering data in Epi-data and provided technical support to the research teams via e-mail, monthly skype calls and on-site visits by the Research Coordinator.

2.4 Field staff at each study site trained on data collection tools and protocols. Field staff and research coordinators/assistants at each of the three sites were trained on research protocol, data collection tools and implementation plan, ethical issues in working with minority groups and consent process. The survey questions were discussed in-depth to ensure consistency of understanding amongst the field staff.

Milestones in third reporting period: March 2014 – February 2015, the project achieved the following:

1.1 Analysis of data and report on agriculture and conditioning factors as well as nutrition situation across the three sites completed: Data collected in the baseline survey on agriculture and nutrition situation were analyzed and a report for each of the three sites was completed. Preliminary findings were shared by the three teams for comments and discussions amongst the team and from HB.

1.2 Nutrition sensitive agriculture interventions and appropriate messages identified: Three interventions were selected to apply in all three sites: 1) home garden improvement to provide nutritious vegetables; 2) chicken raising for eggs to provide animal-source food for children; and 3) nutrition training to improve mother and care takers' understanding of good feeding practices. In addition, Yen Chau site introduced System of Rice Intensification (SRI), vermiculture to provide chicken feed, and a variety of potato from the Netherlands.

1.3 Mid-term assessment of the intervention design, monitoring and implementation plan:

- *Yen Chau site*: Mid-term assessment of the intervention was conducted in combination with the monthly monitoring visit in January 2015. In general, all interventions were working well and the farmers were interested in continuing the models. Chicken raising, seasonal vegetable planting and vermiculture were more attractive than previously used methods, and other families in the commune had been copying them on their own, without project support. Three of the five HHs who applied SRI in rice planting have shown a 10% increase in production. Although one HH had no increase and one HH had a decrease in rice production in the first season, they were willing to continue with the second rice season.

- *A Luoi site*: The mid-term assessment of the interventions was conducted in combination with the monthly monitoring visit in December 2014 after about 3 months of implementation. Participating families were interested in the interventions and were committed to continuing with the models. Families had been applying the practices taught in the nutrition training. Other HHs expressed interest in participating in the interventions, so the research team planned to expand the intervention models to other HHs in February and March 2015.

- *Mae Chaem site*: The interventions started in Mae Chaem in late November 2014 after receiving ethics approval from the Human Experiment Committee of Research Institute of Health Sciences of Chiang Mai University. The research team conducts monthly intervention monitoring and report that the interventions are progressing well. There are some challenges for vegetable planting in the dry season and the team and communities have been discussion solutions for improving water resources. Other organizations and groups

(local health volunteers of Mae Chaem district and Chiang Mai University) have been watching the trials and approached CMU for a proposal to scale-up successful models in other villages.

1.4 Pilot testing of nutrition-sensitive solutions in each site was to complete: At this stage, solutions were in process and would be completed in the coming months.

1.5 Feasibility and affordability of the solutions documented: Feasibility and affordability of the solutions was considered at the outset given that the teams only selected nutrition-sensitive agriculture solutions that were feasible in the project sites and affordable to the local farmers. This has been continually assessed through monthly monitoring visits, and the team actively investigated solutions to any arising challenges. The findings that farmers in each of the three sites are planning to continue the solutions beyond the project supports that the notion that the solutions are feasible and affordable. This was further supported by the fact that non-intervention households were asking to participate or started copying the methods on their own.

Milestones in fourth reporting period (final): March 2015 – February 2016, the project completed the final report with the following details:

4.1 Data integrated and analyzed within and across all sites and change in dietary diversity, household food security and child feeding practices documented. The interventions were monitored regularly and an end-line evaluation was conducted in all three sites by early 2016. Data from monitoring and evaluation was collected, analyzed and used to develop site reports.

4.2 Focus groups held with local community members and feedback on the implementation of the nutrition-sensitive agriculture solutions documented. At each site, focus groups were held with local community members to receive feedback on the interventions as well as discuss affordability, feasibility and recommendations for sustaining and scaling up the successful nutrition-sensitive agriculture solutions. Qualitative information was collected, analyzed and documented in combination with quantitative information.

4.3 Report produced with key recommendations for improving nutrition and food security through affordable solutions and shared between teams and relevant stakeholders. A report from each of three sites was developed and shared with local stakeholders.

4.4 Findings from pilot-testing shared with local community members and relevant local experts/ policy makers, and actions for uptake of the solutions identified. At each of Mae Chaem, A Luoi and Yen Chau sites, the research teams conducted workshops with local community members and leaders to report results of the interventions and discuss policy implications.

4.5 Publication of articles in scientific journals and abstracts submitted to relevant conferences. The article titled "The process of developing a nutrition-sensitive agriculture intervention: a multi-site experience" has been submitted in Feb 2016 to "Food Security: The Science, Sociology and Economy of Food Production and Access to Food", and is currently under review.

4.6 Reports and policy briefs developed and disseminated to policy makers, decision makers and relevant experts. In early March 2016 when all field activities were completed and data analyzed, a dissemination workshop was organized in Hanoi by HealthBridge with participation

of local stakeholders, researchers and some of the farmers and leaders of the National Institute of Nutrition and the Ministry of Health, as well as other organizations working in nutrition and public health. The research teams developed presentations to share key findings of the interventions and the experiences of implementing nutrition-sensitive agriculture interventions (NSAs) for participants' comments.

Synthesis of research results and development outcomes:

The overall objective of the project was to identify local, practical solutions to improve nutrition and food security amongst smallholder farmers in rural upland communities in Vietnam and Thailand through nutrition-sensitive agriculture solutions. The research was granted ethical clearance by the Internal Review Board (IRB) of the Hanoi School of Public Health (for sites in Vietnam) and The Human Experimentation Committee of the Research Institute for Health Sciences, Chiang Mai University (for site in Thailand) for all stages, and research teams complied with ethical principles.

