Development and sustainability of interventions to improve child nutrition: A case-study of ethnic minority communities in northern Thailand

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Contents

Abstract

Background

One third of northern Thai indigenous children aged 0–5 years are stunted. To address this, a Thai research group implemented a nutrition-sensitive agriculture (NSA) intervention in which villagers were supported for 6 months to keep hens and home gardens. The studies undertaken for this thesis were designed to enhance this initiative and its evaluation.

Aims

First, to describe and understand infant and young child feeding (IYCF) practices and the underlying circumstances contributing to stunting in children. Second, to assess the outcomes of the NSA intervention in terms of IYCF and stunting, and the prospects for sustainability.

Methods

A mixed-methods study involved people from eight villages and staff of the health system serving the area. Prior to the intervention, perspectives on child health and IYCF were explored in a two-day workshop and 30 in-depth interviews. Detailed thematic analysis of transcripts was undertaken. This complemented quantitative data obtained through 172 household surveys which was statistically analysed to profile stunted children and their families.

Four of the villages became sites for the NSA intervention and four were controls. Household surveys were repeated after 12 months, permitting statistical assessment of the effectiveness of the intervention. In-depth interviews were undertaken to explore local views about the intervention and its prospects, with thematic analysis carried out.

Results

The baseline survey showed that exclusive breastfeeding for six months was rare and children aged 6–11 months had little variety in their diets. Stunting peaked in children aged 12–23

months (affecting 42%). Half of households experienced severe food insecurity. Compared to non-stunted children, stunted children were not as likely to meet minimum dietary diversity (82% vs 63%, p=0.01), however, most household factors did not distinguish between stunted and non-stunted children.

Situational and social circumstances shaped infant and young child feeding. Cultural beliefs meant that water and rice were given to children before six months of age. Mothers had to work in distant fields within a few months of giving birth, most often leaving the children to be looked after by grandparents. Villagers considered strength and independence of children to be hallmarks of health. In contrast the health system uses anthropometric measurements to characterise child growth and health.

Twelve months after commencement of the NSA, 18% more children living in households receiving the intervention consumed eggs as compared to controls (mean difference 0.18, 95% CI 0.05, 0.30). However, there was no evidence of an impact on dietary diversity, food insecurity or stunting. The intervention was seen as beneficial by the villagers despite activities petering out.

Conclusions

Food insecurity is a major problem in the villages. IYCF practices that facilitate women's return to work within a few months of giving birth also appear to contribute to stunting in children. Growth monitoring was not accompanied by nutrition counselling and its purpose was unclear to locals. The NSA intervention had some short-term benefits. There may be opportunities to increase its impact through engagement with the health system and improvements to infrastructure.

Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and beliefs, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future be used in a submission in my name, for any other decree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

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Date: ……..

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Publications contributing to this thesis

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- Roesler A, Smithers LG, Winichagoon P, Wangpakapattanawong P, Moore V. Local perspectives and context in relation to feeding practices of children under two years in the mountain villages of northern Thailand. Public Health Nutrition [Internet]. 2018:[1-9 pp.].
- Roesler A, Smithers LG, Winichagoon P, Wangpakapattanawong P, Moore V. Perceptions of young child health, growth monitoring, and the role of the health system in remote Thailand where stunting among children persists. Food and Nutrition Bulletin 2018 (Submitted, under review)
- Roesler A, Smithers L.G., Wangpakapattanawong P, Moore V. A nutrition-sensitive agriculture intervention to reduce malnutrition in children in the ethnic communities of northern Thailand: local perspectives and prospects for sustainability. Maternal and Child Nutrition 2018 (Submitted, under review)

Presentations arising out of this thesis

- Roesler A, Smithers LG, Moore V. Local insights underpinning the development and formative evaluation of a behaviour change communication strategy to improve child nutrition in northern Thailand ethnic minority communities. School of Population Health Seminar Series, Adelaide, Australia, February 2014.
- Roesler A, Smithers LG, Moore V. Nutrition insights in indigenous communities of northern Thailand. Agrifood Research Network Conference, Adelaide, Australia, November 2016.
- Roesler A, Smithers LG, Moore V. Local insights into the nutrition of children aged 0–5 years in northern Thailand. World Congress on Public health, Melbourne, Australia, April 2017.
- Roesler A, Smithers LG, Moore V. Outcomes of an agricultural intervention to improve dietary diversity in children up to age 5 years in the Indigenous communities of Thailand. 11th Annual Florey Postgraduate Research Conference, Adelaide, Australia, September 2017.
- Roesler A, Smithers LG, Moore V. Local insights into the nutrition of hill tribe children aged under 5 years in northern Thailand: before and after an agriculture intervention. International Congress of Nutrition, Buenos Aires, Argentina, October 2017.
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Abbreviations and acronyms

AED	Academy for Educational Development
BF	Breastfeeding
BFHI	Baby friendly hospital initiative
CI	Confidence interval
cm	centimetre
EBF	Exclusive breastfeeding
FANTA	Food and Nutrition Technical Assistance
FAO	Food and Agriculture Organization (United Nations)
GEE	Generalised estimating equation
gm	gram
HAZ	Height-for-age z-score
HFIAP	Household Food Insecurity Access Prevalence
HFIAS	Household Food Insecurity Access Scale
HH	Household
HIV/AIDS	Human immunodeficiency virus/acquired immune deficiency syndrome
HKI	Helen Keller International
HREC	Human research ethics committee
ICRAF	World Agroforestry Centre
ICC	Intra-class correlation coefficient
IDRC	International Development Research Centre
IYCF	Infant and young child feeding
KSC-GMS	The Knowledge Support Center for the Greater Mekong Sub-region
MI	Multiple imputation
NCHS	National Centre for Health Statistics

NSA	Nutrition-sensitive agriculture
PHO	Public health officer
RIHES	Research Institute of Health Sciences
SD	Standard deviation
SE	Standard error
SPSS	Statistical Package for the Social Sciences
SUN	Scaling up nutrition
TIP	Trials of improved practices
UN	United Nations
USAID	United States Agency for International Development
UNICEF	United Nations International Children's Emergency Fund
UNSCN	United Nations Standing Committee on Nutrition
VHV	Village health volunteer
WASH	Water, sanitation and hygiene
WAZ	Weight-for-age z-score
WHO	World Health Organization
WHZ	Weight-for-height z-score

List of Figures

List of Tables

Chapter 1
Introduction

1.1 Background

In 2016, 23%, or just under one in four children under age 5 worldwide had stunted growth (1). Stunted growth is a low height-for-age and is a sign of inadequate nutrition or poor health (1). It is a concern because of the associated negative consequences, including an increased risk of death and poor cognitive and physical development (2). The effects of stunting during the critical window of 1000 days, starting from pregnancy and continuing through the first 24 months of life, are difficult to reverse (3). Preventing stunting during this period is of utmost importance.

In the late 80s it was reported that about 25% of Thai children under 5 years of age were stunted based on World Health Organization (WHO) growth charts (4). In more recent times the percentage has decreased. Between 2010–2015, 16% of Thai children under 5 years of age were reported as stunted, based on national representative data (5). Winichagoon (4) has attributed the decline to improvements in the Thai socio-economic situation and community level actions (4). At the current percentage, stunting in Thai children is classified as low severity by WHO, and is no longer a key priority to address for the Thai Government (6). However, some subsets of the population are continuing to display a higher percentage of stunted children.

A study in 2011 of 3119 Thai children aged 6 months to 12 years revealed a disparity between the rural and urban children with 4% of urban children and 8% of rural children recorded as stunted (7). The percentage of hill tribe children stunted is reported to be even higher again (6). For example, stunting prevalence in Karen hill tribe children was 71% in 2002 (8). Current anthropometric reports for Karen and Lua hill tribe children in Mae Chaem, northern Thailand indicate that approximately 30% of the children are stunted (9).

1.2 Multi-site nutrition-sensitive agricultural initiative

The current situation in the hill tribe communities of Thailand necessitates efforts to both understand and to act to reduce the high rates of undernutrition in these children. As undernutrition and poor food security are experienced similarly in the Vietnamese hill tribes, a multi-site research initiative was proposed including hill tribe sites both the Vietnam and Thailand (10). The International Development Research Centre (IDRC), Canada provided funding for the multi-site research initiative. The funding began in 2013 and was provided over a three year period. The participating institutions and respective hill tribe site with whom they were working were: the Chiang Mai University/International Centre for Research in Agroforestry (ICRAF), in Mae Chaem, Thailand; the Hue University of Agriculture and Forestry and the Hanoi University of Agriculture, in Hue and Hanoi, Vietnam (see Figure 1). Technical support across all three sites came from HealthBridge Foundation of Canada. This thesis will use 'international research team' to refer to the consortium of participating organisations; 'ICRAF' will be used to refer to the team working on the Thai site, which is the focus site for this thesis.

Planning for the multi-site research initiative started in January 2013. It was a nutrition-sensitive agricultural (NSA) initiative. NSA initiatives refer to integrated nutrition and agricultural activities that have the ultimate goal of improving the nutrition status of participating households. NSA initiatives have received some focus in more recent years, particularly as a means to improve anthropometric outcomes in rural farming areas suffering from stunting (11, 12). Certain crops, animals, or agricultural practices are introduced that will benefit the health of the farming community. Often nutrition education is included, due to evidence that if agriculture interventions do not explicitly include nutrition education they have a limited ability to improve the health and nutrition of participating communities (13-15).

The overall goal of the multi-site NSA initiative in Thailand and Vietnam, was to identify and trial local and practical NSA solutions, such as improved nutritious crops, to create sustainable long-term improvements in nutrition and food security in the hill tribe communities of Vietnam and Thailand. Additionally, an aim was to address the current gap in the global knowledge base of strategies to integrate agriculture and nutrition at the local level in rural villages.

Figure 1. The three locations (in red) of the multi-site nutrition-sensitive agricultural initiative

In January 2013, members of the international research team attended a project development workshop in Chiang Mai, Thailand, organised by HealthBridge, Canada. At the workshop the design of the NSA interventions for each of the three sites were discussed, including parameters that each site must adhere to and those broad parameters which were flexible. Each site was able to choose their own NSA activities and how they would implement and support the local intervention; however, all sites needed to measure dietary intake, anthropometry, household food security and IYCF practices for cross-site comparisons and overall analyses.

At the time of the workshop I had recently completed 18 months of work in Chiang Mai, Thailand that involved researching health and nutrition in the southeast Asian region. I was notified by a fellow dietitian of the multi-site NSA initiative. My interest in the initiative led me to contact the involved parties to learn more, and I was invited by the international research team to join the workshop.

1.3 Thai nutrition-sensitive agricultural intervention

The research undertaken for this thesis was conducted at the Thai site. Details of the internationally funded work completed by ICRAF at this site will now be provided.

1.3.0 Approach of the nutrition-sensitive agricultural intervention

ICRAF was responsible for the NSA intervention at the Thai site. A participatory approach was employed in planning the NSA intervention so that nutrition and agricultural activities identified were appropriate, relevant and met the needs of the local community (16-18).

1.3.1 Thai NSA intervention

Four intervention and four control villages of Karen and Lua ethnicity were involved in the NSA intervention. The villages were chosen based on high levels of stunting, food insecurity, access to the researchers and existing relationship with the researchers. A total of 106 intervention households were involved in the intervention with children aged 0-5 years of age. In September 2014, prior to the intervention, ICRAF provided training to intervention households on how to prepare chicken coops using local materials. The villagers were given two months to construct their own chicken coops. In November 2014, the intervention began and five laying hens were provided to each intervention household. The Institut de Selection Animale (ISA)-Hisex Brown variety of hen was chosen based on advice from agronomic and animal experts. The hens were immunised prior to provision.

Five types of vegetable seeds for home gardening were given to each household, including ivy gourd, which is high in beta carotene (Simopoulos, 2003); yard long bean, a drought tolerant crop; false pakchoi, which grows fast; bird chilli, high in vitamin A; and Thai eggplant, which is commonly used in the villages and is a source of energy and protein (19). No specific instruction was provided to the villagers on home gardening.

Nutrition education was provided in a one hour community session in each intervention village. The main messages shared in the nutrition education sessions included, the promotion of EBF for six months, the provision of an egg daily as complementary food for infants and for children up to age 5 years, and to provide variety in children's diets including meat, vegetables and fruit from 6 months of age. In addition, posters repeating these messages were displayed within the village. ICRAF visited intervention households monthly for six months, from November 2014 to May 2015, to monitor growth in the gardens and egg production, to provide chicken feed, and to provide agricultural and IYCF advice.

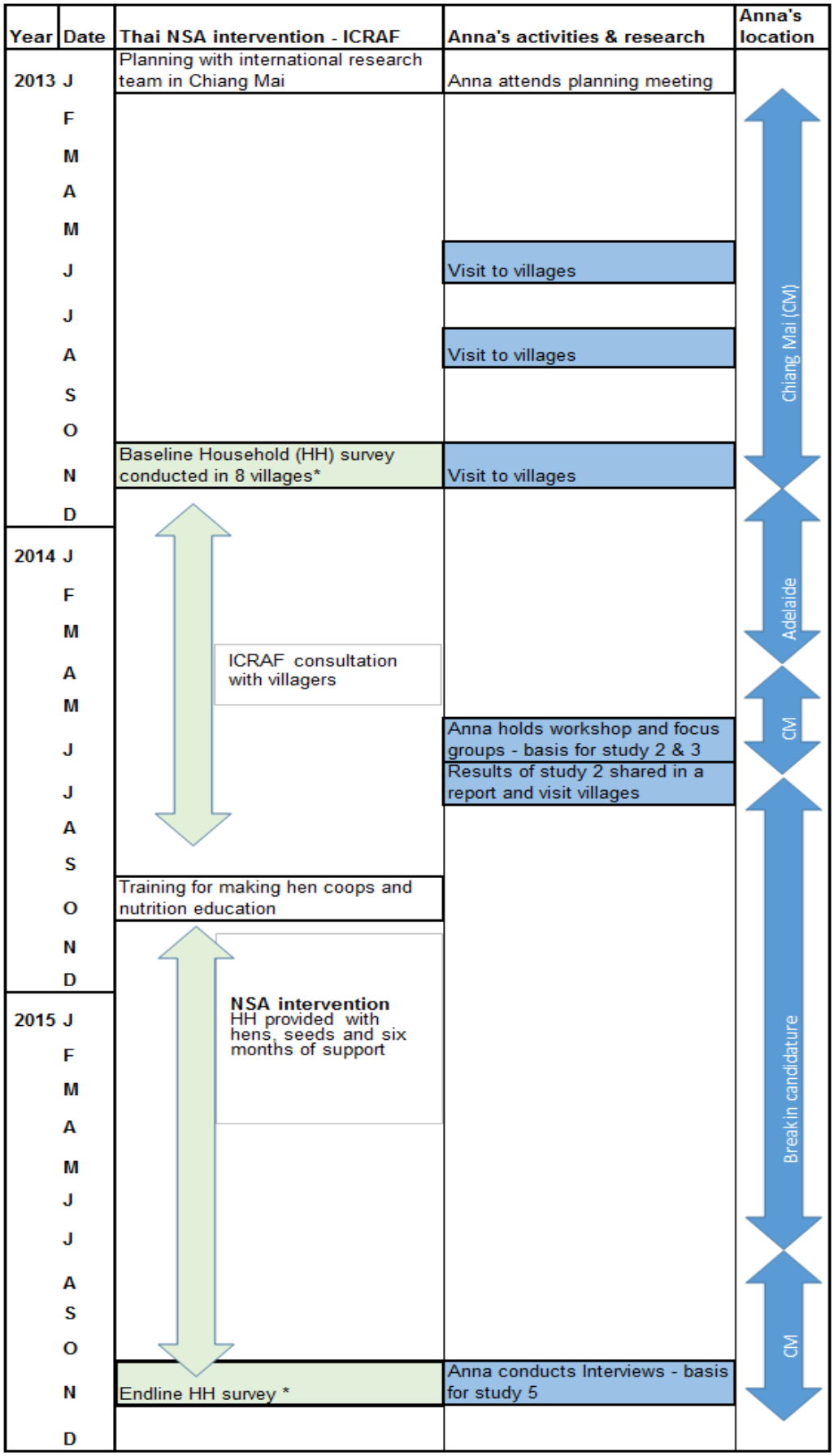
1.4 How my research fits into the nutrition-sensitive agricultural intervention

My original intention was to support educational aspects of the NSA intervention in relation to nutrition. However, when considering the time available and skills I wanted to develop, my involvement in the research evolved into a number of different elements. Figure 2 highlights the main NSA intervention activities completed by ICRAF and my research activities, clearly delineating the different scopes of work. The main activities that I completed were analyses of the quantitative data collected by ICRAF, interviews to understand infant and young child feeding and contextual influences and a qualitative evaluation of the NSA intervention.

1.4.0 Building community connections and rapport

From the outset of the NSA intervention, I attended activities, such as the international research team meetings, to better understand the Thai NSA intervention and provide nutrition advice and input. In terms of connections with the villagers, prior to starting my research, I visited Mae Chaem three times with ICRAF: the first time was to meet the district public health officer (PHO) and to visit Mare Key Mook Noi, a participating village; the second to attend the training conducted by ICRAF on the NSA intervention survey instrument. Next, I visited the villagers over a two-week period as part of the ICRAF survey team conducting the baseline survey in November 2013. I assisted with measurements of children and informally spent time with villagers, building connections and understanding of their daily life. During this period, ICRAF members and I would stay in the villagers' homes and eat with the villagers. Once my studies began, I again visited the villagers before undertaking my research as a means to strengthen connections, rapport and understanding.

Figure 2. Timeline of the activities of the NSA intervention and Anna's research



* Anna was subsequently provided with these data that were the basis for study 1 and 4

1.5 Thesis aims

The overall aims of this thesis were to gain an in-depth understanding of current IYCF practices and the underlying circumstances contributing to the high prevalence of stunting in hill tribe children aged 0–5 years. This information was used to enhance an NSA intervention delivered in the Karen and Lua hill tribes of northern Thailand. Following implementation of the intervention, IYCF, stunting and sustainability of the intervention were assessed. The specific aims of each of the five studies presented in this thesis are listed below:

1.5.0 Pre-intervention

1. To describe the current prevalence of stunting in children under 5 years in the ethnic communities of northern Thailand; to describe the variety of foods fed to children; to describe household characteristics, including food security, and to investigate associations of these factors with stunting (Study 1, Chapter 4).
2. To gain an in-depth understanding of infant and young child feeding practices, accompanying beliefs, and their socio-cultural context in the Karen and Lua ethnic communities of northern Thailand (Study 2, Chapter 5).
3. To understand how villagers and health workers (volunteers and officials) gauge health of children under 5 years; whether growth monitoring is salient; and the relationship between villagers and the health system in this remote location (Study 3, Chapter 6).

1.5.1 Post-intervention

4. To determine if the NSA intervention in the northern hill tribes of Thailand improved dietary diversity, household food security and the anthropometry of children aged 0–5 years (Study 4, Chapter 7).
5. To explore how the NSA intervention implemented in the hill tribes was received by the villagers and how it fared a further six months after external support ended (Study 5, Chapter 8).

1.6 Thesis outline

This chapter introduces the causes, consequences and prevalence of stunting, both globally, within Thailand, and its persistence in the hill tribe communities of northern Thailand. NSA is introduced and briefly explained along with the multi-site NSA initiative, the Thai NSA intervention and how the research in this thesis fits into the Thai NSA intervention. The chapter finishes by outlining the aims of the studies in this thesis.

Chapter 2 includes a literature review of undernutrition and its determinants, followed by an in-depth look into the hill tribe context, describing activities occurring there and in similar communities to reduce childhood stunting. Chapter 3 is split into two sections; the first will describe the methods of the NSA intervention implemented by the international research team and ICRAF. The second provides an overview of my approach to conducting the five studies presented in the thesis.

Chapter 4 presents the diets of children aged under 5 years, the prevalence rates of stunting and investigates associations between stunting, diet and other household variables. Chapter 5 presents an in-depth view of the circumstances and practices contributing to IYCF practices. Chapter 6 investigates factors associated with the Thai public health system and how they may have contributed to the persistence of child stunting over time.

Chapter 7 presents the effects of the NSA intervention on IYCF practices, food security and anthropometry. Chapter 8 provides an in-depth understanding of community members and health official's perspectives following the NSA intervention. IYCF knowledge, beliefs and practices are explored in addition to the success of the intervention and its prospects for sustainability. Chapter 9 provides a synthesis of the findings of the thesis with concluding remarks.

Chapter 2
Literature review

The structure of this chapter is as follows: section 2.1 begins by describing malnutrition, particularly undernutrition and its determinants; 2.2 introduces the background context of the research including the setting for undernutrition in Thailand and the hill tribe communities; 2.3 outlines common IYCF practices and associations with undernutrition, and the causes of the practices in Thailand and in the hill tribes; 2.4 covers what has been done previously to address undernutrition, including nutrition education and nutrition-sensitive agriculture in developing country settings and 2.5 briefly outlines justification for this body of work.

2.1 Malnutrition and undernutrition

Malnutrition is a global problem that results from either a deficiency, known as undernutrition, an excess, known as overnutrition or an imbalance of nutrients. Malnutrition, mainly in the form of undernutrition, is attributed to 35% of deaths among children below 5 years of age and 11% of the total global disease burden (20). This thesis will focus on undernutrition.

Undernutrition can be determined using child growth standards that classify children based on age, sex, and anthropometry. Some countries have developed their own growth standards, however the WHO child growth standards are the most commonly used around the world. The WHO standards have been developed using child growth data from both developing and developed countries (21). The standards can be used to identify healthy growth and undernutrition including low weight-for-height (wasted), low height-for-age (stunted) or low weight-for-age (underweight).

Wasting is a sign of acute undernutrition that can be reversed with early detection and appropriate management. It is most common in children aged 6-24 months. Stunting is a sign of chronic (or long term) undernutrition, resulting in delayed musculoskeletal and cognitive development and is difficult to reverse, especially after 2 years of age (22). Underweight includes either or both wasting and stunting.

2.1.0 Global nutrition goals and interventions

International goals have been set to address the large number of children suffering from the different forms of undernutrition. In 2000 the Millennium Development Goals were developed which focused on major global priorities including the reduction of hunger and malnutrition. The Sustainable Development Goals succeeded these and included a greater focus on food security and the promotion of 'sustainable agriculture'. In 2008, the 1000 day period was highlighted in the Lancet Maternal and Child Undernutrition Series as an important period to ensure adequate nutrition and health for growth (2, 20, 23-25).

Despite the international focus on the reduction of childhood malnutrition, it was recognised that many programs were small in scale (26). The Scaling Up Nutrition (SUN) Movement was launched in 2010 to help increase the reach of nutrition-related programs (26). Meanwhile the United Nations (UN) developed a framework to help guide implementers and organise the abundance of nutrition tools available (27).

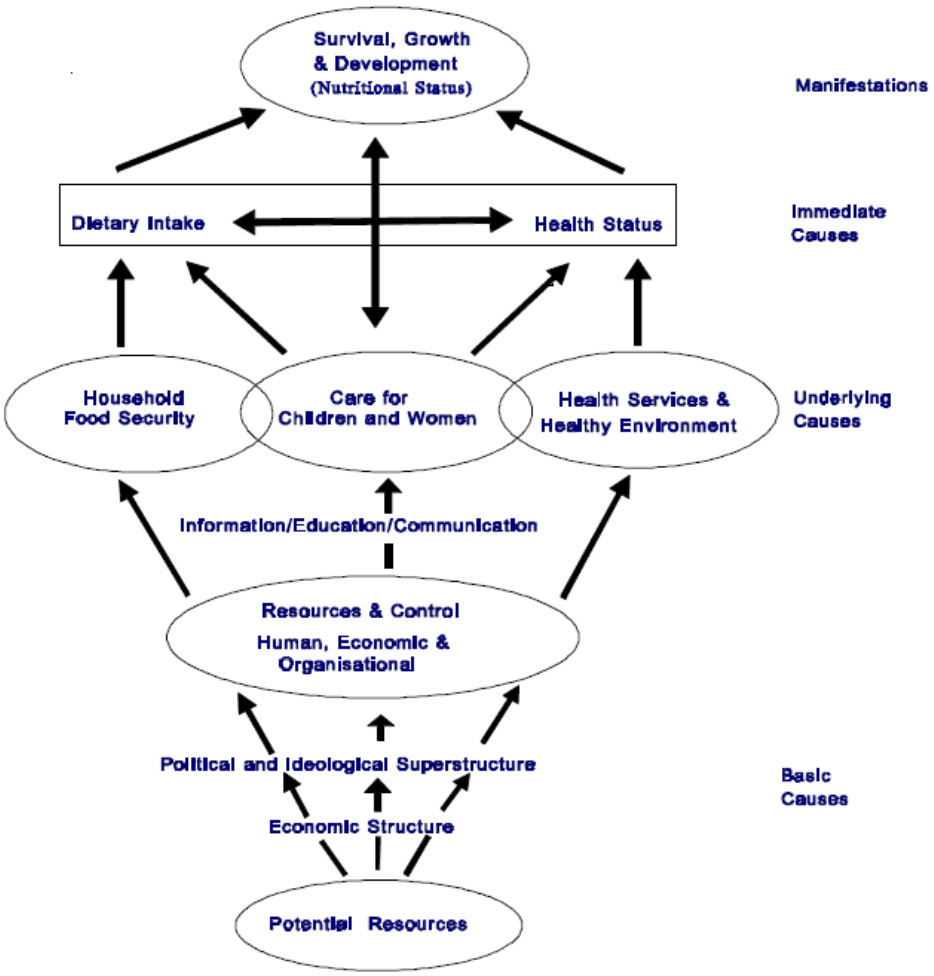
Since the above mentioned goals and actions, support has continued to build surrounding efforts to reduce undernutrition around the globe. In 2012 the UN Secretary-General set the aim to eliminate all forms of malnutrition and build inclusive and sustainable food systems with the 'Zero Hunger Challenge'. The UN declared a 'Decade of Action on Nutrition' from 2016-2025 (27). In 2012, WHO set the goal to achieve a 40% reduction in stunted children aged under 5 years by 2025 (28). Combined, these goals and actions indicate the importance placed on the reduction of undernutrition around the globe.

2.1.1 Determinants of undernutrition

Undernutrition is the result of a number of complex interactions (29, 30). The UNICEF conceptual framework for the determinants of malnutrition (undernutrition) is one of the most well-known frameworks used to display these interactions (Figure 3) (31). It was first developed in 1990 but has since been modified to reflect increased understanding in this field

(20, 32). The framework recognises that the immediate determinants of undernutrition include dietary intake and disease, followed by underlying determinants including household food security, health services and a healthy environment and care for children and women. Beyond this at the contextual level basic determinants include social, political, and economic factors and structure. An updated version of the Framework by Black et al. (33) has changed the focus from the determinants of undernutrition to actions to achieve optimal child nutrition and development. The next section will briefly outline the determinants of undernutrition, from the immediate through to the basic determinants.

Figure 3. UNICEF Conceptual Framework: Causes of malnutrition and death (UNICEF 1990)



2.1.2 Determinants of undernutrition - immediate

2.1.2.0 Dietary intake - Infant and young child feeding practices

Guiding principles to inform IYCF practices have been developed by WHO based on scientific evidence for the best nutrition and health outcomes for children (34, 35). One important practice is exclusive breastfeeding (EBF) until 6 months of age. EBF has substantial evidence to support its role in reducing stunting due to its immuno-protective affect and supply of essential nutrients (36, 37). Non-breast milk substances introduced prior to 6 months of age increases risk of infections and displaces nutrient intake provided by breast milk, so it is not recommended (38-40). Other guiding principles include; maintenance of breastfeeding; responsive feeding; safe preparation and storage of complementary foods; amount, consistency, frequency, energy density and nutrient content of complementary food; food supplements and feeding during and after illness (34, 35).

2.1.2.0.0 Dietary terminology

At this point I will define important dietary terms that will be used throughout the thesis. The first is dietary intake, it refers to consumed food. The next term is food groups, and it refers to sets of foods based on similar nutrient composition. The final term is dietary diversity, referring to the number of food groups consumed in a 24 hour period. A detailed explanation of dietary diversity and relationships between each of the defined terms with stunting and food security are provided in section 2.3.1.1.

2.1.2.0.1 Dietary requirements for adequate child growth

Between 0-6 months of age, breastmilk provides all the nutrients a child needs for good health. From 6 months of age, breastmilk alone is no longer adequate. Micronutrients (vitamins and minerals) rather than macronutrients (carbohydrate, protein and fats) become limiting in breastmilk and child's nutrients stores become depleted. Children therefore require

additional food sources high in vitamins and minerals to supply nutrient requirements (34). At 9-12 months of age, three quarters to one hundred percent of requirements for iron, phosphorous, magnesium and calcium, need to be supplied by complementary foods, highlighting the need for nutrient dense complementary foods (34).

2.1.2.0.2 Common nutritional deficiencies in children aged 0-6 months

Nutrient deficiencies commonly seen around the world in infants and young children, include, iron, zinc and vitamin B6 (34). A deficiency in iron can often lead to iron-deficiency anaemia, characterised by the appearance of abnormal red blood cells, leading to tiredness, fatigue and potentially stunting. Another common deficiency is zinc. Zinc deficiency is associated with poor growth and poor immunity. Other problem nutrients include vitamin A, iodine and calcium, these deficiencies are dependent on the context and the nutrient content of the complementary foods supplied there.

2.1.2.1 Disease

Malaria, measles, acute respiratory infection, and HIV/AIDS are among the most common diseases increasing children's susceptibility to undernutrition (41). The infections can influence undernutrition status in different ways including increasing risk of diarrhoea and nutrient loss, increasing nutrient requirements, decreasing dietary intake, reducing absorption of nutrients and increasing catabolism and nutrient loss (41). These effects can lead to a cycle of repeated infections, reduced immunity and poor nutritional intake (41).

2.1.3 Determinants of undernutrition - underlying

2.1.3.0 Environment

Unhealthy environments are those where infections can be easily transmitted (42). The main contributors are poor water and sanitation that can lead to high rates of diarrhoea and increased the risk of undernutrition (43). A study in Vietnam found undernutrition to be much higher in the communities using unsafe water, unhygienic latrines and where hand-washing

with soap before and after preparing food was not practiced by carers (44). On the other hand, environments where there is clean water and good sanitation have been associated with improved growth in children (45-48). A study in Bangladesh reported a difference in the height-for-age z-score of 0.54 SD in favour of children from clean compared to unclean homes. Clean homes had no stool in the toilet, clean drinking water, and water and soap available to use after the toilet (47).

2.1.3.1 Health services

The health system has an important role to play in providing adequate health services to prevent undernutrition. Adequate health services have been associated with a decrease in undernutrition risk (31). Of particular interest in this thesis is the role of the health system in supporting health and nutrition in infants and young children. Now the system will be briefly introduced specifically in relation to remoteness, IYCF and growth monitoring.

2.1.3.1.0 The health system: remote

One of the roles of the health systems is to be responsible for primary health care, which involves improving the health of the entire population including the rural, poor and malnourished (49). Avenues to improve the reach of the health system have therefore been explored, particularly in remote locations. Village health volunteers (VHVs), also known as community health workers, have been introduced in a number of countries as a relatively affordable avenue to increase the health system's reach (50). VHVs are people from within the community who are given basic training to provide health care and promotion within their communities and act as a liaison between health staff and the community (50-52). A systematic review of VHV's effectiveness concluded that VHVs are associated with increased EBF and delivery of health promotion in many low and middle income countries (53). One study indicated that VHVs effectiveness may be dependent on their level of

knowledge, attitudes, training and performance highlighting the importance of these aspects (54).

2.1.3.1.1 The health system: IYCF

The health system can be an avenue for IYCF education and advice. Nutrition education provided through the health system has been associated with improvements in IYCF including EBF (55), complementary feeding and also growth (56). In a poor peri-urban area of Peru, enhancing the quality and coverage of nutrition education via the health system resulted in IYCF practices improvements including feeding nutrient dense thick foods, and providing diets meeting energy, iron and zinc requirements. Young children in the poor peri-urban area were three times more likely not to become stunted compared to children from control areas (56). Additionally nutrition education has been found to be particularly beneficial when it has well organised supervision, support and training for staff (50, 55, 57).

2.1.3.1.2 The health system: growth monitoring

Growth monitoring has long been endorsed and promoted by WHO and often implemented through the health system (21). Growth monitoring involves monitoring the anthropometrics of children aged 0–5 years of age, commonly on routine visits to the health system, such as for immunisations. Growth monitoring involves a set of procedures including the measurement of children, plotting their growth on growth charts, assessing growth compared to the standard, provision of nutrition counselling (detailed further in section 2.4.5.0) and targeting supplementary feeding to undernourished children or those children at risk.

2.1.4 Food security

Food security is defined by the Food and Agriculture Organization (FAO) as having adequate food availability, accessibility, utilisation and stability (58, 59). This refers to having a food system with an adequate supply of affordable, safe and nutritious foods at all times. Between 2014-2016 it was reported that there were 795 million people around the world who were

food insecure and the majority were based in developing regions (60). The developing regions have lower social protection and economic security, which are major contributors to food insecurity (60). Integrated approaches have been developed to address the many causes of food insecurity. An example is the Integrated Food Security Programme implemented in Malawi from 1997-2004. The program included agriculture, family planning, income generation, food for work, health care, safe water and food preparation activities. Positive changes in food security occurred along with a 10% reduction in the prevalence of stunting (61). Thus food security has multiple determinants that require consideration to prevent food insecurity.

2.1.5 Care for children

One factor that has been found to highly influence undernutrition is the ability to care for children, or caregiving behaviour (29). Care is a broad concept that refers to 'provision in the household and the community of time, attention, and support to meet the physical, mental, and social needs of the growing child' (62 p21). Engle outlines that in order to understand care there are both care practices and maternal resources to care (62). Care practices include, a) care for women, b) breastfeeding, c) psychosocial stimulation, d) food preparation, e) hygiene practices and f) care during illness (64). Maternal resources relate to education, physical health, mental health and women's empowerment. In communities where there are high rates of undernutrition, there is often a lack of care practices and resources limiting the ability of caregivers to care (64). There is recognition that responsive feeding, an aspect of care, is important for influencing dietary intake and growth (65-67). Responsive feeding relates to a carer responding to the verbal and nonverbal cues of the child while feeding (33). A study in rural India over 12 months reported reduced stunting and improved dietary intake in the children fed responsively compared to controls (65), highlighting the benefits of responsive feeding.

2.2 Undernutrition in Thailand

This next section will introduce Thailand and provide a background on how the prevalence of undernutrition in children 0–5 years old has changed overtime in Thai children. A number of changes have been associated with halving the prevalence of undernourished (stunted or underweight) children under 5 years of age from 25% in the late 1980s to 12% in 1995 (4).

In the 1960s Thailand was classified as a developing country. At that time the Thai Government began implementing National Economic Development plans that outlined actions to improve access to services including healthcare, income distribution, agriculture, infrastructure and transport, particularly in the rural areas (68). After three cycles of the five-year plan, the fourth included a national multi-sectoral nutrition plan to improve food supply, distribution, education, basic health services and resource allocation. This was due to an increased awareness of the high percentage of children with undernutrition in the country.

In 1978 the Alma-Ata Declaration of primary health care occurred promoting health care for all (69). The Thai Government actualised the principles in the international declaration, including reaching out to vulnerable individuals and ensuing equal access to health care for all citizens. The Thai health system expanded and introduced VHVs in the 1980s (68), to reach out and connect the health system with the community.

Growth monitoring was introduced via the Thai health system in the early 1980s. Its aim was to identify and provide support for carers and their undernourished children. It involved quarterly weight and height measurements of children under 5 years of age. These assessments were conducted either by VHVs in the village or during visits to the public health office, such as for child immunisations. Thai growth standards were used to classify children as either healthy or undernourished, and necessary treatment provided if required (70).

Following the introduction of growth monitoring the Poverty Alleviation Plan was implemented by the Thai Government in the early 1980s, aiming to reach out to rural and remote regions and improve the economic situation of the poorest communities through rural job-creation, village development and agricultural production (4). The Poverty Alleviation Plan aimed to support communities to be in control of their own development in partnership with the government (71).

The plans and activities listed above were implemented over a 15-35 year period and associated with a number of improvements in Thailand. These improvements included a 14-fold rise in national income (72), increased access to health facilities and safe water, better sanitation services and reduction in mortality rates. Thailand during this time moved from a low to a middle-upper income country, as assigned by the World Bank (73). Now in Thailand undernutrition is no longer a key priority. The prevalence of both stunting and underweight have dropped to 16% and 9% (5), respectively, classified by WHO as 'low severity' (74).

2.2.0 Thai hill tribes

Despite the national level improvements in the reduction of undernutrition, underweight and particularly stunting remain a concern in the hill tribes of northern Thailand. In 2002 about 1% of the Thai population were classified as hill tribe villagers equating to around 800, 000 people (75). The hill tribes are made up of 23 ethnic minorities mainly originating from south and southwest China and dwelling in the remote northern hilly areas of Thailand where they first entered (76). The largest ethnic group is Karen, making up nearly 50% of the ethnic minorities (75). The Karen and Lua ethnic hill tribe groups are the population groups of focus in this thesis due to the high prevalence of childhood stunting and household food insecurity in these villages.

The villagers of the hill tribes have traditionally practiced a subsistence lifestyle, including hunting and gathering, and caring for diversified crops such as pulses, legumes, rice and corn.

‘Shifting cultivation’ also known as ‘swidden agriculture’ was traditionally practiced. This involves slashing areas, often forests, to create farming fields and to provide nutrient rich soil. Starting from the 1970s and continuing until now, the Thai Government has placed increasing pressure on farming communities to stop the slash and burn practice, to preserve the forests (77, 78). The push has resulted in a change in farming practices in the hill tribes to fixed field farming. Fixed field farming repetitively uses the same piece of land increasing the use of fertilisers and pesticides and has been associated with growing just a few staple crops, known as ‘mono-cropping’. The increased use of chemicals is required to rid pests that are more prevalent in monocrops and to improve yields as the nutrients are lacking in the soils constantly in use. The changes in farming practices have increased the financial inputs required by farmers, yet improvements in food security have not been reported (79).

2.2.1 Hill tribes of Mae Chaem

The Karen and Lua hill tribe villages of Mae Chaem, Thailand were the focus of this thesis due to this research supporting an intervention implemented by ICRAF to address stunting and poor food security. These hill tribes are a part of the Chiang Mai province that has the largest hill tribe population of about 191,000 people, as reported in 2002 (75). The term hill tribe has been officially used since 1959 when the Thai Government set up the Central Hill Tribe Committee which is responsible for the welfare of the hill tribes (76). The term is still used in official documents today, and not seen as derogatory (76).

Measurements of the Mae Chaem hill tribe children in 2013 indicate that based on Thai growth standards 30% of children under 5 years of age were stunted and about 16% were underweight (9). These percentages are much higher than 8% or 4% of rural or urban Thai children, respectively stunted or 6 and 10% of the urban and rural Thai children respectively underweight (based on WHO standards which generally give higher percentages than the Thai standards) (7). Thus, undernutrition among the Mae Chaem hill tribe children is a

concern, particularly stunting, due to its high severity classification by WHO. Stunting is therefore of particular interest throughout this thesis.

In the Mae Chaem hill tribes, villagers have moved from shifting cultivation to fixed field farming, as has been occurring in other hill tribes in Thailand. The main cash crop in the Mae Chaem hill tribes is animal feed maize, and this is not suitable for human consumption. Households are commonly made up of a daughter and her spouse and children living in the household of the mother's parents (80). Both men and women play very prominent roles in crop cultivation. Similarly, both are involved in decisions regarding child health and childcare. Child care involves social negotiation between parents and older generations which is a result of there being no firm line between individual and household (80). Dietary intake is predominantly rice-based (81) and a number of nutrient deficiencies such as vitamin A and iron have been recorded (82).

2.3 Infant and young child feeding practices in Thailand and the Thai hill tribes

Now that the determinants of undernutrition and the Thai hill tribe scene has been set, this section will look at IYCF practices contributing to undernutrition globally, in Thailand and in the Thai hill tribes and specifically the Mae Chaem hill tribes where information is available. Firstly, breastfeeding will be outlined, followed by its specific determinants, then complementary feeding and lastly the determinants of both breastfeeding and complementary feeding will be shared.

2.3.0 Breastfeeding

Breastfeeding is known to be the safest and most nutritious food to give children in the first six months of life. In 2016 The Lancet Breastfeeding Series was released that highlighted the significant economic and health benefits when governments support breastfeeding (83, 84).

EBF is a significant aspect of breastfeeding that refers to providing only breast milk not even water for the child's first six months. However, only 35% of infants worldwide are said to EBF during the first four months of life' (85). EBF protects against child infection, malocculation, increases intelligence and also has benefits for the mother (83).

In Thailand, breastfeeding is generally well accepted and believed to be nutritious and healthy (86). EBF is however not common. In the most recent State of the Children Report published in 2016, 12% of Thai children aged under 6 months were EBF compared to children in nearby Asian countries of 65% in Cambodia, 40% in Laos, 29% in Malaysia and 24% in Myanmar (5). Thailand has one of the lowest rates of EBF not only in the Asian region, but world-wide (87). It is important to note that the EBF recommendation increased in Thailand from 4 to 6 months in 2002, therefore the low adherence may be linked to a delay in the spread and acceptance of the changed recommendation, although the recommendation has been in place for over 15 years (88).

2.3.0.0 Determinants of EBF

In southeast Asia, early return to work by mothers is a commonly reported reason for the cessation of EBF (89, 90). Evidence from rural Vietnam indicates that women who return to work are 14 times less likely to EBF than women who do not return to work, where work is mainly farming activities (89). Other beliefs and practices associated with the early cessation of EBF include; waiting for breast engorgement to feed, feeding water, the belief that breast milk causes illness when the mother has eaten bad foods or had emotional upsets and the belief that clear milk is an indication of inadequate milk (87). In Karen mothers in Thailand, concern that breastfeeding will affect the shape of the breast has also been reported (91). Interventions are needed to address these multifaceted determinants (84).

2.3.1 Complementary feeding

2.3.1.0 Timely introduction

Complementary feeding is frequently reported to begin too early or too late in many populations (85, 92). WHO recommends that nutritious foods be introduced from 6 months of age (85), however an analysis of nine southeast Asian countries indicate that children are introduced to foods later than 6 months of age. As few as 6% of infants in Myanmar and as many as 99% of infants in Mongolia are introduced to food from 6 months of age, although the majority of countries report 60% or more of infants being introduced to foods from 6 months of age (93). In Thailand, 75% of the children were reported to receive food in a timely manner (5).

2.3.1.1 Dietary diversity

Not only when foods are introduced to children, but also the diversity of the foods fed are important. Dietary diversity is an indicator of the quality of dietary intake (94-96) and it can be measured by the number of food groups consumed. WHO have outlined seven main food groups including grains, roots and tubers; legumes and nuts; dairy products; flesh foods; eggs; vitamin-A rich fruits and vegetables; and other fruits and vegetables (96). According to WHO, an intake of four or more of the seven food groups is the minimum required to indicate adequate nutrient intake of children 6–23 months. They indicated that in most populations this would mean consuming at least one animal-source food, one staple and at least one fruit or vegetable, therefore supplying a range of nutrients (96). A review of Demographic Health Survey data collected from five south Asian countries (Bangladesh, India, Nepal, Pakistan and Sri Lanka) revealed that the minimum dietary diversity of children aged 6–23 months was generally achieved by fewer than half of the children (92). It is important to also note that dietary diversity is not only a measure of the quality of food but it can also be used as a measure of food security as dietary diversity is related to the access to enough food (33, 97,

98). The measure is not perfect, but can be used as a proxy measure. In Thailand there is little data on dietary diversity (99), however data indicates nutrient deficiencies are present in children 0–5 years of age, particularly for iron, vitamin A, vitamin D and iodine (100). Anaemia (including the iron deficiency form) has been reported as much higher in the rural regions of Thailand. In the rural children aged 6-36 months 42% compared to 26% of the urban children were diagnosed with anaemia (7). In the hill tribes, data collected in 2001 from Karen children aged 1-6 years revealed that about 10% of children had anaemia and 5% of children had iron deficiency anaemia. In this same population about 20% of the children had one or both of Vitamin E and A deficiencies and 97% of the children had dry scaly skin, which may be indicative of nutrient deficiencies. Other signs of lacking nutrients were evident in the children including angular stomatitis (vitamin B2) bleeding gums (vitamin C) and bow legs (vitamin D), however dietary diversity was not reported (8, 82, 101-104).

2.3.2 Determinants of IYCF practices

IYCF practices including breastfeeding and complementary feeding are influenced by a range of determinants (31, 92, 105, 106). Pelto et al. (29) outlined four IYCF determinants believed to be the most amenable to change:

1) Maternal time allocation and competing demands on women's time. Work is often a necessity and children are left with other carers that limit the mother's ability to breastfeed and care.
2) Beliefs, knowledge and perceptions, which may include carers not feeding children unless the child asks for food or food taboos that result in the delay of nutritious foods being introduced to young children.
3) Health of the caregiver and other family members influences feeding as caregivers need to be healthy in order to give adequate care.

4) Social networks, social pressure and normative expectations. Pressure from social groups can be both positive and negative.

Some of the aforementioned determinants have been reported to influence IYCF practices in the hill tribes (78, 80, 107). Firstly the hill tribes are affected by poverty and remoteness which limits access to food, healthcare and information sharing (80). Household food insecurity has also been noted (78) and increased costs associated with farming and the transition in farming practices have also impacted IYCF practices (107). Cultural beliefs, such as the early feeding of children within the first months of life is recognised as common and believed to strengthen children (108). These beliefs are often perpetuated by grandmothers and elders in the community (81, 108). Lastly, top-down health system approaches have been reported as limiting the individualisation of care and it is not clear whether this persists today (109).