The research was designed in two stages in which each stage served specific objectives of the project as follows:

The **first stage** was carried out between July 2013 and March 2014. The objective was to assess nutrition and agriculture practices to respond to the three specific objectives including:

- **Specific objective 1:** To characterize the nutrition situation, nutrition practices and knowledge, and food consumption patterns in participating upland communities.
- **Specific objective 2:** To characterize the local farming practices, including documenting the heterogeneity of agro-ecological practices to identify potential practices that could be tested as nutrition-sensitive agricultural solutions.
- **Specific objective 3:** To analyze the relationships between food production, availability, and consumption, and the conditioning factors (e.g. gender dynamics, market infrastructure, natural resources, including local wild foods) that limit or promote healthy diets.

The detailed findings of Stage 1 have been reported earlier (Second Interim Report and individual site reports). Building on existing descriptions of the pathways between agriculture and nutrition, we considered food and nutrition, the local power structure, gender and family, and community factors regarding agricultural production to identify the most promising NSA interventions to test. From an initial list of nineteen interventions that have been tried elsewhere, or may reasonably be expected to be appropriate for NSA, five or six candidate interventions were chosen per site. Based on the criteria, three to four interventions were selected per site and were implemented in Stage 2. The candidate and selected interventions are shown in Table 1.

Table 1. Proposed and selected NSA interventions for testing in 3 research sites in Thailand and Vietnam: 2014-2015.

Mae Chaem	A Luoi	Yen Chau
Poultry farming → *chicken**	Poultry farming → *chicken**	Poultry farming → *chicken** Vermiculture* for chicken feed
Food preservation	Fishpond	Rice (SRI)*
Home gardening*	Home / school gardening*	Home / school gardening*
Nutrition education*/ child feeding	Nutrition education*/ child feeding	Nutrition education*/ child feeding
Water system improving	Beans & inter-cropping	Pumpkin processing
		Crop diversifying on slopping land

*The NSA interventions selected for testing

The **second stage** was carried out between March 2014 and March 2016. The overall objective was to develop and test nutrition-sensitive agriculture solutions to respond to two specific objectives including:

- **Specific objective 4:** To develop and test affordable and sustainable nutrition-sensitive agriculture practices that improve the nutrition and food security of participating households.
- **Specific objective 5:** To engage multi-stakeholders to promote learning and understanding, and to facilitate broad adoption of solutions, including potential policy impacts.

The NSA interventions were trialed for at least one growing season in each site during the period from May 2014 – November 2015 in the randomly assigned intervention villages. Control villages did not apply interventions. The intervention included only households with children under 5 years in the intervention villages who consented to participate.

Evaluation

The endline evaluation used both quantitative and qualitative methods to quantify the changes in nutrition and food security, as well as any changes in gender roles, sharing workload, and child care responsibility. The evaluation considered the affordability and sustainability of the tested interventions. Data were collected between September 2015 and January 2016 through household surveys and focus group discussion with parents or caregivers of children under five years old (Table 2). Endline data collection closely matched with baseline data collection to allow for comparisons of the two data sets, with additional questions on affordability, policy issues and environment included to assess these aspects of the trials.

For the household surveys, we purposively selected participants from all households (HHs) with U5 children who participated in the interventions, and randomly selected 50 households from lists of households with U5 children in control group. Focus groups discussions were conducted with men and women with children under 5 years who were purposively selected from intervention group to discuss benefits and costs of each of the NSAs, as well as affordability and sustainability of the NSAs from their own perspectives

(Table 2). Gender roles were discussed to see if the research brought any positive or negative changes in this area.

Table 2. Sample size of household surveys and focus group discussions for each of the sites.

Study Participants/ Sampling methods	Sample size			Data collection tool
	Mae Chaem	A Luoi	Yen Chau	
Household survey: Parents/ caregivers of U5 children				
Intervention: Purposively selected all HHs with U5 children who participated in interventions	87	110	54	**Structured questionnaire:** **1.** Agricultural production: Crops/ Animals **2.** Dietary Diversity **3.** Food security **4.** Breastfeeding **5.** Eating habits **6.** Gender roles **7. Affordability*** **8. Policy issues*** **9. Environment*** (*added for end-line survey)
Control: • Mae Chaem: all HHs • A Luoi & Yen Chau: Random selection of 50HHs from HHs with U5 children	69	50	53	
Total: 423 participants	**156**	**160**	**107**	
Focus Group Discussion: Parents/ caregivers of U5 children from Interventions (2-3 farmers participated in intervention)				
2 FGDs of Females / site	12	16	18	**Guidelines:** 1. Gender role 2. Affordability
2 FGDs of Males / site	12	16	18	
Total: 92 participants	**24**	**32**	**36**	

Results

Training on nutrition and values of foods for parents and care takers of children under 5 years

Parents and caretakers of children under 5 years old who participated in interventions were provided with training on nutrition and feeding of children to raise their awareness, increase their capacity and improve nutrition and feeding practices. The training encouraged them to use the nutrient-rich foods that they could produce themselves and other local foods. The training included breastfeeding, complementary feeding, values of food groups, especially protein-rich and vitamin-rich foods that were represented by eggs and different vegetables

as introduced by NSA interventions, and practices of good cooking for children. Between the three sites there were 271 parents and caretakers (243 females, 28 males) of children under 5 years and local staff who were trained on nutrition and child feeding, and who practiced cooking. There were 113, 69, and 83 participants from Mae Chaem, A Luoi, and Yen Chau, respectively (Table 3). According to the results of the focus groups, the training contributed well to their practice of child feeding at home, reflected in increased dietary diversity.