2.4 Addressing undernutrition

2.4.0 Breastfeeding interventions

Across the world there are three major breastfeeding interventions. These include the Baby-friendly Hospital Initiative (BFHI), the International Code of Marketing of Breast-Milk Substitutes and maternity leave legislation (110). All three interventions have been implemented in Thailand initially supported by the National Breastfeeding Project that began in 1989 (111).

2.4.0.0 Baby-friendly Hospital Initiative (BFHI)

In 1991 UNICEF and WHO launched the BFHI. The BFHI promotes and creates safe places for breastfeeding. To become an accredited Baby-friendly Hospital, 10 criteria need to be met including the encouragement of breastfeeding on demand and showing mothers how to breastfeed. A meta-analysis of studies around the world evaluating the BFHI found that the BFHI increased EBF by 49% and any breastfeeding up to 6 months by 66% (84).

The BFHI was launched in Thailand in 1992 (112). Since 2006 the initiative has been promoted under the 'Saiyairak Project' ran by the Ministry of Public Health. The Saiyairak Project promotes the BFHI in the hospital and also within the community, with good evidence to support increasing breastfeeding through both hospital and community initiatives (113, 114). In Thailand the Saiyairak Project, which includes the BFHI, has been successful at improving EBF for six months (112). Hospitals with the Saiyaiak Project have recorded 50% of children at 6 months of age EBF, compared to the overall EBF prevalence in Thailand of 12% (5). In 2011, the majority (99.5%) of Thai public hospitals were BFHI accredited, although only a few private hospitals were registered. The Mae Chaem hospital, which is the main location for birthing of the hill tribe women, is a public hospital with the Saiyairak Project.

2.4.0.1 The Thailand code of marketing of breast milk substitutes and related products

In 1981 WHO adopted the International Code of Marketing of Breast milk Substitutes. The code recommends restrictions on the marketing of breast milk substitutes as there is clear evidence of a negative impact when breast milk substitutes are provided for free in maternity facilities and when promoted by health workers and in the media the code therefore prevents such actions (115). Thailand developed a 'Thailand Code for Advertisement and Sale of Breast milk Substitutes and Related Products 1995', closely following the international code (92).

2.4.0.2 Legislation on maternity leave

An internationally recognised maternity leave legislation was introduced initially in the 1950s and revamped in 2000, for countries to adopt and modify for their country (116). The legislation provides rules for employers to follow to ensure women a minimum number of paid leave days and the safety of return to their job following pregnancy. In Thailand the

government brought in the Maternity Leave Policy the Labour Protection Act of 1998 (117). It provides 90 days of maternity leave with full pay to eligible women who must be employed and have paid contributions to the Social Welfare Fund (100). The scheme therefore does not cover hill tribe women working under informal agreements.

2.4.1 Additional breastfeeding programs

In addition to the three major breastfeeding interventions, a number of smaller, community-based interventions have been initiated. A review of such interventions across 10 developing countries recognised a number of factors associated with successful breastfeeding interventions. These factors included utilising existing workers and providing workers with adequate training, such as counselling techniques. Effective communication, including attention to interpersonal skills, providing an enabling environment and continued reinforcement of appropriate breastfeeding practices were also important (32). Along with partnerships, good leadership and use of theory to plan and implement interventions was seen as important. Additionally, resources to facilitate scale-up and monitoring and evaluation to measure progress were required (118). These factors highlight that how a program is developed, implemented, monitored and maintained are very important.

2.4.2 Complementary feeding interventions

Evidence from developing countries has revealed that modest improvements in growth can occur as a result of improved complementary feeding practices (119-121). A review of the impact of complementary feeding interventions on growth reported improvements in linear growth ranging from 0.20cm (range 0.04, 0.64) mean effect size to 0.47cm (range -0.04, 1.81) (121). Important aspects of interventions included increasing the energy density of complementary foods through simple technologies and improving education and provision of complementary foods. Interventions should be context-specific due to factors such as the initial severity of undernutrition, the degree of household food insecurity, the energy density

of traditional complementary foods and the availability of micronutrient-rich local foods (121).

In addition to the review's findings there is strong evidence to support improved growth outcomes with using pre-tested educational messages promoting the use of locally available animal-source foods (122).

2.4.3 Nutrition-specific interventions

When addressing undernutrition, the term nutrition-specific is used to describe interventions that directly target the immediate causes of undernutrition including disease and an inadequate dietary intake (123). In 2008, 13 nutrition-specific interventions were identified as having benefits to children's health. The interventions fit into three main categories: 1) encourage changes in behaviour through nutrition education, such as EBF counselling; 2) micronutrient interventions, such as multiple micronutrients supplements; and 3) therapeutic feeding, such as treatment of severe acute undernutrition with special foods (23).

2.4.4 Nutrition terminology

In this section I will define four nutrition-related terms that are used frequently throughout this research. Firstly, nutrition knowledge refers to information that an individual has on the science of nutrition. Secondly, nutrition education refers to the process of teaching the science of nutrition to an individual or group (124). In this thesis nutrition education generally refers to generic nutrition messages that are not personalised. The third term is nutrition counselling. It is a method for providing nutrition education. In this thesis nutrition counselling refers to providing personalised nutrition recommendations that focus on incorporating changes in eating patterns and behaviours into an individual's life. Lastly, nutrition behaviour change relates to a change in nutrition related practices by an individual that improves their dietary intake.

2.4.5 Nutrition education interventions

Nutrition education is the most commonly employed intervention to improve undernutrition, either alone or in combination with other techniques (56, 121, 125, 126). Nutrition education was originally based on cognitive behavioural science and the theory that an increase in knowledge translated to a change in behaviours (127). It is now clear, however, that knowledge alone does not translate to behaviours and that a number of cognitive and contextual factors influence behaviours (128, 129). A systematic review of interventions addressing undernutrition in developing countries revealed that education was employed in nearly half of the 42 interventions, and was the most common strategy employed. Nutrition education has been found to have a modest effect on weight (mean effect size 0.28gm; range -0.06, 0.96) and linear growth (mean effect size 0.20gm; range 0.04, 0.64) (121). The benefit of education is that it can reach a large group of people quickly with minimal resources (130), however the impact can vary greatly depending on resources, context, culture, specificity of the message and delivery (120). There is evidence to support certain education techniques, such as trialling teaching new skills prior to use (131), replacing old behaviours with new ones (132), aiming messages at target groups (131) and having community involvement throughout the intervention process from planning through to evaluation.

There are also a number of criticisms of the education approach. Including, its generic approach that does not take individual situations into account (125, 133, 134) and experts extracting information from the community and developing nutrition recommendations without community input (135). Despite the criticisms, nutrition education still appears to be an important component of IYCF interventions and is widely used (26).

2.4.5.0 The role of nutrition education and counselling in growth monitoring

Growth monitoring provides contact with the health system where nutrition education and counselling can be provided. When nutrition education and counselling are provided as a part

of growth monitoring it has been reported to facilitate improvements in the growth of children (41, 136, 137). For example, in Indonesia, attention to nutrition counselling, via training and provision of tools to target nutrition advice, resulted in a forty percent improvement in the nourishment of children compared to those children whose parents did not receive the counselling (138).

2.4.6 The need for nutrition-sensitive interventions

Nutrition-specific interventions alone will not completely address undernutrition. Nutrition-specific interventions with the greatest evidence for impact include the promotion of breastfeeding, behaviour change communication for improved complementary feeding, zinc supplementation, zinc management of diarrhoea, vitamin A fortification or supplementation, universal salt iodisation, handwashing or hygiene interventions, treatment of severe acute undernutrition. If all of these interventions were implemented in the 36 countries that have 90% of the stunted children, they could reduce stunting by 36% (23). Therefore approximately 60% of stunting remains to be reduced through other means. Underlying factors that are not directly nutrition-related need to be addressed in order to see the additional improvements in nutrition outcomes. Interventions that address the underlying factors are called nutrition-sensitive interventions. These interventions may include but are not limited to transport; information technology; water, sanitation and hygiene (WASH); agriculture; social safety nets; child development and schooling. Ruel & Alderman (123) claim that we need large-scale nutrition sensitive programs to enhance the coverage of nutrition-specific interventions.

There is currently a limited number of assessments of the impact of nutrition-sensitive interventions on anthropometric outcomes (123). There is evidence of small benefits resulting from WASH interventions on length of children under 5 years of age including solar disinfection of water, provision of soap, and improvement of water quality (139). There is

some evidence that social safety net programs can improve food security and diet quality. Targeted agricultural programs have shown some signs to improve livelihoods, dietary diversity and women's empowerment (123), however the lack of quality evaluations and trials designed to measure growth outcomes have meant that the impact of nutrition-sensitive interventions is not clear, particularly on growth (123).

2.4.7 Nutrition-sensitive agriculture

One type of nutrition-sensitive program that has received attention, particularly as a means to improve anthropometric outcomes in rural farming areas, is NSA (12, 140). NSA refers to integrated nutrition and agricultural activities that have the end goal of improving the nutrition status of the participating households through farming activities. An example of an NSA intervention occurred in a Malawian population with smallholder farms. Almost 50% of children were stunted and 70-85% of households experienced food insecurity. The intervention was participatory and involved the villagers deciding to plant legumes between crops to provide a protein dietary source for children and improve soil fertility. Nutrition education was also provided (12). Following implementation there was a strong improvement in child growth in the villages with increased participation, weight-for-age z-score increased by 0.8 and height-for-age z-scores similarly increased (although the figures were not presented) (12).

2.4.7.0 Nutrition education within nutrition-sensitive agriculture

Along with agriculture-related activities, nutrition education is a key component of NSA interventions. In a review of 30 agriculture interventions it was found that when nutrition education was a feature of the NSA intervention, it was more likely to have a positive effect on nutrition quality and growth of children (13).

2.4.8 Well-designed nutrition-sensitive agriculture interventions

Eleven reviews of the impact of NSA interventions on anthropometric outcomes in children were carried out between 2001 and 2013 (13, 14, 23, 42, 123, 141-146). All of the reviews came to the same conclusion that there is limited evidence of NSA interventions having an impact on anthropometry, however weaknesses in the studies' designs and evaluations limited the ability to make conclusions (14). There is a need for evaluations of well-designed NSA interventions to inform future activities (15). These studies need to take underlying determinants and contextual factors into account to build contextual understanding (147).

2.5 Research justification

There is evidence that the hill tribe children living in the remote mountainous regions of Thailand have a particularly high risk of stunting that has persisted over time (6). Programs to address undernutrition have been implemented at a national level in Thailand with countrywide improvement. However stunting continues to persist in the Thai hill tribe children. It is important to understand what is contributing to the persistence of stunting in the hill tribes in order to address the situation.

ICRAF, with support, implemented an NSA intervention in the hill tribe communities of northern Thailand to address the high rates of child stunting. Despite the growing consensus that integrating nutrition and agriculture is important, there is still very little research investigating whether these approaches are effective (148). There is a great need to investigate systematically what works, particularly in conditions of limited resources and over time.

Chapter 3
Research Process

This chapter explains the research context. Section 3.1 details the NSA intervention implemented in Thailand by ICRAF and section 3.2 to 3.7 outlines the research that I conducted and how it fits with the research conducted by ICRAF. This next section also provides an overview of my research providing some consideration for methods and approaches used. Throughout the chapter I reference where detailed methods of each study can be found.

3.1 Thai nutrition-sensitive agricultural intervention

3.1.0 Experimental design

ICRAF implemented a pre-post longitudinal field trial in the Thai sub-districts of Pang Hin Fon and Ban Thup, Mae Chaem District, Chiang Mai Province, Thailand. The eight villages involved in the study were chosen for their high rates of stunting and food insecurity, geographic accessibility (e.g. could reach there by car) and existing relationship with ICRAF.

3.1.1 Sample size estimate

At the outset of the trial HealthBridge calculated the sample size needed to estimate a prevalence of 50% of children meeting the minimum dietary diversity. Due to not having any dietary diversity data for the population at that time a prevalence (p) of 50% of the children meeting minimum dietary diversity was chosen as it would provide the largest sample size. The following formula described by Kish was used to calculate the sample size (149):

$$n = (Z_{1-\alpha})^2[p(1-p)/\epsilon^2]$$

A total of 151 households was required to estimate the prevalence of minimum dietary diversity of 50% with 8% error (ϵ) and a 95% confidence interval (CI) $(Z_{1-\alpha})$. To account for refusal or absence, 10% (15 households) was added resulting in 165 households.

HealthBridge also calculated that 165 households would be able to detect a 20% difference in minimum dietary diversity between the treatment and control groups (alpha 0.05, power

80%). Note that is it not clear why HealthBridge chose this sample size calculation or why they chose to use an 8% error, these calculations were conducted prior to my involvement.

3.1.2 Recruitment

VHVs in all eight villages were provided with a list of households with children aged between 0–5 years old and asked to identify 20 carers to participate in the survey. An announcement was also made on the village local speaker system at the time of the baseline survey to invite carers to participate. Respondents were mainly mothers with some fathers and grandmothers.

3.1.3 Surveys

The surveys conducted before (baseline) and after the NSA intervention (endline), in November 2013 and November 2015 (see Figure 3) captured data on key nutrition indicators for children and of the local agricultural situation. The surveys were conducted at a central location in the village that villagers could easily access. The survey instrument was developed by the international research team. The instrument was then adapted to the local setting and translated to Thai by ICRAF.

Prior to conducting the survey the local suitability of the survey instrument was assessed in a workshop with VHVs. The instrument was also pre-tested in five households from a nearby Karen village not participating in the intervention. To ensure consistency in data collection, training sessions on administering the survey instrument were conducted for the ICRAF staff and for the VHVs who assisted ICRAF staff in data collection with translation between local language and Thai.

3.1.4 Survey instrument

The survey included respondent and household details, nutrition knowledge, food insecurity and dietary intake questions. The latter two question sets are detailed below. Further details of other variables will be given in specific chapters, where they are used in analysis.

3.1.4.0 Food insecurity

The Household Food Insecurity Access Scale (HFIAS) was developed in 2006 and validated by the United States Agency for International Development (USAID) together with the European Commission and FAO (150, 151). The HFIAS tool can capture four aspects of household food insecurity: scale, related domains, related conditions and prevalence. In this research prevalence was investigated. The prevalence is determined based on the responses to each of nine questions which have an associated frequency question (Table 1) and food insecurity category of either secure, mildly, moderately or severely food insecure (152, 153). The most severe food insecurity category given for any of the nine questions was the overall household food insecurity rating. 'Food secure' households do not worry about having enough food, mildly food secure households experience uncertainty surrounding having enough food, moderately insecure households cut back on quality of foods, and severely food insecure households cut on quantity and/or quality of foods consumed.

Table 1. Household Food Insecurity Access Scale questions

Question number	Question
Q31	In the past four weeks, did you worry that your household would not have enough food?
Q31A	If yes: How often did this happen?
Q32	In the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of lack of resources?
Q32A	If yes: How often did this happen?
Q33	In the past four weeks, did you or any household member have to eat a limited variety of foods due to lack of resources?
Q33A	If yes: How often did this happen?
Q34	In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of lack of resources to obtain different types of food?
Q34A	If yes: How often did this happen?
Q35	In the past four weeks, did you or any household member have to eat a small meal that you felt you needed because there was not enough food?
Q35A	If yes: How often did this happen?
Q36	In the past four weeks, did you or any household member have to eat fewer meals in a day because there was not enough food?
Q36A	If yes: How often did this happen?
Q37	In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food?
Q37A	If yes: How often did this happen?
Q38	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?
Q38A	If yes: How often did this happen?
Q39	In the past four weeks, did you or any household member go a whole day and night without eating anything because there wasn't enough food?
Q39A	If yes: How often did this happen?

Source (153)

3.1.4.1 Dietary intake

The respondent was asked about the diets of him/herself, the mother, father, and all children in the household aged 0–5 years in the preceding 24 hours. For each individual, age and gender were ascertained, along with consumption of liquids (14 questions), and foods consumed from nine food groups (17 questions); the food groups were based on the work of Kennedy et al. (94). In addition, breastfeeding was characterised for all children via five questions based on WHO IYCF recommendations (96). This set of questions is reproduced in Appendix A.

3.1.4.2 Anthropometry

Heights and weights of children were assessed at the time of the survey. Height and length were measured to the nearest centimetre using a portable stadiometer. Supine length was measured for children under the age of 2 years, placing the measuring board on a flat surface with one person supporting the head and a second positioning the child. Weight was measured to the nearest 100 gms using an electronic scale. A two-hour training session was provided to ICRAF staff in order to conduct the anthropometric measurements consistently.

3.1.5 Randomisation

The villages were randomised into either control or intervention after participation was secured and before baseline surveys of eligible households were completed (detailed above). An ICRAF staff member who had never been to the villages oversaw the randomisation process which involved the generation of numbers via a computer algorithm that were randomly assigned by the computer to each of the eight villages. The two Karen villages given the lowest numbers were assigned intervention villages, and the remaining two Karen villages assigned control, and this same process was repeated for the four Lua villages.

3.1.5.0 Intervention villages:

Ban Ho and Kok Noi of ethnicity Lua; Ban Thung Ke and Mae Khi Muk Noi of ethnicity Karen.

3.1.5.1 Control villages:

Ban Pae and Mued Long of ethnicity Lua; Ban Mare Hare Tai, Se Do Sa and Kong Kai of ethnicity Karen.

Additional background activities that assisted in the development of the NSA intervention are detailed in Appendix B, along with research activities that were planned but not undertaken.

3.1.6 Data collection and analyses

In November 2015, 12 months following implementation of the NSA intervention and six months after the supported intervention phase had ceased, the survey instrument was again administered (at endline) for all participating households. The endline survey was conducted at the same time of year as the baseline survey to avoid seasonal effects. The data was briefly analysed and reported (19), but limited time, resources and funding prevented a detailed analysis by ICRAF. Later ICRAF agreed that I could undertake a detailed analysis as part of my thesis (Chapter 7).

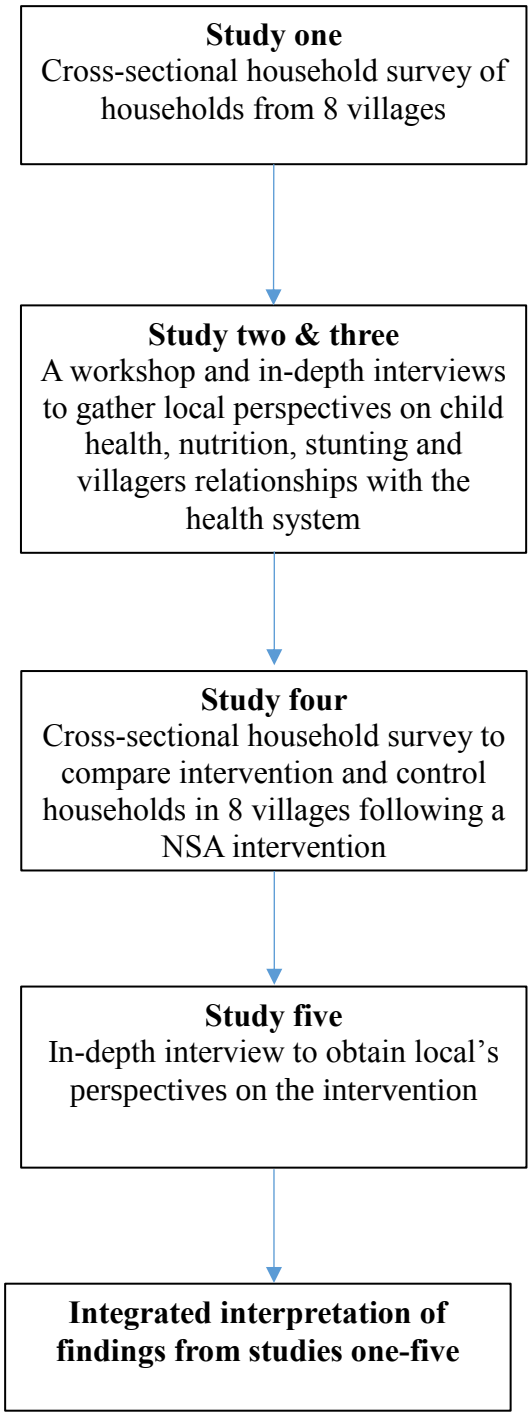
3.2 Mixed methods research

The research conducted by me consisted of both qualitative and quantitative research, known as mixed methods research. This approach provides greater understanding of a research problem than either qualitative or quantitative research alone allow (155). Quantitative assessments often provide an overview of the situation, a description that is numerical, impersonal and objective. The emphasis on measurement enables certain types of comparison, for example, with national or international benchmarks, and statistical analysis of data as a way to identify correlated (or associated) variables. However, in order to gain an

in-depth understanding of local practices and their meanings, qualitative research methods are appropriate as they provide a subjective perspective highlighting intentions attached to behaviours that may be shared to varying degrees (156).

This research was made up of five studies, three qualitative and two quantitative. The ideal flow of the studies is outlined in Figure 4, depicting a sequential mixed methods design. In this ideal version, each study shapes and informs the ones that follow. Due to time and funding constraints, and the logistics of engaging with a larger program of work, my contributions to the studies did not actually occur in this order (see Figure 2). Despite this, where ever possible awareness of other components of the work was maintained, and in the discussion sections of each study I attempted to scaffold the findings.

Figure 4. Mixed methods research – proposed ideal flow



3.3 Quantitative Studies

I completed two quantitative studies as a part of this research, including study one and study four (Figure 4). Study one was based on a cross-sectional study conducted by ICRAF involving a household survey in eight ethnic villages prior to the implementation of the NSA intervention (described in section 3.1). The methods taken by myself to complete this study are detailed in section 4.5. Study four was based the same household survey but conducted 12 months following the implementation of the NSA intervention comparing the intervention and control groups. The methods taken by myself to conduct this study are detailed in section 7.3.

3.4 Qualitative Studies

I also undertook qualitative research for study two, three and five (Figure 4). Study two and three both analysed data collected from a workshop and in-depth interviews conducted prior to the NSA intervention. The methods to undertake the research are described in section 5.5 and 6.5. While study five utilised in-depth interviews to understand the NSA intervention 12 months following its implementation, the methods undertaken are described in section 8.5. In this section, I will explain how I approached the qualitative research, as such an explanation with self-reflection is best practice. In contrast, quantitative research does not require this by way of introduction, as that tradition assumes the researcher is impartial (even irrelevant), with adherence to the method demonstrated by following conventions for presenting the research and analysing the data.

3.4.0 Conceptual approach

The research is based on a social constructionist epistemology, which posits that a person (and a community) constructs their own meaning and reality of the world in a social environment (157). In asking community members about their lived experiences, an

understanding of the meanings behind specific practices and the ways in which they are related is gained. This is particularly important for me as a researcher working with the Thai, Karen and Lua people. I aimed to gain an insight into these people's lives, in order to respectfully and effectively assist with developing an appropriate nutrition education.

3.4.1 Research among indigenous hill tribes

When considering beforehand the range of potential benefits this research may have for the hill tribe communities, the principles outlined in the Guidelines for Ethical Research in Australian Indigenous Studies (158) were referenced. Although the principles were written for Australian Indigenous peoples, much of the content is relevant for conducting research in other indigenous populations.

The six main values taken from the principles that this research aimed to uphold were: spirit and integrity, reciprocity, respect, equality, survival and protection and responsibility. In relation to the research on the hill tribes these principles were translated into the identification of realistic solutions to current IYCF problems, including the development of the NSA intervention and nutrition education. Participants received a monetary sum as token compensation for the time they had taken out of their productive hours to be involved in the research. The research aimed to respect and value the opinions and knowledge of the community by giving an opportunity to discuss and share opinions. A network of individuals knowledgeable in nutrition and local culture were referred to, to ensure that the project adhered to rules about cultural safety and appropriateness. The nutrition education developed using the research findings was designed to contribute to the right of equitable access to nutrition information for all people by sharing the findings with the community.

I have aimed to remain conscious and sensitive to the fact that the informants themselves own the Indigenous knowledge. I have therefore only shared information disclosed to me when given informed consent and deemed that it will benefit and not be harmful for the community

members. In this research I have been accountable to the community via sharing the findings of the research with the public health office and ICRAF.

3.4.2 Participatory approach

It has been recommended that marginalised communities be involved in the research process so that they are consciously participating in something that is meaningful to them (17). The villagers' voices need to be heard and their current knowledge and practices understood (17). The villagers have a wealth of knowledge and some of the members may have already found better solutions to problems that their peers are facing that they can share (18). Such as the older generations have rich insights on the usage of wild resources (159) and highland agro-ecosystems (160).

3.4.3 Qualitative research: Credibility

It is important to ensure the trustworthiness and credibility of all data, including qualitative data. Therefore a number of methods were applied to the collection and interpretation of the data. Triangulation was used to gain a comprehensive view of the hill tribe's situation. Triangulation involves using multiple sources to draw conclusions (161). I used my field notes and observations, ICRAF's findings, in-depth interviews and the workshop to provide a fuller understanding of situations. To improve the trustworthiness of my findings I implemented the research strategies of prolonged engagement, persistent observation and reflexivity (162, 163). I spent substantial time with the villagers over a total of six occasions. While in the villages I would spend time with different families and in some cases the same family over an entire day, to better connect with and understand their daily life patterns and feelings of the people. Furthermore, I applied a number of strategies to ensure a reflexive practice, described below.

3.4.4 Qualitative research: Reflexivity

Following a reflexive practice is important from a social constructionist view on which this research was based. This acknowledges that I can affect the outcomes of the research through the actions I take and my beliefs and past experiences (164). I therefore included time to reflect on my impact on the research process and to ensure I was bringing rigour to the research process. Strategies I employed included meeting with the advisory team, sharing findings with Dr Prasit Wangpakapattanawong on a regular basis as he has a long-term relationship with and deep understanding of the villagers, keeping a reflexive journal, sharing findings with the district PHO, and seeking their feedback. I also kept an audit trail of activities and thoughts surrounding the activities, thoughts arising from the analysis process and drafts of reports.

3.5 Positioning self as researcher

In order to effectively work with the hill tribes I needed to build rapport with the community and also ICRAF. Firstly, with ICRAF it was important to work with them in order to be informed and to best be able to support the NSA intervention. ICRAF also helped to connect me with the community through their existing relationships and village visits, which were not possible to do on my own. I was based in the ICRAF office for the first two years of my doctoral studies, this allowed me to work closely with ICRAF and to support them in the development of the nutrition education as a part of the NSA intervention.

3.5.0 My background

I will now offer some insights on my background to show why I was passionate to conduct this research. I was first introduced to undernutrition in remote indigenous populations when working as a dietitian with Papua New Guinean and Indigenous Australian populations. In 2009 I worked for a year in Nepal, investigating and supporting health workers to provide IYCF education. Following this, I moved to Thailand and worked on IYCF research across

southeast Asia. I was employed by Menzies School of Health Research to work on projects related to breastfeeding, nutrient deficiencies and malnutrition. During this period I took Thai language lessons, with the view that it would be crucial for the success of this research. Not all villagers spoke Thai, as their mother tongue was Karen or Lua, but most had some understanding of Thai. My fluency of Thai improved to the level of 'independent user', which meant I could connect with villagers one on one. The villagers often commented on how happy they were that I could speak Thai with them. Thai was also spoken in the ICRAF office, therefore, comprehension of the language allowed me to not only communicate with the ICRAF staff but also to be informed on the NSA intervention activities.

3.5.1 Advice

For this research I developed a network of individuals knowledgeable in nutrition and local culture. The purpose of these contacts was to ensure that the proposed research activities were appropriate for the local context and to provide advice on appropriate processes, interpretation of findings, publication protocols and dissemination of results to communities and the wider public. I will now outline the members of the advisory team.

Dr Chawapornpan Chanprasit, Associate Professor at the Department of Public Health Nursing in Chiang Mai University conducted her PhD on IYCF practices in a Karen community. Dr Chawapornpan and I met on a number of occasions to discuss approaches for working with the hill tribe communities. She provided me with Karen contacts who helped me gain an understanding of this ethnic group.

Somluck Nimsakul is a nutritionist at the Research Institute of Health Sciences and provided me with background information on nutrition programs and previous research in the hill tribe communities. Somluck was able to provide me with a number of Thai research articles that she summarised in English.

Dr Ari Patcharaporn at the Faculty of Nursing at Chiang Mai University provided me with insights on the on-going research by Chiang Mai University on nutrition and the areas where gaps in nutrition research remain.

Dr Sakda Pruenglampoo is a nutritionist at the Research institute of Health Sciences (RIHES), Chiang Mai University. Dr Sakda had been a part of the team who conducted research in 2002 that brought to attention the high rates of stunting and poor nutrition in the hill tribe communities, leading to the funding for this NSA intervention (82). Dr Sakda helped review my proposed methods for the study, including the drafts of the initial workshop, and provided feedback on what was realistic for the hill tribes.

The PHO in Mae Chaem who oversaw the public health service in the Mae Chaem region, including the hill tribes of this study. I met with him when I visited Mae Chaem, which totalled six times over the period of the research. He helped me to understand the greatest health priorities in the region, including health targets for the hill tribes. I would report my findings following visits to the hill tribes and he would provide his feedback and thoughts.

Dr Prasit Wangpakapattanawong was the principal investigator of the NSA intervention in Thailand. We would discuss how my research and the intervention were progressing on a fortnightly basis. Dr Prasit also has extensive experience on conducting research in the hill tribes (82). He conducted his PhD studies over 15 years ago in the same region and has spent a large amount of time in the villages.

In addition, Dr Pattanee Winichagoon from Mahidol University in Thailand has helped in providing local insights. Dr Pattannee has extensive experience in nutrition research, particularly community nutrition programs in Thailand, including programs in the hill tribes.

I additionally spoke with Dr Susanha Yimyam, a specialist researcher on breastfeeding practices in Thailand. Dr Peter Berti, who was the overall technical support for the multi-site

NSA initiative also shared ideas from his extensive experience and involvement in NSA interventions in Asia and Africa.

Each contact provided different support throughout my research, preparing me and fine-tuning the research to suit the culture and needs of the locals involved. I acknowledge that none of the members were from the village, however, the villagers were involved through the workshop and informally through meetings in the villages.

3.6 Ethics approvals and consenting processes

This research was granted ethical approval by the University of Adelaide, Australia (HREC# H-2014-51). Ethical approval for the research was also sought in Thailand and provided by RIHES (Study code 4/57). This approval process required working with a member of RIHES to fill in the relevant documents and to translate the research proposal and supporting documents into Thai. I was regularly in contact with both ethic committees to provide annual updates and information on changes in the research. For the quantitative components of the research, ICRAF had also sought ethical approval from RIHES. In order to conduct research in Thailand, I had also gained permission through the National Research Council of Thailand. Prior to the workshop, the district PHO was sent the participant information (Appendix C) sheet to share with the invited VHVs. Before the interviews, the VHVs were provided with the participant information sheet to share with the community. On the day of interviews, the VHVs introduced myself and the translator to participants. At this time I provided the participant information sheet and gave a verbal explanation of the study. In a number of cases participants had already met me, heard about the research, or heard about the NSA intervention. For the workshop and in-depth interviews, the participant information sheet outlined the expected benefits, eligibility criteria, what would be asked of participants, details on the recording, use and storage of these recordings, anonymity, ability to withdraw at any

stage and contacts if required. Written informed consent (Appendix D) was sought from all the respondents.

There may have been sensitivity around some practices, so care was taken to be sensitive and respectful. The identity of participants was protected with the use of pseudonyms for all participants of the qualitative research. Quotes and descriptions were selected with care so that individuals would not be identified. Interviews were conducted at a location chosen by the participant, which could be in their home or outdoors. A translator was present at all research interviews. Bilingual facilitators ran the workshop and they had an awareness and understanding of cultural and local sensitivities. For the quantitative data, all survey data provided by ICRAF had been de-identified and numerical codes used to indicate households. Only aggregated data was displayed when reporting the results of quantitative analyses. All electronic databases and analytical output have been stored on password-protected computers. All hard copy data and analyses have been stored in secure, locked cabinets.

The district PHO was consulted about whether to reimburse participants. It was deemed appropriate to provide reimbursements for VHVs and villagers but not PHOs or nursing staff. VHVs attending the workshop in the city of Mae Chaem, had their accommodation and food arranged and were reimbursed for their time away from work and travel. For the villagers involved in the interviews, a reimbursement to cover time was provided.

The preliminary findings were communicated to the participants as soon as possible, to assist in developing the nutrition education (Appendix E). A report of the qualitative findings was also shared with the district PHO with working knowledge of English. The overall findings of the NSA intervention have been relayed back to the villagers via ICRAF.

Chapter 4

A household baseline survey describing dietary diversity, household food security and stunting

4.1 Preface

The aim of Chapter 4

To describe stunting in infants and young children in these communities and to explore associations with dietary diversity and household factors including food security.

This chapter includes the first study of the thesis, which examined specific contributors to the persistence of stunting, including dietary intake and household factors. Data for this study was collected by ICRAF who then took at quick look at the data. I was interested to complete further analyses and go beyond ICRAF's presentation of numbers and percentages of the main variable, in order to provide a greater understanding of associations between dietary intake, household factors and stunting.

Models were limited based on power. The power calculation conducted by ICRAF was conducted to look at differences between intervention and control, however the samples when considering sibling pairs meant that power could not be guaranteed. Furthermore, some of the key variables were not spread to provide sufficient comparison groups. There were limitations in the data available such as for the breastfeeding standards, which meant that these could not be determined.

Some important aspects of the analyses include that the dietary data was not analysed for children based on breastfed and non-breastfed as is recommended by WHO (165). Inspection of graphs of breastfed and non-breastfed children (by age) showed that cessation of breastfeeding typically occurred around 18 months of age; only a small sample of children were not being breastfed at the time of the baseline study, while at endline only a few children were breastfed. Therefore, breastfed and non-breastfed children were considered as one group.

Another aspect to consider is the growth standards used to determine the healthy growth of children. Each child's height and weight were compared to both Thai and WHO growth reference standards, with differences expressed as height-for-age (HAZ), weight-for-age (WAZ) and weight-for-height (WHZ) z-scores. Due to a few reasons that will be explained below, the WHO growth reference standards were used in this research.

The Thai growth standards are closely aligned with the WHO growth standards, except for HAZ among infants, with Thai values about one standard deviation (SD) lower than the WHO growth reference for both boys and girls (70). The WHO growth standards were published in 2006 replacing the previously recommended 1977 NCHS/WHO child growth references. Based on breastfed infants and appropriately fed children of different ethnic origins raised in optimal conditions and measured in a standardised way (166), the WHO growth standards confirm that ethnicity has minimal effect on the growth of infants and young children as compared to environmental impacts. The WHO growth standards are deemed appropriate for use by all populations (21) and adopted by 125 countries (167).

The WHO growth standards served as the main growth standards in this research due to a few reasons including the initial analyses showing little difference in the outcomes when using either the Thai or WHO growth standards, the reference population is unclear for the Thai growth standards and the WHO standards would also enable comparisons with other countries. Version 3.2.2 WHO Anthro 2011 software (WHO, Geneva, Switzerland) was utilised to do the conversion. Cut-offs for the nutrition status of stunted, wasted and underweight were set at -2SD of the reference population (21).

This study has been submitted and in press with the Journal of Public Health.

4.2 Statement of authorship

Roesler A, Smithers LG, Wangpakapattanawong P, Moore V. Stunting, dietary diversity and household food insecurity among children under 5 years in ethnic communities of northern Thailand. Journal of Public Health 2018 (In press)

Anna Roesler (Candidate)

Designed the study, collected the data, performed the analysis, interpreted the results and wrote the manuscript. Overall percentage of contribution 70%.

Signed: Date: ……18/04/18…….

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);

ii. permission is granted for the candidate to include the publication in the thesis; and

iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution

Lisa Smithers

Contributed to the design of the study and interpretation of the results, and reviewed the manuscript.

Signed: Date: …06/04/2018…….

Prasit Wangpakapattanawong

Contributed to the study design and reviewing the manuscript

Signed: …. .. Date: …10/04/2018…….

Vivienne Moore

Contributed to the design of the study and interpretation of the results, and reviewed the manuscript.

Signed: Date: ……06/04/18…….

4.3 Abstract

Background

The aim of this study was to describe stunting in infants and young children in these communities and to explore associations with dietary diversity and household factors including food security.

Methods

A cross-sectional survey of households with children under 5 years from eight villages. Adult respondents provided information on foods consumed by each child and details of the household. Heights and weights of children were measured.

Results

Adults from 172 households and 208 children participated. Overall, 38% of children were stunted. Exclusive breastfeeding was rare, but the proportion consuming breastmilk at 24 months (75%) was high. Few children (7%) aged 6-11 months met minimum dietary diversity. Stunted children were less likely than non-stunted children to meet minimum dietary diversity (63% vs. 82%). Widespread food insecurity did not discriminate between stunted and non-stunted children. Stunting was elevated when households had little land and few animal varieties.

Conclusions

Stunting was widespread in children under 5 years of age, in part reflecting poor dietary diversity, especially at age 6–11 months. Stunting was worst in households with least assets. Small increases in land or animals, or equivalent resources, appear to be required to improve child nutrition in extremely poor families.

4.4 Introduction

Stunting during the critical window for child development, starting from conception and continuing through the first 24 to 59 months following birth, can result in delayed cognitive and physical development, and is difficult to reverse (22, 39). In Thailand a growth monitoring program was established in the 1980s, as well as poverty reduction schemes and primary health care programs (4). Despite great improvements at a national level (168), in the ethnic communities of northern Thailand, approximately 30% of children continue to be stunted (based on a Thai reference population) (9), a prevalence considered by the WHO to be 'high severity' (74).

Poor IYCF practices have been identified as key proximate causes of stunting (81, 82). These practices include a lack of exclusive breastfeeding to 6 months of age and limited dietary diversity throughout infancy and early childhood. Food insecurity and poverty are recognised as underlying determinants of stunting and poor IYCF practices (20). Food security is defined as having adequate food availability, accessibility, utilisation and stability (58, 59). Past evidence suggests that food insecurity occurs in the rural areas of north and north east Thailand (79). In 2007 increases in food prices and production costs were reported to be making it more difficult for poor, vulnerable Thai households to maintain their livelihoods, possibly contributing to ongoing food insecurity and thereby to child undernutrition (79).

The persistence of stunting among indigenous children in Thailand (9) is concerning. Investigation of specific contributors is required, in order to devise contextually relevant solutions. The aims of this study were therefore: to describe the current prevalence of stunting in children under 5 years in the ethnic communities of northern Thailand; to describe the variety of foods fed to children and household characteristics, including food security, and to investigate associations of these factors with stunting.

4.5 Materials and methods

4.5.0 Study setting

This study was conducted in eight ethnic villages in the Mae Chaem District of north east Thailand. Villages were chosen based on willingness to be involved in a future agricultural project. (The official term given by The Ministry of Thailand to the ethnic highlander communities is "Chao Khao" which translates to "hill people" or more often "hill tribes" and is not considered discriminatory.)

4.5.1 Design

A cross-sectional study of households with children under 5 years of age was undertaken. Participants were recruited by village health volunteers, through personal invitations and village announcements. Mothers were specifically encouraged to participate, however, fathers and some grandmothers also responded. To be eligible, an adult needed to be involved in the care of a child aged under 5 years and be willing to participate in the planned agricultural project. The survey was conducted in November 2013.

A total of 172 households participated in the survey. Data were obtained for 208 children under 5 years of age, corresponding to 57% of all eligible children (Appendix F, Table A1).

The survey instrument was developed by the international research team. Survey questions were reviewed by members of the ICRAF team, then trialled with five families from a Karen hill tribe community that was not involved in the study.

The ICRAF team calculated that a sample of 165 households was required for the future agricultural project. *Post hoc* calculations indicated that this sample would be sufficient to detect an excess of stunting of 35% (i.e. risk ratio of 1.35) using a 95% CI, with power of 0.7, where a risk factor affected about a third of the sample. Statistical power would be reduced for less common risk factors and increased for more common risk factors.

4.5.2 Ethics

The research was approved by RIHES, Chiang Mai University, Thailand (No.40/2014) and the University of Adelaide, Australia (HREC# H-2014-51). Permission was also granted by the community.

4.5.3 Data and measures

The sex and age of each child under age 5 years was recorded along with breastfeeding commencement and duration. Foods consumed over the past 24 hours were obtained utilising a locally adapted version of the dietary diversity questionnaire by Kennedy et al. (94) A child dietary diversity score was derived. One point was given for each of the nine food groups consumed. We used a cut point of ≥4 food groups to indicate minimum dietary diversity, following WHO's IYCF indicators (96).

Heights and weights of children were measured. A portable stadiometer was used to measure length and height. Supine length was measured for children under age 2 years. Height, weight and age of each child were converted to height-for-age z-score (HAZ) using the WHO growth standards as the reference, version 3.2.2 WHO Anthro 2011 software (WHO, Geneva, Switzerland). Children with HAZ more than two standard deviations below the median were classified as stunted.

Nutrition knowledge of adult respondents was assessed by true and false questions derived from the Thai food-based dietary guidelines (169), and the Thai Maternal and Child Health Book (170). Questions covered exclusive breastfeeding, need for clean water and choice, amount and timing of complementary foods during infancy. For older children, questions addressed food groups and meals per day. If all answers were correct, nutrition knowledge was classified as 'good'.

Household food security was assessed and categorized according to the Household Food Insecurity Access Prevalence (HFIAP) (153). Categories were collapsed for further analyses, with 'food secure' and 'mild insecure' combined to form 'no or mild food insecurity'. The 'moderately insecure' and 'severely insecure' categories were similarly combined.

Agricultural activities of each household were ascertained through question sets for up to 12 common types of crops and 18 animals. The question sets covered size of land and crop/herd/flock and who was responsible for decisions pertaining to obtaining, selling, and use of funds. The predominant decision maker was determined as the one most often making the decisions. A variable to summarise household assets was created based on the medians of the amount of land owned (2 hectares) and the variety of animals owned (2 types) and their cross-classification. Those with few assets had little land and few types of animals, an intermediate group had either little land or few animals but not both, and those with the most assets had at least 2 hectares of land and at least 2 types of animals.

4.5.4 Data Analyses

Descriptive statistics were calculated and tabulated. The median and interquartile range for HAZ was calculated separately for children in four age groups.

Food groups consumed by children were graphed according to age. For children aged 6 months or more, aspects of diet, mother and household were compared for those stunted and not stunted. Some characteristics of the mother were only available if the mother was the informant. For binary variables, associations were quantified as prevalence ratios and 95% confidence intervals (CIs). To facilitate interpretation of results, other variable such as age of mother, educational attainment and household size were also dichotomized.

The association between household food insecurity and child stunting was of particular interest. To assess whether confounding by other factors affected this association, multi-variate analysis was undertaken with regression risk analysis (using a log binomial link

model) including child and family factors (171). This procedure is more appropriate than using odds ratio and logistic regression since the outcome (stunting) is not a rare occurrence. (171, 172).

As values for siblings are correlated, data were analysed with and without clustering by family. Results from these analyses were similar, reflecting the relatively low number of families in which there was more than one child under 5 years (17%). All analyses were conducted using SPSS statistics 24 (SPSS Inc., Chicago, Il., USA).

4.6 Results

Table 2 describes the characteristics of the adult respondents. The great majority were mothers, of whom two thirds had primary school education and almost all reported that they were farmers.

Table 2. Characteristics of adult respondents (n=172)

Respondent	**Age (yrs)**	**n**	**%**	**Educational attainment**	**n**	**%**	**Occupation**	**n**	**%**
Mother (n=154)	<20	11	7.1	None	42	25.9	Farmer	148	96.1
	20-29	83	53.9	Primary	72	44.4	Office work	1	0.6
	30-39	53	34.4	Some high school	39	24.1	Hire labour	2	1.3
	≥40	7	4.5	High school	7	4.3	Housewife / no occupation	2	1.3
				Further studies	2	1.2			
							Village head's wife	1	0.6
Father (n=14)	<20	0	0	None	4	28.6	Farmer	14	100.0
	20-29	4	28.6	Primary	5	35.7			
	30-39	7	50.0	Some high school	2	14.3			
	≥40	3	21.4	High school	2	14.3			
				Further studies	1	7.1			
Grandmother (n=4)	45-49	1	25.0	None	3	75.0	Farmer	3	75.0
	50-54	2	50.0	Primary	0	0	Teacher	1	25.0
	≥55	1	25.0	Some high school	1	25.0			

Four in five households had only one child aged 5 years or less (Table 3). The majority of households farmed two or three crops, one of which was usually rice. The majority of households owned chickens and/or pigs. Half of the households were severely food insecure and three quarters were affected by some degree of food insecurity.

In total, 38% of children under 5 years were stunted. As shown in Table 4, the proportion of children stunted increased from 9% in those under 6 months, peaking at 48% of those aged 12-23 months. Compromised growth was widespread, with HAZ for the majority of children below the median of the WHO reference population by age 6 months.

Among the 24 children under 6 months, most had consumed water and a third had consumed solids, resulting in only 13% being exclusively breastfed. However, extended duration of breastfeeding was common with 97% and 75% of children receiving some breast milk up to 12 months and 24 months of age, respectively. Figure 5 describes the food groups consumed by children according to age. Among the 15 children aged 6–11 months, only one met minimum dietary diversity. For the majority of children in this age group the only complementary food was rice; one in five had consumed eggs in the past day. The proportion of children meeting minimum dietary diversity increased with age, being 61% and 79% among those aged 12-23 and 24-59 months respectively.