Nutrition-sensitive Agriculture Solutions Tested

Testing of the NSA interventions started in Yen Chau in May 2014 and was evaluated in August 2015. In A Luoi, the dates were September 2014 and November 2015, respectively, and in Mae Chaem the dates were November 2014 and December 2015, respectively.

Chicken raising: Chickens and feed were provided to the participating households in the intervention villages. The chickens had been vaccinated and the households were trained on relevant farming techniques. The families were responsible to monitor the egg production and consumption of their children and family members with technical support and periodic supervision from health or agriculture staff of the commune.

Home gardening: Several varieties of vegetables were provided to the participating households in intervention villages. The farmers were provided with seeds or young plants, as well as technical training and monthly monitoring by agriculture extension staff. Five varieties of nutrient-rich vegetables were promoted for home gardening in Mae Chaem and Yen Chau and 11 varieties were grown in A Luoi.

Additional details can be found in the individual site reports (Annex 4 – CMU report for Mae Chaem; Annex 5 – CARD report for A Luoi; Annex 6 – CARES report for Yen Chau).

Additional interventions in Yen Chau site only: some households in intervention villages of Yen Chau voluntarily applied the System of Rice Intensification (SRI). Some households tried vermiculture to produce feed for chickens. Moringa, a new species of vegetable, and some other nutrient-rich and high-production fruit varieties were introduced to some families in the intervention group in Yen Chau (see Annex 6 – CARES report).

Food security at household level in three sites

At endline in A Luoi, the average Food Security Score was higher in intervention households (6.8 ± 4.3) than in control (8.8 ± 5.0; $p < 0.001$). The average Food Security Score did not improve in Mae Chaem and Yen Chau. Similar results are found when comparing Food Security classification, with intervention households in A Luoi showing increase in Food Secure and decrease in Food Insecure (mildly, moderate and severely) ($\chi 2$ test, $p<0.05$), with no changes in the control group. In Mae Chaem and Yen Chau Food Security status did not change (Table 4).

Dietary Diversity at household level in three sites

For the intervention groups alone (see Table 5), the Dietary Diversity (DD) and Minimal Adequate Diet (MAD) scores improved in children 6-23 months in Mae Chaem and A Luoi. The average number of food groups (average, SD) increased in Mae Chaem from 2.7 (± 2.1) to 4.8 (±1.4; t-test, $p < 0.001$) and in A Luoi from 2.3 (±1.3) to 4.3 (±0.8; t-test, $p < 0.001$), but

did not change in Yen Chau (3.0 ±1.6 at baseline and 4.5 ±1.3 at endline; t-test, p>0.05). The percentage of children who received ≥4 food groups per day increased in Mae Chaem from 39% to 93% (χ2 test, p <0.001) and in A Luoi from 27% to 94% (χ2 test, p <0.001), but did not change in Yen Chau (30% at baseline and 75% at end-line, χ2 Fisher' exact p>0.05). These changes may be due to increasing age of children in the sample, rather than real changes.

The proportion of children who consumed a MAD increased in A Luoi from 9% to 48% (χ2 test, p <0.001) and in Yen Chau from 4% to 75% (Fisher's exact test, p <0.001), but did not change in Mae Chaem (3% at baseline and 14% at end-line; χ2 test p>0.05).

Consumption of iron-rich or iron-fortified foods increased in Mae Chaem from 36% to 93% (Fisher's exact test, p<0.001) and in A Luoi from 52% to 84% (Fisher's exact test, p<0.01) but did not change in Yen Chau (52% at baseline, 100% at endline; Fisher's exact test, p>0.05).

*Comparison between intervention and control groups (*Table 5*)*

DD at endline in intervention groups in Mae Chaem and A Luoi was significantly higher than in control groups. In Mae Chaem, the number of food groups consumed per day of children was 4.8 (±1.4) in intervention group compared to 4.4 (±1.7) in control group (t-test, p<0.001), and the proportion of children who received ≥4 food groups per day was 93% in intervention group compared to 80% in control group (χ2 test, p <0.001). In A Luoi, number of food groups consumed per day of children was 4.3 (±0.8) in intervention group compared to 3.1 (±1.4) in control group (t-test, p<0.001), and the percentage of children who received ≥4 food groups per day was 94% in intervention group compared to 43% in control group (χ2 test, p <0.001).

In Yen Chau, DD was not significantly different between intervention and control groups. The number of food groups consumed per day in children was 4.5 (±1.3) in intervention group compared to 2.2 (±2.6) in control group (t-test, p>0.05) and the percentage of children who received ≥4 food groups per day was 75% in intervention group compared to 50% in control group (Fisher's exact test, p >0.05).

The proportion of children who consumed a MAD at endline in intervention groups in A Luoi and Yen Chau was higher than in control groups. In A Luoi, 48% of children had a MAD in intervention group compared to 10% in control group (χ2 test, p <0.01). In Yen Chau 75% consumed a MAD in intervention group compared to 25% in control group (Fisher's exact test, p <0.01). MAD did not change in Mae Chaem (14% in intervention group and 10% in control group, χ2 test p>0.05).

The focus group discussions with female and male farmers reflected that they perceived that the interventions positively improved dietary diversity of their families. The NSA interventions provided home-produced foods for their children and family members, especially in A Luoi where the participating households produced chicken meat and eggs for use (with enough eggs for children under 5 years old to use almost daily). Various types of vegetables were more available for children and family members, especially in the harvest seasons. However, diseases of poultry and hard weather/ drought conditions limited the farming and maintenance of chicken and vegetables and thus further solutions should be researched and tested for year-round production.

Chicken raising to provide animal-source food

Chicken raising was implemented in all three sites as a possible source of nutrient-rich foods for children and other members of the family. However, after about 6 to 15 months of implementation, only in A Luoi did the intervention participants still maintain a high percentage (97%) of chickens provided by the project and had higher consumption of eggs and chicken meat compared to control group (see Table 6). However survival rates may not be critical – the chickens only produce eggs for a year or two and so eventually need to be replaced. In Mae Chaem, roosters were not provided so there was no potential for sustaining or growing the flock. In Yen Chau and A Luoi households were generally able to breed new chicks and the average flock size approximately doubled during the project, so that there were eggs to consume and this will presumably continue after the project ends.

Home garden improvements to have diversified vegetable production for home consumption

In Mae Chaem, A Luoi and Yen Chau, 87, 60 and 54 households, respectively, participated in vegetable farming.

In Mae Chaem, 74% to 91% of intervention HHs grew one of the 5 varieties in their garden, compared to a maximum of 58% in control HHs (Annex 4 - Table 13). The percentage of intervention households consuming vegetables ranged from 48% to 83%. The hard weather and water shortage limited the production of many species/varieties.

In A Luoi, 60% of the households maintained the vegetable cultivation throughout the trial. Among the intervention HHs, 30% produced vegetables surplus to the consumption needs of their family. Vegetable consumption was significantly higher than in control group (Figure 1; Figure 2) among both children under 5 years and their parents. The intervention HHs even freely gave vegetables to their neighbours. However, heavy rains fall from September to November every year, with 70% of the annual rains in these months, which damage all farming activities and reduce vegetable production to very low levels.

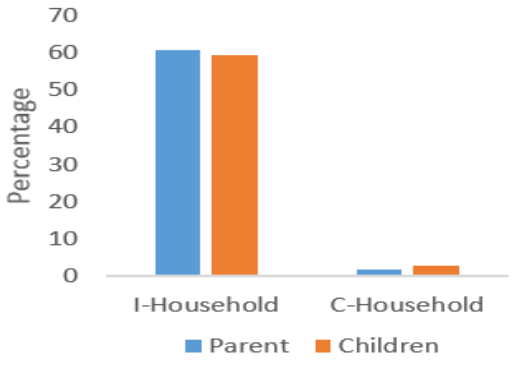

Figure 1. In A Luoi, the percentage of U5 children and their parents who consumed vegetables per week at end-line is higher in intervention HHs compared to control HHs

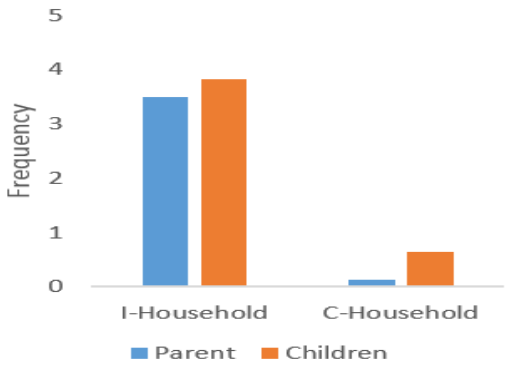

Figure 2. In A Luoi, frequency of vegetable consumed per week at end-line among U5 children and their parents is higher in intervention HHs compared to control HHs

In Yen Chau, intervention HHs grew more types of vegetables compared to control HHs at endline ($p<0.05$). The percentage consuming all or most of their vegetables was higher in intervention HHs (from 28 to 47%) than control HHs except for papaya (Annex 6 – Table 10). In addition, many HHs in the intervention group had more produce sold in the market, reflecting a surplus to the consumption needs of their family that may have contributed a small amount to their income (Annex 6 – Table 14).

Additional interventions were trialed in Yen Chau: System of Rice Intensification (SRI) that used a lower density of paddy rice along with appropriate application of fertilizers; vermiculture to produce chicken feed; and planting Moringa (a new species of vegetable), and some other nutrient-rich and high-production fruit varieties. These interventions were successful in the demonstration households, and are promising for future scaling up after further study of best practices and consideration of their appropriateness with different ethnic minority groups.

Affordability and sustainability of the NSAs interventions in the sites

Most farmers in all three sites would like to continue the chicken raising and vegetable farming interventions (Table 7). The farmers perceived the benefits from the interventions, and wanted to continue further in considering what inputs would be needed and what barriers need to be overcome in order to continue with the interventions.

In Mae Chaem, the household survey found that though most chickens did not survive, 60% of intervention households expressed their interest in increasing the number of chickens and 16% wanted to maintain the number they have - as long as there is continued project support (including chicken breeds and feeds) to raise the chickens (Annex 4 – Table 20). As the farmers were not provided with roosters, they did not sustain the chickens themselves and we are unable to answer what we really want to know – do the farmers intend on continuing with the chicken intervention after the trial ends. Among the 5 vegetable varieties promoted by the project including Ivy gourd, Yard long bean, False pakchoi, Bird chilli and Thai eggplant, 59% to 76% of the participated households wanted to increase and remain farming each of them (Annex 4 – Table 16).

The FGDs with farmers revealed that for chicken raising, they could easily provide inputs such as finding bamboo or buy some small materials to make the chicken coop. Two women's groups also mentioned using local foods to feed chicken as one of inputs needed but they do not consider it a heavy investment. The main benefits they got from chicken raising included "nutritious foods for children", "saving money by not buying eggs", and "having eggs for both children and adults". These benefits outweighed the costs. However, disease causing the deaths of chickens was the key limiting factor. Insufficient local feed for the chickens, which limited egg production, was also an important limitation. Vegetable production in home gardens required good varieties and water, however the farmers insisted they will continue to raise vegetables and they will try to learn more to produce seeds and save water or identify other varieties that can be appropriate for their areas.