Comparisons between stunted and non-stunted children are presented in Table 5. While patterns in the data were consistent with many expected protective or adverse effects, many associations were not statistically significant. Stunted children were less likely to consume dairy (and alternatives) and to meet minimum dietary diversity, compared to their counterparts

Table 3. Characteristics of households (n=172)

Household characteristic	n	%
Ethnicity		
Karen	97	56.4
Lua	74	43.0
Other	1	0.6
Number of children <5 years		
one	139	80.8
two	30	17.4
three	3	1.7
Household size		
2-3	19	9.1
4-5	70	34.3
6-7	76	36.5
8-12	39	18.8
Households with elders	100	58.1
Women head of household	22	12.8
Most common crops cultivated		
rice	164	95.3
corn	133	77.3
kidney beans	57	33.2
Most common animals owned		
chickens	142	82.6
pigs	120	69.8
cows	30	18.6
Household assets (n=169)		
least (<2 hectares, <2 animal types)	26	15.4
intermediate	81	47.9
most (≥2 hectares, ≥2 animal types)	62	36.7
Food insecurity		
secure	44	25.6
mild	21	12.2
moderate	20	11.6
severe	87	50.6

Table 4. Height-for-age of children by age group (n=208)

Age group (months)	n	%	Median HAZ	Interquartile range	% below 2 SD
<6	24	11.5	-0.4	-1.0, 1.0	8.7
6-11	16	7.7	-1.8	-2.8, -0.1	33.3
12-23	51	24.5	-1.9	-3.0, -1.3	48.0
24-59	117	56.3	-1.8	-2.6, -1.1	40.9
All	208	100.0	-1.7	-2.6, -1.0	38.4

Figure 5. The proportion of children consuming food groups by age group

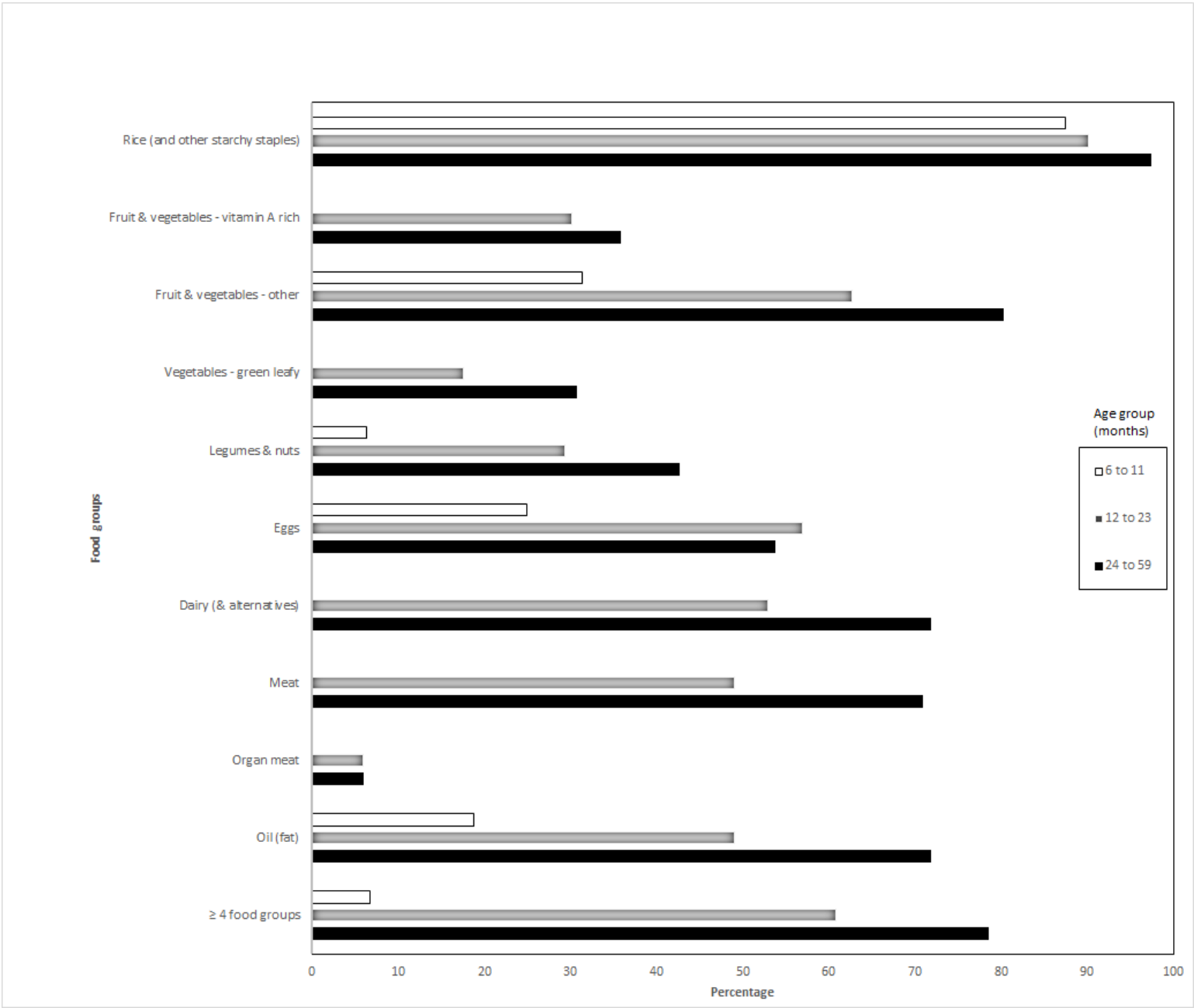


Table 5. Characteristics of stunted and non-stunted and children aged 6-59 months (n=180)

Characteristic	Not stunted (n=104)		Stunted (n=76)		Prevalence ratio [95% CI] for stunting
	n	%	n	%	
Mother's education (n=162)					
none or primary school	23	47.9	25	43.1	reference
at least some high school	67	58.8	47	41.2	0.8 [0.6, 1.2]
Mother's age					
<30 years	61	57.0	46	43.0	1.0 [0.7, 1.5]
≥30 years	43	58.9	30	41.1	-
Household size					
< 6	49	62.0	30	38.0	-
≥6	55	54.5	46	45.5	1.2 [0.8, 1.7]
Ethnicity (n=179)					
Karen	50	52.1	46	47.9	1.4 [0.9, 2.0]
Lua	54	65.1	29	34.9	-
Head of household (n=173)					
man	85	56.3	66	43.7	-
woman	14	63.6	8	36.4	0.8 [0.5, 1.5]
Nutrition knowledge					
less than good	55	56.1	43	43.9	-
good	49	59.8	33	40.2	0.9 [0.7, 1.3]
Foods consumed in last 24 hours					
Egg - yes	58	62.4	35	37.6	0.8 [0.6, 1.1]
- no	46	52.9	41	47.1	-
Dairy - yes	70	64.2	39	35.8	0.7 [0.5, 1.0]
- no	34	47.9	37	52.1	-
Green leafy vegetables - yes	31	68.9	14	38.1	0.7 [0.4, 1.1]
- no	73	54.1	62	45.9	-
Dietary diversity					
minimum not met	26	45.6	31	54.4	-
minimum met	78	63.4	45	36.6	0.7 [0.5, 0.9]
Household food insecurity					
none or minor	41	63.1	24	36.9	-
moderate or severe	63	54.8	52	45.2	1.2 [0.8, 1.8]
Predominant decision maker					
father	28	56.0	22	44.0	reference
mother	11	73.3	5	33.3	0.7 [0.3, 1.6]
joint	47	57.3	35	42.7	1.0 [0.7, 1.4]
other	18	56.3	14	43.8	1.0 [0.7, 1.6]
Household assets (n=178)					
least	10	41.7	14	58.3	1.6 [1.1, 2.7]
intermediate	47	56.0	37	44.0	1.3 [0.9, 1.9]
most	47	64.4	25	34.2	reference

Household food insecurity tended to be higher among families of stunted children, but the association was not statistically significant. Multi-variate analysis demonstrated that this finding was not due to confounding by other factors: after adjusting for mother's education, mother's age, household size, ethnicity, head of household a woman, and nutrition knowledge the prevalence ratio was 1.16, 95% CI [0.68, 1.98].

Children living in households with least assets were 1.6 times more likely to be stunted, compared to those in households with 2 or more hectares of land and 2 or more types of animals; results were consistent with a graded relationship between household assets and prevalence of stunting.

4.7 Discussion

4.7.0 Main findings of this study

Our study showed that the current prevalence of stunting in children in the hill tribe communities remains of 'high severity' according to WHO and is far greater than the Thai national rural average (7). Stunting prevalence peaked in children aged 12–23 months, and from 36 months of age all children had standardized height-for-age below the median of the WHO reference population.

There was low variety in complementary foods consumed by children aged 6–11 months. From age 6 months, children with diets that met minimum diversity were somewhat less likely than others to be stunted. Three quarters of the households were affected by food insecurity. We did not observe an association between household food insecurity and stunting, however, children living in households with the least assets had the greatest prevalence of stunting.

The finding that minimum dietary diversity was achieved for the majority of children aged 24-59 months while stunting remained prevalent may at first seem counter-intuitive. It draws attention to a number of matters, however. Elsewhere we have described complementary

feeding practices in the villages (Chapter 5), including reliance on local food with an appropriate texture, such as banana, during infancy. Meat and vegetables are given when children are older and have teeth and can eat independently. This style of complementary feeding has been associated with malnutrition in other locations (24). Importantly, dietary diversity is a proxy for nutrient adequacy (94) and although positive correlations with macronutrient adequacy have been demonstrated, it remains possible that in this setting energy and/or protein intake are low. Finally, stunting was extensive in children at younger ages and such improvements in nutrition as do occur, appear to be insufficient for widespread recovery.

4.7.1 What is already known on this topic

In studies of Karen children undertaken over a decade ago, the prevalence of stunting was reported to be 50–75%.(8, 173). Findings from seven other southeast Asian countries indicated that, with the possible exception of Cambodia, indigenous Thai children under 24 months of age were least likely to meet minimum dietary diversity (174).

In food insecure environments where there is a high risk of stunting, there is good evidence that child growth can be improved with the provision of formulated complementary foods (175). Issues surrounding the use of complementary foods must be considered, including production requirements and costs, in addition to acceptability (175). In the ethnic communities of northern Thailand, poverty and the remoteness of the villages make these issues especially pertinent.

Household food insecurity and stunting have been associated elsewhere (20, 97, 98, 176). Other household factors also commonly reported to influence stunting include maternal education (177, 178), household composition (179), variety of crops (11, 180), ownership of livestock, particularly small animals and fowl (181, 182), and women's involvement in

decision making (183). While these specific factors were not associated with stunting in this study, stunting was highest in children in household with the least assets.

4.7.2 What this study adds

The high prevalence of stunting and the change across age groups found in the present study indicates that measures to prevent stunting are required from before 6 months of age. Rice is given to infants at around 3 months of age, and its contribution to energy intake would seem to increase markedly when mothers returned to work. Nutrient-rich complementary foods were limited for children aged 6-11 months. Together, these factors are likely to explain the escalation in stunting prevalence during infancy.

Breastfeeding until children were at least 2 years of age was common. Although the contribution of breast milk to energy intake was not quantified, it appears to be relatively small. Note also that the contribution of extended duration of breastfeeding to malnutrition has been questioned, with inadequate accompanying diet arguably the main problem (47, 48). Our findings regarding minimum dietary diversity suggest that this is the case in the hill tribe communities.

Consumption of dairy in the last 24 hours was associated with reduced prevalence of stunting in children from 6 months of age. Dairy was in the form of small cartons of ultra-heat treated milk. It is possible that the ability to purchase these partly explains the differential in stunting across categories of household assets.

Traditionally, milk has not been consumed in south-east Asian countries but this appears to be changing. Currently in Thailand all children aged 2–5 years attending public pre-schools are provided with 200 ml of milk on school days. This is beneficial for child growth (184), but it cannot address chronic undernutrition occurring before age 2 years. For younger children, it is necessary to promote better diet quality and quantity.

Alternatively, a supplementary feeding program for children under 5 years, in which the government supported community production of complementary foods for children under 2 years, was previously implemented in some areas in Thailand (185). Some anecdotal reports suggested positive results (4, 185). A similar intervention may benefit these communities.

This study draws attention to the structural determinants of stunting. It has previously been pointed out that in the poorest economic conditions, maternal education does not relate to child growth (106), because there is limited ability to act on any knowledge or attitudes gained through education. Likewise, women's empowerment, as reflected in decision making or control of assets may not improve child health until some minimum threshold of resources is met (183). Food insecurity is chronic for the majority of families and it is plausible that this is why the measure did not differentiate between stunted and non-stunted children.

4.7.3 Limitations of this study

This study had a cross-sectional design, limiting insights into directions of associations. Although inclusion was not by random selection, at least half of children under 5 years were involved for all but one village and the anthropometric data obtained closely match that reported by the health office (9). The sample size was small and this may be the reason why a number of expected associations were not observed. The 6-11 month age group was particularly small, accordingly, results for this specific age group must be interpreted with care.

There are some limitations to the characterization of children's diets. Dietary intake data was based on a single 24 hour recall of foods (and not amounts). Dietary diversity is a proxy indicator for nutritional adequacy and is not necessarily a gauge of dietary adequacy at the individual level or in all settings.

Maternal malnutrition may affect breastmilk quality and quantity but we did not investigate this. There are some taboos around foods women may eat after giving birth, but any impact on maternal nutrition is unclear.

There may be a major role for another factor, such as parasitic infections (8). In a cross country analysis (186), sanitation was one of the most important factors explaining reductions in stunting. These factors were not assessed in this study.

4.7.4 Conclusion

In conclusion, children under 5 years living in remote Thai ethnic communities continue to have high levels of stunting and IYCF practices do not align with WHO recommendations. Apart from household assets, most maternal and household characteristics did not differentiate between stunted and non-stunted children, possibly reflecting constraints of poverty or limitations of our study. Increases in land or animals, or their resource equivalent in some other form, appear to be required to improve child nutrition in extremely poor families.

Summary of Chapter 4

This chapter highlights the high prevalence of stunting in the 0-5 year old children in the Thai hill tribe children. Apart from household assets, most maternal and household characteristics did not differentiate between stunted and non-stunted children.

Chapter 5

Local perspectives and context in relation to infant and young child feeding practices

5.1 Preface

The aim of Chapter 5

To gain an in-depth understanding of infant and young child feeding practices, accompanying beliefs, and their socio-cultural context in the Karen and Lua ethnic communities of northern Thailand.

As outlined in Chapter 4, the findings suggest that stunting is highly prevalent in children under 5 years of age in the Thai hill tribe villages. The large majority of villagers are experiencing food insecurity, although this was not found to be associated with childhood stunting. Poor IYCF practices maybe contributing to the high rates of stunting, including low rates of EBF and low diversity in the diet, particularly in the children aged 6–11 months. This chapter presents the second aim of this thesis, to examine IYCF practises and their determinants within the social-cultural context of the Karen and Lua ethnic hill tribe communities. Qualitative methods were employed to undertake this research, including, focus groups and in-depth interviews.

Participants in this study were nurses, public health officers, VHVs and villagers with children under 5 years of age. The PHOs included sub-district PHOs that are based at the sub-district health office and have management roles such as VHV manager and health data collector while the community PHOs are based in small public health offices close to villagers in order to provide hands on health care to the villagers. The VHVs are local villagers with basic training to support and connect villagers with the public health office. The findings from this study were utilised to help inform the development of nutrition education created by ICRAF to improve IYCF in the hill tribes.

This chapter has been submitted and under review in the journal Public Health Nutrition.

5.2 Statement of authorship

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Principal Author

Anna Roesler (Candidate)

Designed the study, collected the data, performed the analysis, interpreted the results and wrote the manuscript. Overall percentage of contribution 70%.

Signed: … .. Date: ……18/04/18…….

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);

ii. permission is granted for the candidate to include the publication in the thesis; and

iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution

Lisa Smithers

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Contributed to the study design and the evaluation and editing of the manuscript.

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Contributed to the design of the study and interpretation of the results, and reviewed the manuscript.

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5.3 Abstract

Objective

To gain an in-depth understanding of infant and young child feeding practices, accompanying beliefs, and their socio-cultural context in the Karen and Lua ethnic communities of northern Thailand.

Design

A two-day workshop and 30 in-depth interviews were undertaken in June 2014. Dialogue occurred with assistance of translators and was recorded, transcribed and translated. A detailed thematic analysis was undertaken.

Setting

Northern Thai indigenous communities in which one third of the children under 5 years of age are stunted.

Subjects

People with various roles in the local health system and 26 villagers who cared for infants and young children.

Results

Predominant breastfeeding was said to occur for one to three months, but was not exclusive due to early introduction of water and/or rice. EBF for 6 months was impeded by the need for mothers to return to farming work, with the early introduction of solids enabling infants to be cared for by other family members. Low variety in complementary foods was typical during infancy, with few local foods having appropriate texture and special preparation of foods rarely described. A pervasive underlying issue is women's responsibility to labour and lack of time to care for their young children. Poverty and food insecurity also featured in participants' accounts.

Conclusion

In combination, women's limited time to care, poverty and food insecurity are perpetuating poor nutrition of children in early life. Agricultural solutions that are being explored should also attend to the burden of work for women.

5.4 Introduction

Undernutrition in the first 24 months following birth can result in delayed growth and development that is difficult to reverse, so good nutrition during this period is of utmost importance. Proximal causes of undernutrition from birth to 24 months are non-EBF and inappropriate complementary feeding practices (22).

Undernutrition has been reported repeatedly in children in the hill tribes in northern Thailand (8, 81, 187). In 2013, one third of children in the Karen and Lua ethnic communities in the district of Mae Chaem were stunted (9), a much higher prevalence than the national rural average of eight per cent (7). Food insecurity and poverty have been identified as underlying causes of undernutrition in these communities (79) which are remote, with roads frequently unpassable in the monsoon season. Historically, villagers lived by subsistence farming, more recently growing maize as a cash crop and sometimes selling animals.

WHO and UNICEF have made recommendations to improve young children's nutrition, including EBF for the first six months, after which safe, nutritionally-adequate, age-appropriate and responsive complementary feeding should commence (34, 35). Recently the United Nations General Assembly announced a 'Decade of Action on Nutrition' from 2016-2025 to address malnutrition and food insecurity. This announcement asks governments to commit to addressing undernutrition of children under 5 years of age. Thailand support this global effort.

Extended duration of breastfeeding is well documented in Thailand, including in rural ethnic communities, but the period for which it is exclusive is relatively short (81, 108). Detailed information on complementary feeding practices is limited. Past studies of child nutrition in the ethnic hill tribes have described poor quality and quantity of food intake, and some relevant local beliefs have been documented (81, 82, 108). In-depth exploration of local accounts for IYCF practices and the socio-cultural context in which these are maintained has

not been undertaken. However, research in other locations suggests that such an approach can provide valuable insights (188, 189).

A program of research was undertaken with villagers in northern Thailand to inform the development of a locally-tailored initiative to improve child nutrition (154). The aim of this particular study was to gain in-depth understanding of current IYCF practices, including accompanying perceptions and beliefs, and the socio-cultural context of practices not aligned with WHO recommendations. As recommended by Pelto et al. (29), the study was designed to draw out the complexity of these matters beyond that possible using a quantitative survey.

5.5 Materials and methods

A qualitative study was conducted in two Karen and two Lua ethnic hill tribe villages in the district of Mae Chaem, northern Thailand. These villages had already been chosen by ICRAF as sites for an agricultural intervention. The villages are located at least 100 km from Mae Chaem, the nearest major city. Only one of the villages had an electricity supply. The number of households in the villages ranged from approximately 50-100.

A workshop was held with local VHVs in June 2014. The district PHO invited two VHVs from each village, where possible one male and one female; five men and three women attended. VHVs are community members with basic training in health care, who support around 10 households in relation to matters such as hygiene awareness and provision of medications.

The two day workshop was designed to stimulate dialogue and to encourage participants to articulate their lived experiences around IYCF practices and their meanings, allowing different understandings to be shared and reflected upon (190). Firstly, a healthy child was explored: what this meant and what it required. Participants formed two groups to discuss this topic, with a facilitator providing guide questions. Discussion points were shared when

the two groups recombined, to stimulate further dialogue. This arrangement was followed repeatedly over the workshop.

A short presentation on undernutrition, prevalence of stunting in hill tribe children, and contributing factors was given. In the two groups, then as a whole group, participants responded to this information and were prompted to discuss IYCF practices. At appropriate points, WHO recommendations were invoked, for example: "What does exclusive breastfeeding mean to you?" Complementary feeding was similarly addressed.

On the second day, participants completed a quiz about WHO IYCF recommendations which was designed to stimulate discussion of the answers, including areas where villagers' perspectives diverged. Prompt questions included: "How could you explain to people what exclusive breastfeeding is?"

Subsequently, in-depth interviews were undertaken with two of the VHVs who attended the workshop, eight other individuals with roles in the local health system, and 20 villagers. The villagers were selected by VHVs, ensuring they were carers of children aged 0–5 years. Topics for in-depth interviews were similar to the workshop but with greater opportunity for individuals to shape the direction and focus of dialogue. While interviews with villagers continued until data saturation appeared to be reached, the number of interviews with health workers and officials was limited by the number employed in the area.

The workshop was conducted in Thai by experienced bi-lingual (Thai/English) facilitators, under the direction of the first author. All interviews were facilitated by a translator. All relevant components of the workshop and all interviews were recorded and later concurrently transcribed and translated into English by the facilitators and translators. Transcriptions were reviewed by the first author with meanings of words clarified and the terminology across facilitators/translators iteratively checked for consistency in the use of translated terms. Participants' names have been changed for confidentiality.

Translated transcripts were coded and organised using NVivo 10 software (QSR International Pty Ltd, Doncaster, Victoria, Australia). A detailed thematic analysis was conducted by the first author. Initially, specific words such as 'breast milk' and 'rice' were coded, as well as ages of children. Coding was gradually expanded to include specific feeding practices and explanations for them. Repeated patterns of meaning around IYCF practices (as well as exceptions) were then linked to the contextual factors invoked to support or legitimize them (191). The analysis was guided by a social constructionist epistemology (192) and was inductive and iterative, with the first author progressively presenting extracts and interpretations to the second and last author for discussion, mapping themes and their inter-relations. Understanding of transcripts was supplemented by observations from the first author's field notes, communication with the ICRAF team and with the Thai co-authors. Prior to the workshop and the in-depth interviews, a participant information sheet was shared with villagers. Written informed consent was obtained from all participants. Participants received a small payment for their time.

5.6 Results

The workshop for VHVs was attended by five men and three women, ranging in age from 24-38 years, all having at least one child of their own (see Table 6). In-depth interviews were subsequently undertaken with two of these VHVs and also with three district PHOs (age range 30-48 years, one female), three community PHOs (age range 29-45 years, one female), and two maternity nurses (both female, aged 25 and 32 years). Twenty other villagers were interviewed, two men and 18 women, aged 20-42 years (see Table 7).