In A Luoi, since the mid-line of the interventions, many non-participating households in intervention villages became convinced of the interventions being trialled and actively copied the interventions for themselves without project support (35 HHs began chicken

raising, and several HHs planted the same vegetable species/ varieties as the interventions in their home garden).

In Yen Chau, farmers perceived that having breeding chickens, producing eggs, and learning chicken rearing techniques were the main benefits of the chicken raising intervention. Having new vegetable varieties, having vegetables available for eating, and receiving training on vegetable growing were considered the main benefits of home gardening. While the inputs required were also important and serious challenges were identified, especially for chicken raising, the farmers in Yen Chau still wanted to continue farming vegetables and raising chickens in the space their families have available. They recognized the need of vaccines for chicken (Annex 6 – Table 27). They recommended the provision of vaccines and various chicken breeds to diversify the chicken flock.

The farmers reported that the free provision of chicken (with feed) and vegetables was an important motivator to get people started in changing their practices. However, a minority people in the project sites, due to their culture, customs, and traditions of not changing practices often, did not think they would continue with the intervention, as they would not be able to deal with problems that arose. Further education and counselling on planning for sustainability should be included in future work and therefore time for capacity building by the researchers and local supervisors should be included in future budgets.

Benefits of nutrition training and education

A key factor that contributed to the positive results of the project was training on nutrition and feeding practice for parents and caretakers of children under 5 years old, especially women.

Women in Mae Chaem reported in the FGDs a very important and laudable improvement in breastfeeding for children. Before the project many women went to work in the field just after giving birth, but now they go to work in the field 3 or 4 months after giving birth, and just work in the morning and go home to breastfeed their child in the afternoon (Annex 4 - Table 26). While this is better than earlier practices, there is still room for improvement to achieve recommended practices. Men found training very interesting as they learned many new ways to cook eggs for their kids. The participants also considered training as having helped save money as they learned how to produce and use home-grown foods. Women in the Lua group in Mae Chaem also found more benefits from nutrition training as they learned how to reduce consumption of “not healthy foods” and moreover, could share their knowledge with family members, friends and neighbours (Annex 4 – Table 29).

In A Luoi, farmers, including men and grandparents who used to be reluctant to do “female work” participated actively in nutrition training and education. This may have contributed to the survey results showing higher consumption of nutrient-rich foods at endline (Annex 5 – Table 17).

In Yen Chau, the intervention group perceived knowledge about nutrition in general (breastfeeding, complementary feeding and how to cook complementary foods), and diversifying food types as the main benefits of nutrition training (Annex 6 – Table 27).

Gender roles

Gender roles changed during the project in all sites. In Mae Chaem, men became more involved in sharing the workload of their wives in both chicken raising and home gardening (Annex 4 – Tables 24 & 25). The intervention HHs in A Luoi had a higher percentage of men involved in caring for chickens (mainly in disease prevention) than in control HH (Annex 5 – Table 9). Yen Chau women in intervention group had a greater role in chicken raising, which they shared with men, and more decision making power regarding vegetables selection, selling, and use of revenues than in control HH (Annex 6 – Tables 25 & 26).

In all three sites, the qualitative data also showed a greater contribution at endline from men to project work, as well as to the general workload of women, especially in childcare (Annex 4; Annex 5; Annex 6). Interestingly, men in Mae Chaem did not recognize that they helped more in childcare and other home chores but their women did recognize and appreciated the change in men's behaviour (Annex 4 – Table 26). The help from men assisted the change in breastfeeding, as analysed previously, in Mae Chaem (Annex 4 - Table 26). Both men and women in intervention group in this site had more roles in home gardening than the control group (Annex 4 – Tables 24 & 25).

Synthesis of results towards AFS themes:

AFS theme #1 - Increasing agricultural productivity (Availability)

Overall, the project resulted in greater availability of nutrient-rich foods, including chicken eggs and meat, as well as various vegetables for children and other members of the family.

In A Luoi, the intervention participants maintained 97% of the chickens provided and so consumed more eggs and chicken meat than the control group at endline and 60% of the households maintained the vegetable cultivation throughout the trial. Among the intervention HHs, 30% produced vegetables surplus to the needs of their family's diet.

Vegetable farming in home garden brought positive changes, though they still faced difficult farming conditions including lack of water (Mae Chaem) or heavy rain (A Luoi). In Mae Chaem, 74% to 91% intervention HHs grew each of the 5 varieties in their garden while at most 58% of control HHs farmed each variety.
In Yen Chau at endline intervention HHs grew more types of vegetables than control HHs ($p<0.05$). The percentage consuming all or most of their vegetables was higher in intervention HHs (from 28 to 47%) than control HHs, except papaya. In addition, many households in intervention group had greater amounts of produce sold in the market at a small volume.

Additional small-scale interventions in Yen Chau demonstrated the potential of SRI, vermiculture to produce feed for chickens, and Moringa, a new species of vegetable, and some other nutrient-rich and high-production fruit varieties.

AFS theme #2 - Improving access to resources, and/or markets and income (Accessibility)

In some cases there was production in excess of household needs (eggs in A Luoi, and vegetables in Yen Chau), so that the intervention HHs gave to their neighbours (A Luoi) or

sold for more income (Yen Chau). In Yen Chau, the women had higher decision than baseline regarding the use of revenues.

AFS theme #3 - Improving nutrition (Utilization)

There were improvements in children's DD in intervention HH (but not control) in Mae Chaem and A Luoi. The average Food Security Score was higher in intervention than in control households in A Luoi. The Food Security Score did not improve in Mae Chaem or Yen Chau.

The changes were mostly regarding eggs and vegetables. In A Luoi while the intervention HHs maintained their chickens, they consumed 9 eggs/week on average (control HH ate ~4 eggs/week). Over the trial time, 60% of the households maintained well the vegetable cultivation and 30% produced surplus vegetables for the needs of their family consumption. As a result, the percentage of households who consume vegetables and the amount that they consume is significantly higher in the intervention group than in control group among both children under 5 years and their parents.

In Yen Chau, intervention HHs grew more types of vegetables than control HHs and ate more nutrient-rich vegetables than control HHs (although control HHs ate more papaya).

AFS theme #4 - Informing policy

The sites developed reports to share experiences of implementing NSA with local stakeholders, researchers and some of the farmers themselves. However, the results at this stage are more appropriate for disseminating results of interventions and sharing implementation experience, rather than forming policy recommendations.

The results from Mae Chaem were shared with local authorities at sub-district level to recommend they integrate NSAs in their annual and multi-year policies, and that action plans incorporate nutrition into agricultural promotions, ensure food and nutrition security.

A Luoi and Yen Chau's recommendation was that local authorities ensure technical support for chicken raising, including efforts to provide vaccines for disease prevention in poultry, as well as regular training on nutrition with practicum for parents and care takers of young children, focusing on the use of local nutrient-rich foods.

Project outputs

The manuscript titled "The process of developing a nutrition-sensitive agriculture intervention: a multi-site experience" (jointly developed by HealthBridge and 3 research institution partners) has been submitted in Feb 2016 to "Food Security: The Science, Sociology and Economy of Food Production and Access to Food". It (abstract below) is still undergoing peer review.

Each project team has developed an end of project research report:

> Annex 4 – CMU Final research report: Nutrition-sensitive agricultural interventions and impacts in Mae Chaem district, Chiang Mai province, Thailand. Prepared by Prasit Wangpakapattanawong and Sakda Pruenglampoo. Chiang Mai University, Chiang Mai, Thailand. May 2016.

Annex 5 – CARD Final research report: Endline Survey Report on: Agricultural production, food security and nutrition in A Luoi district, Thua Thien Hue province. Prepared by Le Van An and Ngo Tung Duc. Centre for Agriculture and Forestry Research and Development, Hue University of Agriculture and Forestry, Vietnam. March 2016.

Annex 6 – CARES Final research report: Nutrition-sensitive agricultural interventions and impacts in Yen Chau district, Son La province VIETNAM. Prepared by Pham Van Hoi, Nguyen Ngoc Son and Nguyen Thi Thanh Huyen. Centre for Agricultural Research and Ecological Studies, Hanoi University of Agriculture, Hanoi, Vietnam. January 2016.

Problems and challenges:

In all sites, difficult natural conditions (drought in Mae Chaem, heavy rain and flooding in A Luoi and Yen Chau) were main challenges for the project implementation and monitoring. To deal with these conditions, the teams motivated local partners to monitor and supervise field activities and follow-up with the crops that can be planted during period of hard weather.

Poultry disease in Mae Chaem and Yen Chau affected chicken raising activity and the teams sought vaccines and other ways to raise the chickens.

In Yen Chau, there was a small problem regarding monthly monitoring on intervention group performance in project-provided crops and chicken. Monthly data were not fully gathered by local counterparts as expected. Some households were missing from monitoring in certain months (because local counterpart could not meet them during their farm visits). So instead data were collected every 3 months.

There is a concern for affordability and sustainability of the interventions. It was believed that free provision of some initial supports including vegetables, chickens and feed was important starter to motivate change in practices of local people. However, the people in the project sites do not have a culture in which practices are often changed, and we are not sure if they will continue in the practices and deal with problems as they arise by their own efforts and resources. Certainly, there will be minimal continuation in Mae Chaem where the farmers were not provided with roosters and sustainable chicken production does not seem possible. Further education and counselling on planning for sustainability should be planned, and therefore time for capacity building and for the researchers/ local supervisors to work long term with the farmers should be budgeted. This leads to the next and final challenge.

The greatest challenge was the short duration of the project. We had only one to one and a half growing seasons to test the NSAs. Ideally we would have much more time to develop the interventions, and then test them for at least three growing seasons. The IDRC-funded Soils, Food and Healthy Communities project in Malawi took 7 years to complete the research and generate positive impact in the communities. We think we would have had much more success if we had five years or more.

Overall assessment and recommendations:

Overall, the project was managed and coordinated smoothly by HealthBridge offices in Hanoi and Ottawa. There were budgeting issues resulting from the fluctuating exchange rates. The project was budgeted in Canadian dollars, but expenses were incurred in local currency. As the Canadian dollar fell in value, the money locally available decreased, and some budget allocated for activities had to be adjusted, specifically for the Personnel line (was overspent CAD 3,076 that was 2.8% of the personnel line's budget) and the Research lines (were underspent CAD 3,076 that was 5.9% of the research lines' budget).

Our key recommendation to IDRC is to fund projects of longer duration, or with a second phase if the first phase is promising. As mentioned in the problems section, we had only one to one and a half growing seasons, and it just is not enough time to test, refine, test again and document impact. Above we mentioned the Soils, Food and Healthy Communities project in Malawi took 7 years to complete the research and generate positive impact in the communities. In a recently completed (not yet published) three year NSA project in Bolivia we have witnessed the same problems that arise from trying to rush what should be a long, five to 10 year process into just a few years. A recent paper from Nepal (Food Policy 61:185–197) demonstrated that there were greater health impacts after two years then after one year. While we appreciate that there can be other pressures pushing for immediate results, we think there would be overall greater efficiency and effectiveness to have longer duration projects, even if this means fewer projects are funded.