Table 6. Characteristics of the village health volunteers (VHVs) (N=8)

Indicator	**VHVs** n (%)
Gender	
Female	3 (38)
Age group, years	
21-25	1 (13)
26-30	3 (38)
31-35	2 (25)
36-40	2 (25)
Occupation	
Farmer	6 (75)
Other	2 (25)

Table 7. Characteristics of the villagers (N=20)

Indicator	**Villagers** n (%)
Gender	
Female	18 (90)
Age group, years	
≤ 20	2 (9)
21-25	8 (36)
26-30	7 (32)
31-35	3 (14)
36-40	1 (5)
41-45	1 (5)
Occupation	
Farmer	19 (95)
Other	1 (5)
Number of children aged 0–5 years	
1	10 (45)
2	7 (32)
3	5 (23)

5.6.0 Breastfeeding is widespread but not exclusive for six months

All participants said that children in the villages were breastfed, in agreement with previous research (19). Villagers saw breastfeeding as beneficial for the following reasons: *'prevention of painful nipple';* '*connecting with the child'; 'warmth'; 'protection against disease'; 'high immunity'; 'provision of all nutrition' ('somboon'); 'clean'; 'economical'; 'grow up quickly'; 'it provides strong health'; 'strength'; 'makes the child well natured and easy to teach'* and *'will be intelligent'.* These understandings echo previous findings about the value placed on breast milk throughout Thai society (193).

Breastfeeding was rarely exclusive for six months. Villagers understanding of EBF varied but, in general, EBF was not distinguished from other modes of breastfeeding. There seemed to be a common perception that breast milk was important but exclusivity did not matter.

> *'... maybe good give only milk of mother ... up to the child some one and a half years some two year[give only milk of mother] ... not sure doctor said 6 months ...'* (Noin, mother)

> *'When the mothers come to the health office they come to get vaccinations at two months and all that so when they come the PHO will ask are you giving breast milk for how many months and all that. One problem is that they have is that mothers when asked they are confused between EBF and normal breastfeeding and mothers say yes yes we give breastfeeding, but in between they are giving water ...' (PHO1)*

Non-EBF was due to the cultural practice of feeding water or to early introduction of rice or both. Water was reported to be given by most mothers from as early as one month. The amount of water was reported to be the '*tip of (a) teaspoon*', given to help '*wash out*' milk and/or rice from the throat and prevent '*dry throat*'. Predominant breastfeeding (breast milk and other liquids) is common practice in Thailand (4) and other parts of Asia (194-196).

5.6.1 Introduction of complementary foods before six months

Rice was introduced as early as one month and almost always within the first three months:

> *'I will give rice one time a day… [because] the baby is crying and [will] not sleep. The people in the past, once they are born they just eat rice … like for them when they were born their parents immediately gave them rice.'* (Sarn, father)

The early introduction of rice is consistent with previous studies conducted throughout Thailand (4, 81, 197).

As illustrated in the quotes that follow, villagers often referred to a need to supplement breast milk with rice from approximately three months, due to a belief that breast milk was not sufficient as the child grew. The view that in the mountains mothers could not make sufficient breast milk, leaving the child hungry, appeared to be widespread. Rice was seen to strengthen the child (although it was unclear if it was seen to be nutritionally equivalent to breast milk).

> *'If [we] stay long time in the city then [we are] able to [give only breast milk for 6 months], but up here in the mountains [we do] not have complementary food (referring to food that goes with rice) … The milk will not be full of all the different [food] groups up on the mountain …'* (Maew, mother and VHV)

> *'Grandparents looking after [the child] give rice at three or four months because the child is hungry as the mother's milk is not sufficient.'* (Maew, VHV and mother)

> *'[Rice] has benefits. [I] give [it to my] child and [it] helps them grow if [my] child [does] not eat [it they] will be very thin and not strong.'* (Fan, mother)

It was also common for villagers to report that they fed children rice earlier than recommended in order to prepare them for later feeding.

> *'The grandparents said that if I don't give rice in the beginning, then the child will not want to eat rice when they grow up.'* (Duk, father)

This concern appeared to be particularly related to the circumstance that the mother *'may not be able to go to work'* if the child relies only on breast milk. The early introduction of complementary foods built familiarity and thus facilitated the mother's return to work.

> *'At birth the doctor said drink only breast milk for 6 months and then eat rice/food… Mash rice, make mash and give in the first month just one meal to practice eat then second month two meals and third month three meals. The child to practice because in the mountains [we do] not have complementary food [appears to be referring to infant formula]. '* (Geb, mother)

Worldwide, the perception of insufficient breast milk is the most common reason for early supplementation and/or discontinuation of breastfeeding (198, 199). Past reasons described for early introduction of rice in Thailand have included following traditional practice (72, 200) as well as insufficient breast milk (4, 87). Our work draws attention to the contextual significance of giving the child rice, which we now elaborate on.

5.6.2 Mothers return to work within a few months of giving birth

Some mothers returned to working in the fields as early as one month after birth but more often this was reported to occur from three months. This is similar to other rural, agricultural communities in Vietnam (89). The time often corresponded to when the villagers felt the child was able to stay with another carer. Only one mother mentioned that she took her child to the field with the aid of another family member. Most mothers did not take their children to the field due to the laboring requirements, '*weather*' and '*difficult*' conditions. The time spent away from the child progressively increased, resulting in an increase in complementary feeding and a decrease in breastfeeding.

> '*Give milk in the morning and go for half a day then need to return as have so much milk.'* (Yang, mother)

Mothers returning to farming work was usually seen as a necessity. It was a duty accepted without question.

> *'I must go back to work….[I] do not have anyone to help with work … [parents] they are too old.'* (Raw, mother)
>
> *'I feel I can [stay at home for first 6 months] but my husband goes [to work] alone and he will be tired so we have to help each other. When we are going [to work] we are not harming our child ... we are doing it to raise him up.'* (Tiang, mother)

Pelto et al. (29) have drawn attention to the demands on women's time, and specifically the heavy workloads for women in subsistence farming communities, as a major impediment to being able to care for their children through EBF for six months and appropriate complementary feeding. This has been described as women 'balancing' or 'reconciling' competing responsibilities. However, the strong cultural consensus around these arrangements makes it unlikely that it is a conscious process in the way these terms may suggest. In his theory of social practice, the sociologist Bourdieu proposes that as individuals grow up in a community, they are imbued with a set of dispositions and expectations, commensurate with their status (201). In this way, an apparent fit develops between a person's expectations and their circumstances. Thus, women in the hill tribes accept that they must physically labour and that those who are older should look after infants and young children.

5.6.3 Duration of breastfeeding often to two years

The total duration of breastfeeding was variable although there were many reports of breastfeeding continuing beyond the child reaching age two years. Mothers stopped breastfeeding in various ways, often by using deterrents, such as plasters, medicine, or other substances placed on the breasts.

The need for independence to complete daily activities was often reported as the reason for ceasing breastfeeding.

> *'If it is convenient for the mother, then that's okay [to continue to breastfeed]. But it's also related with the mother. Like the mother, myself, I need to go to a meeting, and [if] the child is attached to breast milk, then I can't leave my child.'* (Maew, mother and VHV)

Other reasons also given for ceasing breastfeeding included the belief that the child was old enough to stop, painful breasts, and fears of poor child growth due to filling up on breast milk.

5.6.4 Infant formula is desired but in limited use

Most villagers had heard about formula or seen it in nearby cities. Formula was generally desired by families, but its use was limited. It was sometimes prepared as a liquid and sometimes used to thicken rice meals.

> *'I used to be in Chiang Mai looking after children and saw them eating formula, so that is how I know [about formula] - so I want to give [formula] to my own kids.'* (Sod, mother)

Some participants were aware that breast milk was preferable to formula.

> *'I think by receiving only mother's milk, the child's immunity should be more than formula milk that is sold. [Breast milk] already has complete nutrients ... if we give breast milk … the child will get the warmth ... and the love.'* (Maew, mother and VHV)

The major limitation on the use of formula was its affordability. One box cost around 70-90 baht and the estimated income of villagers is 70-100 baht per day (December 1, 2015 statistics provided by the Mae Chaem Council Office; unreferenced). A mother talked of how she wanted to feed formula to her three children, but she did *'not have the money to buy [it].'* (Sod, mother)

Formula was typically used for the length of time it took to consume a box, a few months. A limited period of formula use has also been reported in other rural, poor communities, due to the high cost and limited access (194).

A VHV reported on how some villagers would dilute formula in order to extend it: '*They're also very poor. They buy formula milk. But for 4 ounces, they put only one or two spoonfuls ...",* (Kip, mother and VHV). Undernutrition from diluting formula is a recognised problem in many countries (34). This study was not designed to quantify the extent of formula use or its contribution to undernutrition, but it does not appear to be a notable contributor.

5.6.5 Little variety in transitional foods

Variety in complementary foods was not provided until much later than the WHO recommended time of around six months (34). Rice and banana, occasionally egg, were given to children from three to 12 months. Vegetables and meat were rarely said to be given to children under 12 months of age. Absence or provision of these foods was predominantly related to perceptions of children's readiness to eat different foods: '*From the age of three years, they should be able to start eating these vegetables [referring to a range of vegetables]',* (Aek, father and VHV).

Villagers often reported introducing a food when the child could eat it independently: '*When he wants to eat and can ask for food and eat by himself'* (Song, mother).

This agrees with previous reports (81, 108). One mother reported that she will start meat at 9-10 months as that is when the child *'starts to have teeth'* (Noin, mother).

Most villagers provided young children with foods that had suitable textures that did not require modification, limited in number. One exception was described by a mother of a 17-month-old:

'I make the meat using a strainer and a bottle to press against it to make it small and the meat I would cut into small small pieces and put it into rice porridge to just give it flavour.' (Yang, mother)

The mother indicated that other carers may not do this as '*maybe it is too much work.*'

Pelto et al. (29) describe a spectrum of approaches to complementary feeding, from 'controlling' through to 'disengaged'. These authors affirm that when children are expected to eat independently from an early age and there is little preparation of complementary foods, children are likely to be malnourished, especially between 6-12 months. The underlying issue, again, is seen to be the other demands on women's time. In the hill tribes, widespread cultural agreement that complementary feeding should not be time consuming fits with the expectation that mothers will labour to maintain household livelihood.

Villagers relied heavily on the foods available within and around the villages. This was necessary in view of geographic remoteness, seasonal impassability of roads, and the cost of buying food in the nearest city.

'The nutrition [villagers] might not be so aware about, they eat just what they have … the people here just get by, they try to eat what they can, but it is usually just the same old foods.' (PHO1)

Rice and banana for infants were seen as available and affordable. At five baht each, eggs were seen as relatively expensive.

'The problem with the hill tribe people is that they do not have the money. So I can tell them, "all you need to do is give your child one egg a day and then your child is getting all this protein". And they are like "yes, we know, but we don't have the money to buy the eggs, so what are we going to do?"' (PHO1)

A subtext of poverty and food insecurity is woven through these accounts. This underscores the point made by Pelto et al. (29), among others, that improving complementary feeding depends on availability or access to appropriate foods as well as information.

A number of other factors were sporadically mentioned as constraining food choice for infants. These included fear of choking. For example, one mother of an eight-month-old said she avoided other food as '*when they mash rice with other food this gets stuck in the throat*', (Song, mother). According to a VHV, vegetables may be delayed due to belief they caused diarrhoea: '*7-8 (months), not yet (give vegetables). We're afraid they'll get diarrhoea. If they get diarrhoea, it'll be really troublesome,*' (Maew, mother and VHV). A few villagers mentioned concerns about pesticides on vegetables that were thought to cause diarrhoea.

The villagers have been exposed to campaigns to increase their awareness about worms. Worms were sometimes thought to be associated with consuming meat and vegetables.

> *'Seventy percent of the kids have [worms]. About over 10 years ago another survey [was] done in [village] and 80 to 90% of children [had worms] …'* (PHO2)
>
> *'The body is small, if I give meat I am scared the child will get worms and it is difficult to eat worm medicine as he is still too young …'* (Sarn, father)

Underpinning the concerns about choking, diarrhea and worms was the distance to medical facilities, and therefore the potential risks to health and life.

> *'The people in the mountains they don't dare take a risk … because they see the danger of the hospital being really so far.'* (Noom, father and VHV)

Not only the distance was seen as a barrier but also complicating factors of difficult terrain, needing a vehicle, a driver, and the ability to speak Thai.

5.6.6 IYCF information may not be accessible

Currently, pregnant women receive information about IYCF in the Maternal and Child Health Book given at their first antenatal visit which is usually at the nearest public health office.

The ‘pink book’ includes information with supporting pictures, however the pictures rely on understanding detailed Thai explanations. Thai is rarely spoken within the villages. One PHO reported: *‘The problem here is the language because they are all hill tribes’.* The first author clarified*: ‘so do the women understand Thai?’* and the answer was ‘*mostly not’.*
Breastfeeding information in the pink book includes the benefits of breastfeeding along with proper attachment and positioning and how to express. Complementary foods are explained including examples and portion sizes. No one was reported to formally verbally share complementary feeding information.

> *‘No one really has the duty to tell them (carers) that (what foods to feed after 6 months) but they already know it. It is more like common sense - eat soft food - that is what they are doing anyways.’* (PHO3)

These findings agree with villagers reporting that they were *‘not recommended’* anything about complementary feeding.

5.7 Discussion

This study explored IYCF practices and their meanings among hill tribe communities in northern Thailand. The study confirmed poor adherence to WHO IYCF recommendations, as reported previously (81, 108), but also drew out the socio-cultural context for current views and practices. Key findings of the study are that EBF was impeded by the need for mothers to return to work, with infants usually cared for by older adults who would feed them water and rice mixtures instead of breast milk. Complementary foods were introduced earlier than six months, typically what children could eat with little preparation, and food variety was limited, reflecting local contingencies.
Women’s work is a common barrier to EBF in rural communities in Thailand (4, 81, 87, 90, 108) and nearby countries (89, 196, 202).The issue of other demands on women’s time undermining IYCF arose repeatedly in the review of 16 case studies undertaken by Pelto et

al. (29). Women who were subsistence farmers were specifically mentioned as having heavy workloads.

Pelto et al. (29) trace the history of the concept of care in relation to IYCF, incorporated into the UNICEF framework for the determinants of nutrition in 1990 (31), and elaborated on since (20, 203). In the framework, inadequate maternal and child care is seen as an 'underlying' determinant of nutrition, on the same level as household food insecurity, unhealthy environments and lack of health services; the designated 'basic' determinants are economic, political, and ideological.

For women in the hill tribes, caring for infants is displaced by work to ensure the livelihood of the household. The entrenched mode of household economic organization makes physical labour by women, within a relatively short time of giving birth, a culturally-sanctioned duty. To be able to care through IYCF, women need time as well as support from the community (for example, to redistribute workload) and greater autonomy; these are aspects of empowerment (204). Cunningham et al. (183) speculate that control over workload is especially important when children are very young.

Subsistence farmers work very hard in conditions of poverty, as reported for rural communities throughout Asia (89). In a 2002 World Alliance for Breastfeeding Action forum, Menon (205) drew attention to the role of globalization in further impoverishing people, especially women, in developing countries. Women who had historically survived by fostering subsistence economies have had their meagre livelihoods undermined as land is commercialised, cash crops are introduced and subsidised imported produce is 'dumped'. The increasing struggle to meet basic needs was recognised as inhibiting breastfeeding and as difficult to address without attending to women's empowerment.

Indigenous women in the Bolivian Andes, as described by Jones et al. (133), face similar problems. Farming and herding is a heavy burden for these women, leaving only a small

amount of time for household chores and food preparation, and there was low diversity of foods appropriate for infants. Jones et al. (133) caution against targeting women with behaviour change communication strategies in the absence of changing the socio-cultural constraints on food availability and livelihood security. This principle is widely recognized (29, 32, 206). While agricultural solutions appear promising, Jones et al. (133) draw attention to the important matter that such interventions should not create further work for women farmers. Efforts are needed to 'purposively transform caregiving environments and guide time use decisions toward child and maternal care' (133 p1682), with the support of the whole community.

The appropriateness of collective parenting, at least before a child is six months old, is thus called into question (207). Collective parenting is commonly seen in remote indigenous communities (81, 189, 208-211). As apparent in this study, remoteness also means that outside influences, other views and new information, are encountered only sporadically and therefore local knowledge carries most weight. Grandmothers are thus both involved in child care and a trusted source of information (89, 133, 189, 208, 212, 213), reinforcing certain beliefs and practices that make collective parenting possible but are counterproductive for IYCF. In such contexts, interventions should be sensitive to collective responsibility for parenting (214) and care is needed so as not to break trusted ties within a community (215). For example, Aubel et al. (208) described providing nutrition education to grandmothers in Senegal and encouraging them to promote good nutritional practices related to pregnancy and infant feeding. In Australia, a similar approach for Aboriginal communities has been taken in the Strong Women, Strong Babies, Strong Culture Program that is community designed and was shown to lead to improvement in the health and nutrition of pregnant women and young children (216). For the hill tribes, a first step could entail translating the pink book into local

language with lots of pictures to enhance understanding and sections that are specifically designed for grandmothers.

Along with the obligations on women, remoteness and poverty underlie the IYCF practices described by the hill tribe communities. There are seasonal variations in water supply and road traversability, with access to health and other services limited (217). Improvements in infrastructure to decrease remoteness have been associated with improvements in nutrition elsewhere in Thailand and in south Asian countries as part of integrated and inter-sectoral programs (186, 218, 219).

As part of an intervention to improve child nutrition in the hill tribe communities, it has been proposed to trial a nutrition-sensitive agriculture intervention, involving giving families chickens and seeds for homestead gardens, accompanied by nutritional education (13). From accounts in the present study, eggs are culturally appropriate, already seen to be suitable for IYCF. Gardens could enable women to work closer to home, but more direct efforts, such as cash or food transfers to enable women to remain at home for six months and a village-level complementary feeding program (123), may be required to change long-standing household arrangements and women's roles. Furthermore, other nutrition-sensitive initiatives may be worth investigating in the hill tribes (123).

A limitation of the study was that the researchers were outsiders, although the Thai co-authors have detailed knowledge of the hill tribe communities. To address this, perspectives were sought from a range of people with different roles in the local health system and villagers were included until saturation appeared to occur. Villagers were interviewed in Thai, which was their second language, and this may have prevented full expression of their perspectives. However, interviews were generally unhurried and the translators understood the need for villagers to find the words they wanted, sometimes with help from other family members, often men (who were more fluent in Thai). Grandmother's views were often

obtained with assistance from parents, which again may have affected what was said, but on the other hand grandmothers are respected authorities on the care and feeding of children. We acknowledge that interpretations of translated accounts have been made, and these will be influenced by our theoretical and epistemological stances (191). To reduce this form of bias, the analysis was undertaken in sections with three researchers repeatedly reflecting on the integrity of the interpretation, following which the entire analysis was considered by two Thai academics.

Further research with these communities could provide other insights into the child nutrition situation. For example, research with a specific focus on grandmothers or on men, especially those with leadership roles, would be useful. It would be worth exploring arrangements by which women might be relieved from work for six months following birth of a child, and how support for this could be built.

5.7.0 Conclusion

In conclusion, this study draws out the ways in which underlying factors that feature in the UNICEF framework (31) form a nexus that perpetuates poor nutrition in children in the hill tribe communities. Cultural practices and beliefs are shaped by what is possible (201), as illustrated here. This reinforces the need to address underlying determinants in order to create possibilities for changing practices and collective meaning making. Determinants include the heavy burden of work on child-bearing women in the poor, remote villages along with other structural barriers that contribute to lack of food availability and low diversity.

Summary of Chapter 5

Chapter 4 highlighted the high prevalence of stunting in the 0-5 year old children, while this chapter highlights the infant and young child feeding practices and contextual influencers of stunting. EBF for 6 months was impeded by the need for mothers to return to farming work, with the early introduction of solids enabling infants to be cared for by other family members. Low variety in complementary foods was typical during infancy, with few local foods having appropriate texture and special preparation of foods rarely described. A pervasive underlying issue is women's responsibility to labour and lack of time to care for their young children compounded by the effects of poverty and food insecurity.

Chapter 6

Perceptions of young child health and the role of the health system

6.1 Preface

The aims of Chapter 6
To understand how villagers and health workers (volunteers and officials) gauge health of children under 5 years, whether growth monitoring is salient, and relationships with the health system in this remote location.

As shown in Chapter 5, there appears to be a number of factors contributing to the poor IYCF practices and stunting seen in the Karen and Lua hill tribe children. Women's return to work within three months of birth is affecting women's ability to EBF for 6 months. When children are fed prior to 12 to 24 months, the foods are limited to those of soft textures. Underlying these determinants, poverty and food insecurity are affecting many of the villagers. This chapter presents the third study of this thesis, which investigated how health is gauged by villagers and how stunting has persisted despite a growth monitoring program in situ. Using in-depth interviews and focus groups, this study will help identify the health-related determinants of stunting, specifically investigating the perspectives of locals and health officers on health and engagement by and with the health system. This chapter has been submitted and under review with the Food and Nutrition Bulletin.

6.2 Statement of authorship

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Principal Author

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Designed the study, collected the data, performed the analysis, interpreted the results and wrote the manuscript. Overall percentage of contribution 70%.

Signed: … Date: ……18/04/18…….

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);

ii. permission is granted for the candidate to include the publication in the thesis; and

iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution

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6.3 Abstract

Background

In Thailand, despite widespread improvements in child nutrition, stunting is still highly prevalent among northern hill tribe children.

Objective

To understand how villagers and health workers (volunteers and officials) gauge health of children under 5 years, whether growth monitoring is salient, and relationships with the health system in this remote location.

Methods

Qualitative research was undertaken with eight hill tribe villages. A workshop on infant and young child health and nutrition was held with eight village health volunteers, two per village, selected by a public health officer. In-depth interviews were conducted with 20 villagers and two volunteers who had children 0-5 years. Eight other health workers were also interviewed. All dialogue was conducted in Thai through bilingual facilitators and recorded, transcribed and translated into English. Transcripts were coded and analysed thematically within and across participant groups.

Results

Overall villagers considered strength and independence of children to be hallmarks of health; the size of children featured rarely. Volunteers did not perceive local benefits of growth monitoring and the extent of child undernutrition was unclear to them. Nutrition counselling was seldom mentioned by villagers or health workers. Across all accounts, and considering silences, relationships of villagers with the health system seemed fragile.

Conclusion

Villagers understand child health in terms of functional abilities rather than size. Volunteer health workers in this remote location have limited resources and support. Together this helps explain why, against a background of poverty and food insecurity, growth monitoring does not translate to improvements in child nutrition.

Highlights

Villagers understand child health in terms of functional abilities, not size, so growth monitoring lacks salience and this, along with a lack of support and resources for volunteer health workers, means that the growth monitoring program does not translate to improvements in child nutrition in these remote communities.

6.4 Introduction

In Thailand a growth monitoring program for all preschool children was introduced as a part of the second National Food and Nutrition Plan (1982-1986) (220). In the 1980s undernutrition was common amongst children aged under 5 years, with stunting affecting up to half (221). Over the next thirty years, stunting was significantly reduced in this age group, with prevalence of 16% reported for 2012 (168). The decrease has been attributed to a combination of improvements in household income and in the health system (68, 222). Despite noteworthy advances at a national level, the nutritional status of infants and young children under 5 years of age in the northern hill tribes of Thailand has not improved to the same degree. Up to two thirds of children in the hill tribes were stunted in the 1990s (222, 223, 224) and recent reports indicate a third are affected (9), a prevalence considered by the WHO to be severe (74).