Tables 3-7

Table 3. Summary of training provided to sites – Thailand and Vietnam 2013-2016

TRAINING INFORMATION SUMMARY	Male	Female	Extension staff	Policy makers (local govt)	CSOs (NGO…)	Other academic	Private sector	Other	Specify	Total
Mae Chaem - Chiang Mai										
Education about nutrition knowledge of vegetables and fruits (5 groups of food and benefit of vegetables with 5 colors), importance of egg, complementary food using local materials and breast milk and breastfeeding knowledge	81	18	2	2	1	0	0	9	Local health workers & headmaster	113
A Luoi - Thua Thien Hue										
Enhancing nutrition and children care knowlegde for mothers during pregnancy, lactation and weaning period.	50	10	2	0	2	1	0	4	Local health workers	69
Training on food processing based on available ingredients in the locality	50	10	2	1	0	1	0	4	Local health workers	68
Technical chicken raising	50	10	2	0	0	0	2		Local health workers	64
Techniques for growing vegetable	60	15	2	0	0	0	0	2	Local health workers	79
Yen Chau - Son La										
Training on vermiculture shed preparation and vermiculture production; SRI preparation & production	5	0	1	0	0	1	0	1	Local health worker	8
Training on chicken production techniques	11	70	2	0	0	2	0	2	Local health workers	87
Training on potato plantation practices	10	25	2	0	0	2	1	0		40
Technical training on egg storage, hatching and small chicken raising practices	20	65	2	2	0	0	0	0		89
Technical assistance on SRI rice growing	10	68	2	2	0	0	0	0		82
Recapitulating agricultural techniques trained & technical assistance on new agricultural problem	25	60	2	2	0	0	0	0		89
Training on nutrition practices (for children)	0	83	0	2	0	2	0	2	Local health workers	89

Table 4. Food security status at endline compared to baseline in the three research sites

Mae Chaem	Control			Intervention			P (C-I at baseline)	Total			Test
	Baseline % (Nb1=76)	End-line % (Ne1=69)	P	Baseline % (Nb2=96)	End-line % (Ne2=87)	P		Baseline % (N=202)	End-line % (N=160)	P	
Household Food Insecurity Access-related Scale Score	4.8±4.7	4.5±3.6	>.05	4.8±4.3	4.5±3.9	>.05	**>.05**	4.8±4.5	4.5±3.8	>.05	t-test independent
Food Secure	29	17	>.05	23	16	>.05	**>.05**	26	17	<.05	$\chi 2$
Mildly Food Insecure	13	15	>.05	15	23	>.05	>.05	14	19	>.05	$\chi 2$
Moderately Food Insecure	15	26	>.05	13	17	>.05	>.05	13	21	>.05	$\chi 2$
Severely Food Insecure	43	42	>.05	50	44	>.05	**>.05**	47	43	>.05	$\chi 2$

A Luoi	Control			Intervention			P value (C-I at baseline)	Total			Test
	Baseline % (Nb1=77)	End-line % (Ne1=50)	P value	Baseline % (Nb2=125)	End-line % (Ne2=110)	P value		Baseline % (N=202)	End-line % (N=160)	P value	
Household Food Insecurity Access-related Scale Score	10.8±5.2	8.8±5.0	<.05	13.1±5.4	6.8±4.3	<0.01	<.01	12.2±5.4	7.4±4.6	<.001	t-test independent
Food Secure	4	12	>.05	1	6	<.05	>.05	2	8	<.001	$\chi 2$
Mildly Food Insecure	5	6	>.05	3	19	<.001	>.05	4	15	<.001	$\chi 2$
Moderately Food Insecure	38	42	>.05	30	56	<.001	>.05	33	51	<.001	$\chi 2$
Severely Food Insecure	53	40	>.05	66	19	<.001	>.05	61	26	<.001	$\chi 2$

Yen Chau	Control			Intervention			P value (C-I at baseline)	Total			Test
	Baseline % (Nb1=73)	End-line % (Ne1=69)	P value	Baseline % (Nb2=84)	End-line % (Ne2=54)	P value		Baseline % (N=157)	End-line % (N=107)	P value	
Household Food Insecurity Access-related Scale Score	3.9±5.0	2.4±1.0	<.05	6.5±6.4	3.8±2.5	<.01	**<.01**	5.3±6.0	3.1±2.0	<.001	t-test independent
Food Secure	53	45	>.05	38	35	>.05	**<.05**	45	40	>.05	$\chi 2$
Mildly Food Insecure	10	23	<.05	8	19	>.05	>.05	9	21	<.01	$\chi 2$
Moderately Food Insecure	29	30	>.05	35	37	>.05	>.05	32	34	>.05	$\chi 2$
Severely Food Insecure	8	2	>.05	19	9	>.05	**<.05**	14	6	<.05	$\chi 2$

Table 5. Dietary Diversity in children of 6-23 months in Intervention was higher than in Control groups at endline.

Mae Chaem	Control			Intervention			P value (C-I at baseline)	P value (C-I at endline)	Test
	Baseline (nb1=29)	Endline (ne1=10)	P value	Baseline (nb2=39)	Endline (ne2=14)	P value			
Dietary Diversity									
Number of food groups per day (average (SD))	3.1±2.1	4.4±1.7	>.05	2.7±2.1	4.8±1.4	**<.001**	>.05	**<.001**	t-test Independent
Children who received foods from ≥4 food groups (%)	41	80	**<.05**	39	93	**<.001**	>.05	**<.001**	$\chi 2$
Minimum meal frequency									
Number of meals per day (average (SD))	1.5±1.5	1.3±1.3	>.05	1.3±1.2	1.5±1.1	>.05	>.05	>.05	t-test Independent
Children with ≥ minimum number of meals per day (%)	31	20	>.05	13	14	>.05	**<.05**	>.05	$\chi 2$
Minimum acceptable diet (%)	7	10	>.05	3	14	>.05	>.05	>.05	$\chi 2$
Consumption of iron-rich or iron-fortified foods (%)	72	90	>.05	36	93	**<.001**	>.05	**<.001**	Fisher' Exact
A Luoi	**Control**			**Intervention**			**P value** (C-I at baseline)	**P value** (C-I at endline)	**Test**
	Baseline (nb1=32)	Endline (ne2=21)	P value	Baseline (nb2=33)	Endline (ne1=31)	P value			
Dietary Diversity									
Number of food groups per day (average (SD))	2.6±1.4	3.1±1.4	>.05	2.3±1.3	4.3±0.8	**<.001**	>.05	**<.001**	t-test Independent
Children who received foods from ≥4 food groups (%)	28	43	>.05	27	94	**<.001**	>.05	**<.001**	$\chi 2$
Minimum meal frequency									
Number of meals per day (average (SD))	2.2±1.5	2.2±1.7	>.05	2.1±1.5	3.1±1.1	**<.001**	>.05	**<0.05**	t-test Independent
Children with ≥ minimum number of meals per day (%)	22	38	>.05	30	77	**<.001**	>.05	**<.01**	$\chi 2$
Minimum acceptable diet (%)	13	10	>.05	9	48	**<.001**	>.05	**<.01**	$\chi 2$
Consumption of iron-rich or iron-fortified foods (%)	53	67	>.05	52	84	**<.01**	>.05	**<.01**	Fisher' Exact
Yen Chau	**Control**			**Intervention**			**P value** (C-I at baseline)	**P value** (C-I at endline)	**Test**
	Baseline (nb1=24)	Endline (ne1=4)	P value	Baseline (nb2=23)	Endline (ne2=4)	P value			
Dietary Diversity									
Number of food groups per day (average (SD))	3.5±1.5	2.2±2.6	>.05	3.0±1.6	4.5±1.3	>.05	>.05	>.05	t-test Independent
Children who received foods from ≥4 food groups (%)	58	50	>.05	30	75	>.05	>.05	>.05	Fisher' Exact
Minimum meal frequency									
Number of meals per day (average (SD))	2.6±2.0	2.5±2.5	>.05	1.8±1.9	4.0±2.2	>.05	>.05	>.05	t-test Independent
Children with ≥ minimum number of meals per day (%)	38	50	>.05	26	75	>.05	>.05	>.05	Fisher' Exact
Minimum acceptable diet (%)	17	25	>.05	4	75	**<.001**	>.05	**<.01**	Fisher' Exact
Consumption of iron-rich or iron-fortified foods (%)	79	50	>.05	52	100	>.05	>.05	>.05	Fisher' Exact

Table 6. Characteristics of chicken intervention in three sites.

	Yen Chau	A Luoi	Mae Chaem	
Required characteristics of farmers	land available	ability to provide feed		
Training	chicken raising; eggs storage and hatching	coop construction; food/water trough construction; feed preparation	coop construction	
Provisions				
Hens	9	5	5	
Roosters	1	1	0	
Age of chickens	40-50 days	80 days	135 days	
Breed of chickens	Ri–Luong Phuong F1 crossing		ISA-Hisex Brown F2	
Food	some	15 kg (for 3 months)	15 kg (for 6 months)	
Materials	eating and drinking trays fake ceramic eggs	Fencing		
Vaccinations	fully vaccinated	fully vaccinated	fully vaccinated	
Additional disease control	+ 100 add'l vaccines	2 Veterinarian cabinets	none	
Results at Endline				
Survival rates	32%	97%	6%	
% IHH with chickens	100%	100%	12%	
			in 12% with chickens	*overall*
Final flock size (average / hh)	19.6	12.9	2.5	0.3
Egg production (/month/hh)	28	17	45	1.5
Egg consumption (/month/hh)	17	8.8	39.7	1
Eggs hatched (/month/hh)	8.9	18	0	0

Table 7. The intention of farmers with the chicken and vegetable interventions: plans to increase, remain as is, reduce size, or stop completely

NSAs	Site (# of households)	Stop (%)	Increase (%)	Remain (%)	Reduce (%)	Not yet decided (%)
Chicken raising	Mae Chaem* (N=87)	21	60	16	0	3
	A Luoi (N=50)	6	58	36	0	0
	Yen Chau (N=86)	2	82	11	0	0
Vegetable farming	Mae Chaem (N=87) (ranged as different varieties)	3-9	22-32	37-46	0	21-31
	A Luoi (N=50)	0	17	78	0	5
	Yen Chau (N=54) (ranged as different varieties)	Up to 6	6-42	56-86	Up to 6	Up to 6

* *if they had opportunity to participate in the trial again.*

Annexes

Annex 1 – AFS Themes.

Annex 2 – The process of developing a nutrition-sensitive agriculture intervention: a multi-site experience.

Annex 3 – Supplementary materials for: The process of developing a nutrition-sensitive agriculture intervention: a multi-site experience.

Annex 4 – CMU Final research report

Annex 5 – CARD Final research report

Annex 6 – CARES Final research report

Annex 7 – Report on dissemination workshop to share experiences of multi-site research on nutrition and food security in uplands of Thailand and Vietnam.

Annex 8 – Presentations from dissemination workshop to share experiences of multi-site research on nutrition and food security in uplands of Thailand and Vietnam.