Elsewhere we have described how women in the hill tribes must return to subsistence farming in distant fields, usually within three months of giving birth (section 5.6.2). This impedes exclusive breast feeding for six months, with water and rice mixtures introduced early, partly to allow other family members to care for infants. Bananas, grown locally, are fed to older infants and sometimes eggs, but beyond this there is little variety in infant diets. Poverty and food insecurity mean that the diets of children over 12 months of age are also poor (section 5.7).

The persistence of stunting also invites consideration of the provision of health services in this remote location, where some villages do not have an electricity supply and the roads to Chiang Mai are frequently unpassable in the monsoon season. Thailand has had a primary health care strategy that involves both ‘bottom up’ (from community) and ‘top down’ (central government) approaches since 1979 (225). Village health volunteers (VHVs) support public health officers (PHOs) in outreach to communities (72). Villagers who take on the VHV role

are given a minimum of five days' training and assist their PHO with duties such as provision of medications, simple health checks, hygiene awareness and growth monitoring. Each VHV is responsible for 10-15 households.

The aims of this study were: to investigate perceptions of health of young children (up to 5 years old) amongst parents and caregivers of hill tribe children and those with roles in the remote health system; and to explore how growth monitoring is understood and whether it resonates locally. A further aim was to explore whether and how aspects of the remote health system feature in accounts given by these participants.

6.5 Methods

6.5.0 Study setting

The study was conducted in the district of Mae Chaem, northern Thailand, in June 2014. Four villages were involved, of Karen and Lua ethnicity, located approximately one to three hours from the nearest town with a hospital and markets. The villages were chosen due to their planned involvement in a nutrition-sensitive agriculture program. They ranged in size from 50-120 households and three had no electricity. The majority of villagers are subsistence farmers, growing enough food for themselves and their families, often supplemented with cash crops (mainly maize for animal feed). Some households also raise animals and tend small homestead gardens.

6.5.1 Participants

Study participants attended a two-day workshop or completed an in-depth interview, as detailed in the next section. Two individuals contributed to both activities.

The workshop was for VHVs, with five men and three women, ranging in age from 24 to 38 years, attending (see Table 6). All VHVs had at least one child of their own. The two who had a child aged 0-5 years also accepted the invitation to do an in-depth interview. Twenty other villagers with children aged 0-5 years completed in-depth interviews, the majority

being women (see Table 7).

In-depth interviews were also undertaken with three community and three sub-district PHOs (three male, three female, age range 30 to 50 years) as well as two nurses (both female, aged 25 and 32 years). Community PHOs work in clinics or public health offices near the villages. They provide basic health services that may include immunisation, provision of medications, birth control, deworming tablets, blood pressure checks, antenatal checks and growth monitoring. Sub-district PHOs usually have responsibility for several of these activities across a wider area.

6.5.2 Study design

The first author was introduced to the participating health workers and villagers by colleagues who were already known to them. She visited the villages on three occasions before the study commenced to establish relationships and learn about village life during which time she made field notes. The Thai co-authors were consulted over the course of the study so that the work was culturally sensitive.

The study involved conducting a two day workshop to collaboratively investigate infant and young child health (226). The following topics were addressed: health of infants and young children, feeding practices for children under five, nutrition recommendations and how child nutrition could be promoted within the village.

The workshop was conducted in Thai by four experienced bilingual (Thai/English) facilitators, following semi-structured guides developed by the first author in partnership with the facilitators. Two were researchers from Chiang Mai University who had previously undertaken research in the villages and were known by some of the participants. A further two were community outreach workers from Chiang Mai who had worked in other hill tribe villages but were not known to workshop participants. Semi-structured guides were developed by the first author in partnership with the facilitators, drawing upon the extensive

experience of those who did community outreach work in lieu of pilot testing for questions and concepts. Workshop sessions were audio recorded and later concurrently transcribed and translated from Thai to English by the facilitators.

VHVs were invited to the workshop by the sub-district PHO by telephone, where possible, one male and one female VHV from each of the four villages. The workshop proceeded as a series of discussions in response to open-ended questions, first in small groups (typically for 75 minutes) then as a whole group (for around 60 minutes). Reflection on lived experiences was encouraged, allowing for different experiences to be shared.

In-depth interviews were subsequently conducted with villagers, VHVs, and other health workers, with these participants described in the previous section. Facilitation, preparation of semi-structured guides, audio recording and translation occurred in a similar manner as for the workshop. VHVs selected villagers for interview; a few chose to have a family member or friend in attendance. In-depth interviews were usually 45 minutes long and, for villagers, continued until data saturation appeared to have been reached. Other health workers were approached through a sub-district PHO and interviewers were confined to those available, so saturation was not necessarily reached.

All transcripts were reviewed by the first author in consultation with the facilitators to clarify meanings and so that consistent terms were used in translation. The names of participants' have been changed for privacy. In selecting quotes to present, care has been taken to ensure information is not identifying. All transcripts and analyses have been stored on password protected computers and/or in secure, locked cabinets.

6.5.3 Data Analyses

A thematic analysis was conducted guided by a social constructionist epistemology (157). While meaning is understood to be learnt and shared culturally, thereby shaping practices, there is scope for variation and multiple points of view within communities so attention was

paid to this (227). Themes were coded and identified iteratively, initially focussing on notions of child health and whether size featured in these descriptions, then following strands representing alternative conceptions while attending to comments and silences around growth monitoring. Descriptions of roles of health workers were attended to, within participant types and across accounts from all participants, as well as expectations of and encounters with health services. NVivo 10 software (QSR International Pty Ltd, Doncaster, Victoria, Australia) was used to code and organise data.

All data coding was undertaken by the first author. She mapped themes and their inter-relations, with cross-checking and expansion by the second and last authors occurring through recurrent reading and discussion. The Thai authors commented on interpretation and implications throughout. Understanding of transcripts was supplemented by observations from the first author's field notes, made throughout her time in the villages, and by communication with the World Agroforestry Centre team at Chiang Mai University that also works with the villagers.

6.5.4 Ethics

The study was granted ethics approval by University of Adelaide, Australia (HREC# H-2014-51), and RIHES, Thailand (Study code 4/57). Participants were given verbal and written information about the study in Thai, including the first author being a student with relationships to Thai institutions and the University of Adelaide. Participation was voluntary, and written informed consent was sought from all the respondents.

6.6 Results

6.6.0 Perceptions of child health

Participants were asked "what is a healthy child?" referring to children under 5 years. Four main themes emerged in relation to this and what it required, as shown in Table 8.

Table 8. Themes around child health and their frequency among VHVs and other villagers (N = 26)

Themes	Frequency
Healthy children …	
… are strong	12
… play well	5
… are smart/alert	5
To be healthy children need …	
… rice / healthy food	15
… to be out of the weather	8
… play or exercise	5
… breast milk	4
… clean water	2
Children who are unhealthy …	
… are sick with colds or fever	14
… have diarrhea	8
… lack interest in food	6
… do not play	6
… are not strong	4
Poor health in children is caused by …	
… eating forbidden food	18
… the weather	5
… water that was not boiled	4
… contaminated breast milk	4
… worms	3

Villagers agreed that a healthy child '*plays well*'.

> *'If you want to know [if the child is healthy], mostly, the child will be wandering around and playing with friends in the village. From morning until evening, walking around. Not coming home.'* (Nut, father and VHV)

Some villagers spoke of health as the child having a completely healthy body, without signs of sickness. The Thai term '*somboon*', meaning healthy (or even plump) or perfect, was often used to describe complete health. Villagers frequently used the term '*strong*'. It is noteworthy that hill tribe children often have physically demanding duties, such as preparing animal feeds and feeding animals.

When discussing what is important for healthy children, villagers said that warm clothes, play or exercise were necessary. Breast milk was also seen as important, consistent with the findings from studies conducted throughout Thailand:(168, 228) '*If they drink a lot of milk, the child will be completely healthy (somboon)*' (Ghai, mother).

Additionally, villagers saw other food intake as important for health. A VHV said: '*We need to stress feeding food, because if they eat healthy food, the children will be strong and their bodies will be fresh*' (Aek, father and VHV). In this context, fresh means energetic. Villagers use this term to give an indication of being alert, aware and intelligent. Links between food, education, intelligence, and functioning in a community were expressed by one VHV:

> *'Now they [children] have the pre-school and they have a good basis…When opened the school had a centre and they had the practice of giving food for lunch and how to cook to make for a smart brain and it helps kids know about things know about language and come together in a group and come together as a society.'* (Noom, father and VHV)

Some villagers said clean water was required for good health. Water is usually piped from mountain streams into homes. Prior to consumption by children, water is often boiled on a fire pit or gas stove. '*Warm water, when it's hot, it will kill the germs…You can give cold water, but you must boil it first. That's how it is.*' (Pong, father and VHV). A father who was a VHV (Noom) mentioned '*cleanliness*' as important for health. He meant that a child should have a clean body and washed clothes. Other villagers did not mention this, so it possibly reflects the training given to VHVs.

Signs of an unhealthy child were said to include lack of interest in food, low activity levels, crying without meaning, and symptoms, such as a runny nose. For example:

'My daughter is four years old, when she gets sick, she likes to cry. If she's well, she will wander around. If she's sick she just cries. And her face is pale. Her whole body is pale. And she's tired.' (Kip, mother and VHV)

Cold symptoms and diarrhea were often mentioned as ill health caused by the weather changing or the consumption of forbidden food. Forbidden foods included: foods that were fermented, sour, spicy or oily, certain fruits and vegetables, and cold water. This concurs with other reports (87, 209, 229). Furthermore, several participants said that children would get diarrhea if mothers breastfeed before washing on return from working in the field. Therefore, women take 'bucket showers' on return from work. This practice is reported elsewhere (194) and is associated with the belief that hot milk is sour and showering will cool it. Illustrative quotes are as follows:

'Three times [diarrhea, including] after [the] baby's hand hurt, when [she (the mother) arrived] back from work [and the breast] milk [was fed to the child] hot and [the] third [time when she (the mother) ate] sour food - mango and maryong [a local sour fruit], fermented and fresh, with chilli paste.' (Luuk, mother)

'When she (the breastfeeding mothe)) goes to work and her breast milk is hot, then [if] the baby drinks they (the child) gets diarrhea… she [must] shower first and squeeze the hot milk out.' (Luuk, mother)

The most common causes of diarrhea according to a recent review (230) are drinking contaminated water and inadequate sanitation and hygiene, which do not match the reasons given here. Villagers did not spontaneously mention water, but when prompted they indicated that they gave children boiled water. However, one PHO said: '*Some people [do] not boil [the water]. They put it [the water] in the tank then let residue drop to the bottom then drink it'.*

During the first author's time in the villages, hand washing and water sanitation practices varied in their consistency. The cleanliness of living conditions varied. Penned or staked animals, including pigs and chickens, lived underneath stilted homes. Manure could be trodden on, however, shoes were always left outside the house. Refrigeration was not available for storage of food.

6.6.1 Village children and undernutrition

Children in the community were generally seen as healthy. Parents usually said their children were strong, played well and had healthy bodies. '*No problem [with child health] as they [children] are strong and all …healthwise they are ok, they are strong*' (Geb, mother).
If there were malnourished children, the villagers saw this as result of a childhood abnormality.

> *'Mostly not have [unhealthy children] …most of them (children) are healthy, but some of them, just a few [are unhealthy] but mostly it [is because of] things that have happened from their childhood. It is like when they are young they are already disabled - they are very weak from a young age.'* (Song, mother)

During the workshop, VHVs were provided with information indicating 30% of the village children were stunted. All VHVs present said they were not aware of this. One VHV commented that their growth monitoring measurements of children indicated acceptable growth:

> *'Like we're working as village health volunteers, if we observe, we can't really say that they have undernutrition. Actually when we weigh the children aged 0–5 years, if we compare with the pink booklet (growth chart), most of them are not way below the [normal growth] standard. There are none that are way below standard, because a few times that we weighed the children and compared to the pink booklet that belongs*

to the mothers, as far as we were concerned, not too many are malnourished.' (Aek, father and VHV)

Although the VHVs believed the village children were not malnourished, they thought their children were shorter than the city children. '*Mountain kids (children from the village) compared with same aged kids in the town, the town kids are larger and taller*' (Win, VHV). The VHVs were not certain if the shorter height had any significance, particularly as health gauged by strength of the children was perceived as the same.

'Sometimes we can observe the children, those who are tall are tall and those who are short are short. The strength of some of them is equal. Their balance (height to strength ratio) is not equal.' (Noom, father and VHV)

Hereditary factors and the caring role of older siblings were suggested by three VHVs as the reason why the village children were short. For example:

'Is it possible that heredity is a part of the reason? Maybe the parents are short so the kids are also short.' (Maew, mother and VHV)

'I mean the older one (sibling) is short because he takes care of the younger one. They love their younger sibling so they carry them. This also has a reason [for the elder child being short]. ' (Pong, father and VHV)

During in-depth interviews with other villagers, no one mentioned stunting. One VHV referred to *'smaller'* children as being unhealthy, suggesting it was a consequence of being '*born as a twin or lacking breast milk'* (Kip, mother and VHV).

6.6.2 Remote health system roles and growth monitoring

The health system and growth monitoring were absent from almost all discussions with villagers about IYC health. Thus the accounts below are from PHOs and VHVs.

It is important to bear in mind that VHVs, like most villagers, contribute intensive labour to subsistence farming. Varying degrees of involvement with their role in the remote health system were spoken of by VHVs as well as different collections of duties. For example:

> *'Mainly it about vaccine and mosquitos [and] help with promote in each village about sending unwell people to hospital [as] not have anyone come take them [as] the road is difficult… we (VHVs) help each other. Work of VHV [occurs] when they (PHOs) order us.'* (Noom, father and VHV)
>
> *'No we don't do growth monitoring*.' (Nan, father and VHV)
>
> *'VHV come measure weight uses scales…height and measure head circumference…every child when measure they bring the pink book…they look [if] follow the standard or not… Have a form that has name, weight then write down this…lots of forms, this form has name, weight, height head circumference send to PHO. VHV goes to see small child…visit after birth ask mother if scar [cesarean] ok and if child healthy (somboon)…need to get information about mother and child. Ask the mother if the child is healthy. Milk good? Mother good? Scar good?...Finished send to PHO like that. VHV help recommend [women and children] go to PHO.'* (Aek, father and VHV)

The PHOs appear to view their role as meeting basic health needs. The provision of medications, as requested by villagers, featured highly. '*Taught [women with breastfeeding pain how to manage it] but they like to eat medicine more ... want medicine from here'* (PHO3).

PHOs also reported needing to visit the community, such as following childbirth, to provide check-ups of the mothers and children. However, the remoteness of villages meant that community visits did not always occur. Of note, no villager mentioned PHO's visits.

Growth monitoring of children 5 years of age and under occurred when children visited the public health office due to immunisation or illness and was also sporadically conducted within the villages by VHVs. There were a few instances of growth monitoring during the first author's fieldwork and what took place was quite varied and it was not always clear whose responsibility it was. '*It is the duty of another girl to collect all this information [weights and heights children and related nutrition status] and send it to the [provincial] PHO*' (PHO 2).

Like the VHVs, the PHOs did not raise undernutrition in the communities. All three community PHOs indicated that villagers did '*not have*' problems with undernutrition. Should a child's growth be identified as suboptimal, the appropriate action was not clear to the PHOs. There was some understanding that formula milk might be relevant.

> '*Even if we know who is lower [than healthy growth standards], there is not much we can do anyways. In the past I knew the kids. When I knew who had a problem I would give [formula] milk, but now [the formula milk] goes to the local council.'* (PHO 2)

One community PHO said '*do not have time'* to plot measurements on growth charts. The growth monitoring data are entered in a computer database, which is sent to the provincial office. The first author saw measurements written down and taken away for computer entry. Thus the monitoring is not fulfilling its immediate potential for the community.

6.6.3 IYCF understanding and counselling

Nutrition education and counselling was rarely mentioned by villagers and did not feature in VHVs descriptions of their roles. All PHOs reported providing simple nutrition advice for breastfeeding, such as recommending banana flower to increase breast milk. Beyond this, one PHO explained that there was nothing to be done, which may point to a lack of lactation management support for this PHO: '*Even if they come here [to the public health office with breastfeeding problems], there is nothing they [the PHO] can do, they can give suggestions,*

but usually they [the villager] will work it out in the village' (PHO 2). This was supported by some comments from villagers, such as the following about engorged breasts: '*not go [to anyone for help] and finally it [breast milk] came out by itself*' (Fan, mother).

There was variability in PHO's and VHV's understandings of breastfeeding recommendations, particularly surrounding WHO recommendation of EBF. EBF is the provision of only breast milk, not even water, during the first 6 months of life (96). It is possible that exclusivity is not widely appreciated, or that misunderstandings arose through language translation. Only one community PHO clearly articulated EBF. Nine villagers appeared to have some awareness of EBF recommendations, but the distinction between EBF and BF was generally not well understood. It appears that villagers view the provision of breast milk as important but not exclusivity (Chapter 5.6.0).

There were no reports of villagers receiving significant advice on complementary feeding nor any of this being provided by VHVs or PHOs. One PHO indicated that it was '*not very clear who will tell them*' about complementary feeding (PHO 2), aligning with previous reports (185).

The nurses said that women should receive the Mother and Child Health book at their first antenatal visit. The 'pink book' includes information on the benefits of breastfeeding, proper attachment and positioning, how to express and store breast milk in a refrigerator (not available in most villages) and examples of complementary foods and portion sizes. Supporting pictures are also provided, but they rely on comprehending the Thai explanations that may prove difficult for many villagers. Thus the predominant source of advice on IYCF was older women in the village, as we have described elsewhere (Section 5.7).

The villagers' contacts with the health system seem to be sporadic. There were numerous difficulties in accessing health services including the demands of farming work, lack of transport, cost of transport, poor or unpassable roads, and limited ability to speak Thai. One

PHO provided an example of a pregnant woman visiting the public health office for an antenatal check-up:

> *'…Problem that they (pregnant women) face is that the far away homes…the roads are so bad so a lot of the women they come 1 or 2 times but once getting bigger they are afraid to come [to the public health office]. Some places they have to walk or on the motorbike and very bumpy ride so they feel rather than come for a check-up for health, it is safer to stay at home…especially in the rainy season…the roads are not possible to go.'* (PHO 1)

The sporadic contact with the remote health system seemed to harmonize with viewing IYCF recommendations as optional. In contrast, local wisdom that took into account local constraints was widely viewed as sound (Section 5.7), and is also a possible reason why villagers rarely mentioned health services.

> *'Even my own child the doctor said that [feed EBF 6 months] and I did not listen. When I was a kid at birth they (my parents) would give rice. Then the doctor said for 3 months [give EBF and no rice] and we just followed the doctor as we might as well follow what the doctor says. But now…the doctor said 6 months and we did not listen. If the doctor is going to tell us 6 months we are not going to do it as it is so different from what we are used to doing…3 months is an acceptable difference, but 6 months is too much….If they (PHO) tell us the good things we will listen to them and those things not good we will not listen.*' (Sarn, father)

6.7 Discussion

In the villages, child health is generally perceived as related to the strength of the child, absence of overt illness, and independent play, thus functional capacity. Self-reliance in children is valued in other indigenous communities, including Australian Aborigines (231) and farmers/herders in the highlands of Peru (29). Ethno-theories explain this in terms of the

need for children to learn both independence and interdependence in contexts requiring constant co-operation and labour for survival (232-234). The villagers rarely referred to the height of the child, thus did not follow the Western medical model in which heights and weights are key indicators of the health of children. Growth monitoring does not appear to have a clear role in helping villagers to recognize undernutrition. Instead, villagers generally thought there was no problem with being short. This has been reported in other poor rural communities; for example, in Guatemala, caregivers cannot recognise that their children are malnourished because it is 'normal to have short children' (235 p91, 236); similarly, in rural Kenya, low weight is considered normal (237).

There were few differences between the perspectives of villagers who had roles as VHVs and others, perhaps not surprising given small amount of training VHVs receive and the remoteness of the location. The VHVs seemed to have greater awareness of Thai government (and WHO) nutrition recommendations and related concepts, although that did not mean they adopted these practices, with local knowledge continuing to be prioritised (Section 5.7).

Growth monitoring has long been endorsed and promoted by WHO (21). It has important functions beyond providing measurements: ideally these include counselling and education, regular contact with the health system, community mobilisation and targeted supplementary feeding. For example, the Tamil Nadu Integrated Nutrition Program in India has generated benefits partly through bringing community together each month on the special community weighing days (238). At a population level, growth monitoring can be used to identify areas where undernutrition requires concerted efforts (185) and to assess whether interventions are working (136).

Counselling is key to the success of growth monitoring programs. A systematic review found insufficient evidence for direct benefits of making measurements - the greatest benefits

flowed from the 'opportunity to discuss any queries about childcare' (137 p200). A more recent review demonstrated that growth monitoring was not efficacious in 'large-scale programs with weak nutrition counselling' (136 p87). In Brazil, a review of research on growth monitoring was undertaken recently (239), to understand how "the everyday reality of public health services" meant that difficulties were encountered even though growth monitoring was classified as a feasible health technology. A range of impediments were reported, from lack of equipment and appropriate space to the precarious and improvisational structure of the health services in some locations. Many specific problems highlighted the need for growth monitoring to be part of a comprehensive program in which continued education and support was provided to the health workers who were responsible, and continuous care was available where children with suboptimal growth were identified.

In the hill tribes the VHVs and PHOs appear to have variable knowledge about the growth monitoring process and its wider purposes; many appeared to see it mainly as a bureaucratic activity. Neither PHOs nor VHVs see IYCF counselling as a noteworthy part of their role. This is arguably a consequence of lack of appreciation of the purpose and local benefits of growth monitoring, reflecting problems upstream in the health system, as will be discussed in the next section. The persistence of IYCF issues is thus not surprising, nor is the villagers' reliance on traditional knowledge and advice.

6.7.0 The remote health system: considerations from 'bottom up' and 'top down'

The international model of the VHV (also known as community health worker) emerged in the 1970s in response to a shortage in the health workforce and a need to reach dispersed and poor populations in developing countries. This arrangement promoted a self-help approach, aligning with a 'bottom up' primary health care ethos, supposedly at a low cost (240). The VHV role was introduced in Thailand in the 1980s (68), with selected community members

given sufficient training to enable them to provide basic health care and health promotion, including growth monitoring which was a concerted focus (240). Severely malnourished children received special attention, including free complementary food (68, 240), and parents were counselled (72). However, it is not clear whether this ever occurred in the hill tribes (185).

The effectiveness of the VHV model is dependent on a chain of support, supervision and resources, as VHVs turn to their PHOs who, in turn, are reliant on the next level up. Perry et al. (50) discuss serious problems within this chain that became evident in large-scale programs in a number of countries in the 1980s. At that time, global political and economic forces undermined the commitment of some governments, as well as their ability to finance the VHV model, which was not as low cost as anticipated.

These intersecting problems arguably foreshadow some of the experiences in Thailand. With the East Asian Financial crisis of 1997, the Thai baht fell in value (241) and the Thai Government had to review expenditure, cutting the public health budget by 15% (242). Although public health programs continued, there were indications of reduced impact, as low birthweight in newborns increased, as did underweight in school children and outbreaks of diseases that were the subject of immunisation efforts (e.g. diphtheria and pertussis) (242). A review of health indicators from the 1960s through to 2010 suggests that the retrograde trends were transient, but there has been little further improvement (4).

In 2002 Thailand introduced universal health care coverage that meant all Thai citizens had no out-of-pocket expenses for primary core health requirements (243). This important innovation represented a change in health priorities (4). In addition, globalisation is reported to be affecting the ancient subsistence economies of Asia. The poor have become poorer and have to labour for longer, disproportionately affecting the lives of women (244, 245). Thus

both internal and external circumstances have meant that the context in which the Thai VHV program was first implemented has changed.

The volunteer model has been found to work well in some places at some times (50), but arguably needs to be reviewed periodically, especially when other major changes occur (57, 246). VHVs remain a valuable connection between the health system and the community, with the potential to have greater influence than outsiders on what occurs in their own village, particularly in isolated communities such as the hill tribes. However, VHVs need to be well supervised and supported and their livelihoods considered in order to see benefits at the community level.

Some limitations of this study should be acknowledged. The need for language translation and possible confusion generated by that has been mentioned. The number of health officers in the study was small and data saturation was not necessarily reached, but the views presented resonate with the extensive experience of the third author. Due to time and resource constraints, a single person coded all data; it would have been preferable for a subset of interviews and themes to have been coded by others and cross-checked. We did not have the resources to formally evaluate growth monitoring practices and procedures.

6.7.1 Conclusion

High levels of undernutrition in young children in the hill tribes of northern Thailand have persisted over several decades. While growth monitoring and accompanying activities have greatly improved child nutrition in much of Thailand, this model has not been as successful in these remote and poor villages for a range of contextual factors, from the local to the global. To be effective, counselling must be integral to a growth monitoring program, with VHVs well trained, supported and supervised – and remunerated for their time. This model is not as inexpensive as it was thought to be 40 years ago and the lives of subsistence farmers have

become harder. However, engaging with communities and building trust through respectful dialogue, opportunities that the model could provide, remain essential to changing practices. The PHOs who oversee VHVs also need appropriate skills and ongoing support. However, investment in the workforce at the periphery has been difficult in Thailand in the face of competing health system priorities and impacts of globalization and international financial crises. Consideration needs to be given to preventing the poor from getting poorer and to the livelihoods of the poor who service their

Summary of Chapter 6

Chapter 4 investigated potential determinants of stunting and highlighted that household ownership of a low number of animals and land a child's low dietary diversity were potentially linked to child stunting. Chapter 5 reinforced that that IYCF practices are likely contributing to stunting along with women's responsibility to labour and lack of time to care for their young children compounded by poverty and food insecurity. In this Chapter another important determinant of stunting was investigated, health. It was found that villagers understand child health in terms of functional abilities, not size, so growth monitoring lacks salience and this, along with a lack of support and resources for volunteer health workers, means that the growth monitoring program does not translate to improvements in child nutrition in these remote communities. To be effective, the model of health services, including growth monitoring, requires adequate support, supervision and resources be provided to these health workers and, in turn, to others in the hierarchy.

Chapter 7
Efficacy of the nutrition-sensitive agricultural intervention

7.1 Preface

The aims of Chapter 7

To determine, if the NSA intervention implemented in this community improved dietary diversity and growth in children aged 0–5 years, and to assess whether the NSA intervention increased the proportion of households experiencing little or no food insecurity.

This chapter presents the findings of an NSA intervention in Mae Chaem, Thailand. The intervention was carried out by ICRAF, with support from the Hue University of Agriculture and Forestry, the Hanoi University of Agriculture and HealthBridge Foundation of Canada. The intervention aimed to trial local and practical NSA activities to improve nutrition and food security. The baseline findings prior to the NSA intervention are presented in Chapter 4. That chapter documents the high levels of household food insecurity, low adherence to dietary diversity recommendations and high rates of stunting of children under 5 years of age in this population. Findings of qualitative research also undertaken at this time are presented in chapters 5 and 6. These chapters highlight influential factors, such as time restrictions, culture, poor understanding of feeding recommendations, and limited support within the national health system. Due to limited time and resources, ICRAF or the international research team were unable to write up the results of the NSA intervention and conduct full analyses. I have therefore completed these tasks to provide a better understanding of the impact of NSA interventions and as a valuable learning exercise. This chapter presents an assessment of the efficacy of the NSA intervention for improving dietary diversity, household food security, and ultimately the nutrition status of children under 5 years of age in the hill tribe communities of Mae Chaem, northern Thailand. The methods presented in this chapter refer to the methods of the research undertaken by me that is the analyses of the data

collected by ICRAF, for the NSA intervention that they implemented. In some cases, as explained in Chapter 4, analyses could not be undertaken and modelling was limited due to power.

7.2 Introduction

Undernutrition is often the consequence of inadequate calorific energy or nutrients required for health and growth, and it is associated with increased rates of morbidity and mortality (22, 39). Globally, stunting — an indicator of chronic undernutrition — affects 155 million children (1). Reducing the prevalence of stunting is set as an international global priority (247), with a particular focus on the 1000-day period from conception to a child's second birthday. Stunting during this period has the most risk for long-term damage, and therefore prevention of and reversing stunting during this period is vital (247).

Stunting and underweight was identified as a concern in Thailand in the late 1980s. At that time, 25% of children under 5 years old were reported to be stunted and underweight (4). The Thailand government implemented targeted nutrition supplementation programs as well as broader socio-economic environmental interventions. A primary healthcare strategy was instigated to improve the outreach of healthcare, including the introduction of VHVs to link the community with the public health system. Community engagement projects were undertaken, along with a range of other plans and schemes for poverty alleviation and economic and social improvement (4). The implementation of these interventions was associated with a decrease in child undernutrition, so that about 10% of children were classed as stunted and/or underweight in the late 1990s, a rate classified as 'low severity' by the WHO (4). Stunting, however, persists at 'high severity' (74) in the hill tribe communities of northern Thailand (9). Today stunting is estimated to affect approximately a third of the 0–5-year-olds in the Mae Chaem hill tribe region (9).

A number of factors are contributing to the high levels of stunting seen in the hill tribe communities. A conceptual framework developed by UNICEF in 1990 (31) (Figure 3) and with recent adapatations (33), outlines the determinants of stunting. The immediate determinants include poor dietary intake and disease, followed by underlying determinants,

such as food security, healthcare and a healthy environment. At the broader contextual level determinants include social, political, economic, national and global policies, resources, and governance.

A baseline survey (Section 3.1.3) was conducted in November 2013 in eight hill tribe villages in Mae Chaem, northern Thailand in order to identify some of the immediate and underlying determinants contributing to the high levels of child stunting. Low dietary diversity was observed, particularly among babies 6–11 months old. Low dietary diversity is indicative of poor nutrient intake (94-96) and poor nutrient intake is frequently implicated as a cause of stunting (39). Inadequate intakes of energy, protein, or micronutrients, such as iron, zinc and vitamins D, A or C, are specifically associated with poor growth (39). This aligns with the baseline survey findings that stunted children in this population were less likely to meet minimum standards of dietary diversity compared to non-stunted children (Section 4.6). This suggests that poor dietary intake may be a primary cause of childhood stunting in this population.

Food insecurity is a determinant of dietary diversity and an underlying determinant of stunting (33, 97, 98). Food insecurity occurs when there is low food availability, accessibility, utilisation and/or stability (58, 59). Thus, there may be insufficient quantities of food; an inability to acquire nutritionally adequate food; inability to prepare, consume and absorb a healthy and safe diet; and, in particular, having all three factors present continuously (58). In rural agricultural households in Thailand, food insecurity has previously been reported as extremely high (79), including in the ethnic communities in the north (78, 248). In the baseline survey mentioned above, three-quarters of the hill tribe households were reported to experience food insecurity (Section 4.6). An improvement in food security is therefore a potential avenue to explore to reduce child stunting (176) in the Mae Chaem hill tribes.

Both low dietary diversity and food insecurity are affecting the hill tribe communities of northern Thailand. Nutrition-focused interventions can address low dietary diversity levels directly (33), and nutrition-sensitive interventions can complement those actions by targeting underlying or contextual factors, such as food insecurity, ultimately affecting dietary diversity and stunting (33, 123, 249). In other words, improving the environment in which poor nutrition exists can ultimately lead to improved standards of nutrition (33).

One type of nutrition-sensitive intervention is NSA. NSA interventions consider the economic value of crops and also the health and nutrition of the farming community (154). NSA interventions are often implemented in poor rural communities that are already engaged in farming activities (14), and they orientate agricultural activities to improve the nutrition of the community. NSA interventions generally involve a situational analysis to identify key priorities related to nutrition and the most appropriate agricultural activities to address them. One of the most commonly seen NSA activities is hen farming (14, 146), both for increased production of chicken meat and availability of eggs (250). Eggs are a source of essential nutrients at levels above or comparable to other animal source foods, but are relatively more affordable (250). Home gardens are another commonly seen NSA activity (14, 146). Home gardens are often already present in the rural farming communities where NSA interventions are implemented; however, improvements can often be made so that produce is available all year round and so that nutrients produced match those nutrients lacking in diets (251).

Along with NSA activities, nutrition education is a key component of NSA interventions, as mentioned in section 2.4.6.0. Findings from the qualitative research conducted in the hill tribes suggest that nutrition counselling may benefit the hill tribes (section 6.6.3). Villagers would benefit from IYCF behavioural advice that takes into account their contextual barriers. These findings agree with reports from similar communities to the hill tribes, indicating that where cultural feeding beliefs and practices did not always align with WHO

recommendations, those communities could benefit from IYCF counselling support (108, 194, 252).

NSA interventions have been implemented around the world, with promising results (14, 146). Evidence supports improvements in agricultural production (253, 254), food security (61, 251, 255), intake of nutrients and dietary diversity (11, 123, 251, 253, 254, 256) and the reduction of nutrient deficiency diseases (251, 254, 257). However, these improvements have not always translated to a reduction of stunting in children (14, 144). Poor study design has been partly blamed for the limited improvements (146). In a review of 23 NSA interventions (14), eight of the interventions included anthropometric data, but only two of them measured the incidence of stunting, as the other studies took measurements only at one time point (140, 253). There is a need for more longitudinal intervention studies, and also studies assessing the impact of NSA interventions across cultures and geographies, to understand how well they operate in different settings (15, 42, 123, 144, 146, 258).

Many NSA interventions have been implemented around the globe, and it is generally agreed that pilot trials are effective for testing an intervention prior to investing in a larger implementation (259). As far as we are aware, there have been no trials of NSA interventions in the Karen and Lua hill tribe communities of Northern Thailand. Therefore, a trial NSA intervention was carried out in this region over a 12-month period. An evaluation of the NSA intervention was then required to determine its efficacy for more widespread implementation. The aims of this research were therefore to determine firstly, if the NSA intervention in this community resulted in improved dietary diversity and growth in children aged 0–5 years, and secondly, to assess whether the NSA intervention increased the proportion of households experiencing little or no food insecurity. Change in dietary diversity was the primary outcome, while food security and anthropometry measurements, including stunting, wasting and underweight, were secondary outcomes, as it was assumed that these outcomes were less

likely to change over the short 12-month intervention period (including six-months of the intervention supported and six-months unsupported) than dietary diversity.

7.3 Methods

For the methods related to the NSA intervention implementation, please refer to Chapter 3 and the statistical analysis plan in Appendix G. I will outline below the methods used to analyse the data provided from the NSA intervention.

7.3.0 Outcomes

The chosen outcomes for this study reflect the aims of the NSA intervention. The primary outcome was the proportion of children meeting minimum dietary diversity, as had been designated by the international research team. The secondary outcomes were 1) total dietary diversity; 2) the proportion of children consuming particular food groups: eggs, green leafy vegetables and other fruit and vegetables; 3) the mean anthropometric z-scores (HAZ, WAZ and WHZ) of children; 4) the proportion of children stunted, wasted or underweight; 5) the proportion of households experiencing little or no food insecurity. The criteria used to measure each outcome are outlined below.

Dietary outcomes: For each child, foods consumed over the preceding 24 hours were obtained, using a locally adapted version of Kennedy's dietary diversity questionnaire (94). Total dietary diversity was then derived according to the method outlined by Kennedy et al. (94). One point was given for each of the nine food groups consumed. These nine food groups included rice (and other starchy staples), vitamin A-rich fruit and vegetables, green leafy vegetables, other fruits and vegetables, eggs, dairy (and alternatives), legumes (and nuts), meat, meat–organ. A cut-off point of $\geq$4 food groups was taken to indicate minimum dietary diversity (96). Consumption of eggs, other fruits and vegetables and green leafy vegetables was determined by a yes response to the corresponding food group in the dietary diversity questionnaire.

Anthropometry: Anthropometric measurements of each child were converted to z-scores using the WHO Anthro software (version 3.2.2 WHO Anthro 2011 software, WHO, Geneva, Switzerland). HAZ, WHZ and WAZ were determined based on the WHO growth standards (166). A stunted, wasted or underweight category was determined based on a cut-off of less than -2SD for the respective z-score (166).

Household food insecurity: Food security was measured using HFIAP (150,151). Its level was determined based on responses to nine questions and was classified as secure, mild, moderate and severe (152, 153). Categories were then collapsed for further analyses, with 'food secure' and 'mild insecurity' combined to read 'little or no food insecurity', and 'moderately insecure' and 'insecure' combined to read 'modest or marked food insecurity'. Due to low numbers falling into some categories, it was decided to collapse some groups in order to highlight the differences between the most and the least food-secure households (Section 4.5.3).

7.3.1 Statistical methods

Data was cleaned, checking for missing elements, data input errors and extreme values (such as anthropometric z-scores exceeding ±5 SD on the basis that these values are not consistent with life (260). Analyses proceeded according to a pre-written statistical analysis plan (Appendix G) and were performed according to intention-to-treat principles.

Multiple imputation using chained equations was used to address missing data, on the assumption that data were missing randomly. The variables selected included the nine food groups, nine food security items and children's weights and heights. Fifty datasets were created and combined using Rubin's rules (261). The treatment and control groups were considered separately (262). Given that simple methods of imputation have been shown to perform well for addressing missing baseline data in randomised trials (263), univariate imputation models for each incomplete baseline variable contained only their endline

counterpart. Imputation models for endline variables included baseline variables in addition to auxiliary variables that were significantly associated with the endline variable and/or absence of an endline variable. The suitability of auxiliary variables was assessed using ordinal logistic, binary logistic or linear generalised estimating equation (GEE) models as appropriate. The number of auxiliary variables included in each univariate imputation model was determined based on the prevalence of the endline variable. Multiple imputation of z-scores was intended to be conducted by adding values for height and weight to make up the z-score, as this has been associated with more accuracy than using the z-score directly (264). However, using multiple weight and height variables calculated extreme values that invalidated the z-scores; therefore, z-scores were directly imputed. Clustering was not taken into account in the imputation, as there is little evidence that this improves the estimates (265). The results of the imputed analyses were classed as primary findings.

All analyses were conducted with Stata version 14.1 2015 software (StataCorp, Texas, USA). Villages were regarded as clustered for the purpose of the analysis, as although all of them are in the same region, local differences, such as access to water or religious practices could skew results. Data were then adjusted to allow for clustering within households (i.e. with multiple children), as values for siblings are correlated.

Analyses of the outcomes for dietary diversity and food groups were adjusted for sex, age and the baseline values, on the basis that children consume a greater diversity of foods as they age and evidence that boys generally consume more than girls (266). Similarly, analyses of anthropometric measures were also adjusted for sex, age and baseline values, as evidence indicates that delayed growth and risk of undernutrition (stunting, wasting, underweight) are associated with age (39, 267, 268) and growth patterns are gender-related (269). There were two analyses that did not converge; these were related to the proportions of children classed

as stunted and underweight. The stunted category was therefore only adjusted for sex and baseline values and the underweight category was adjusted for sex and age.

Linear mixed-effects models were used to analyse all continuous outcomes. A Poisson identity model with robust error variance was applied to ascertain proportions. The Poisson model took the place of a binomial/identity mixed-effects model, as outlined in the statistical analysis plan (Appendix G), due to problems with convergence.

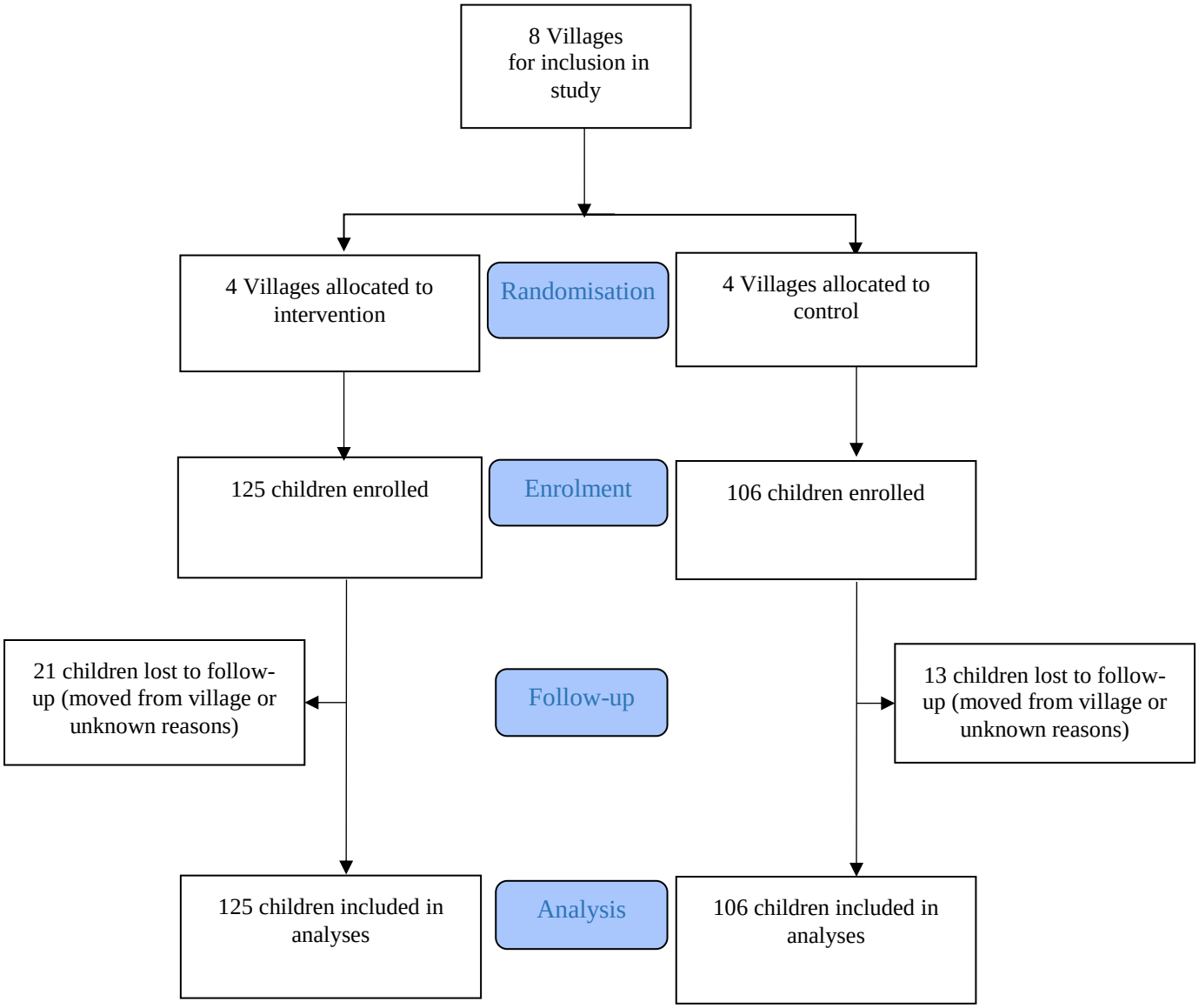
7.3.2 Ethics

Ethical approval to analyse the data of the NSA intervention trial was provided by the Research Institute for Health Sciences, Chiang Mai University, Thailand (No.40/2014) and the University of Adelaide, Australia (HREC# H-2014-51).

7.4 Results

A total of 186 households and 231 children were involved in the trial (Figure 6). Twenty-one of the children were lost to follow-up in the intervention group and 13 children in the control group; however, available data from all children were included in the analyses. Table 8 shows that participants from the intervention and the control villages showed similar results for all characteristics, except for female head of household where the intervention group had an 8% higher proportion of female heads of households than the control group (intervention (16%), control (5%)).

Figure 6. Trial flow of participants



Note: ICRAF were not able to provide an exact date when participants left the intervention; it was therefore assumed that lost participants dropped out at the date of follow up.

Table 9. Characteristics of household, respondent and children at enrolment

Variable	Intervention	Missing %	Control	Missing %
N children	125	NA	106	NA
Household size	6 (2–12)	10	6 (3–11)	7
Crop land size	2 (0–7)	10	2 (0–6)	6
Animal types per household	2 (0–4)	8	2 (0–4)	5
Moderate to severely food-insecure %	64	10	62	6
Ethnicity %				
Karen	58		54	
Lua	41	0	46	0
Mothers' age	28 ± 7	10	29 ± 6	7
Educational level of respondent > primary level %	35	0	32	0
Occupation farmer %	98	0	96	0
Female head of household %	16	8	5	5
Male child %	56	0	51	0
Child age (months)	22 (0–59)	0	28 (0–58)	0

Values are mean ± SD, median (range), or percentage

NA= non-applicable

All the following analyses were adjusted for clustering at village and household level.

7.4.0 Dietary diversity

Table 9 shows that at the end of 12 months the proportion of children meeting minimum dietary diversity was almost identical for the intervention and control groups [0.01 (95% CI -0.10, 0.11]. Similarly, the total dietary diversity results did not differ between the intervention

and control children [-0.02 95% CI -4.07, 4.03]. Figure 7 shows that the proportion of children meeting dietary diversity standards increased for both intervention and control groups from 61% and 64% at baseline to 85% of all children at endline.

7.4.1 Food groups

Table 9 demonstrates that there was no significant difference in the proportion of children consuming other fruit and vegetables and green leafy vegetables at 12 months with the exception of the significant difference in the consumption of eggs when controlling for age, sex, and baseline. The intervention group at endline had an 18% greater proportion of children consuming eggs than the control group (0.18, 95% CI 0.05, 0.30).

Figure 7 illustrates the percentage of children consuming each of the key food groups contributing to dietary diversity (excluding starchy staples, which were consumed by nearly all children). Intake of all food groups, except organ meat and dairy, increased from pre- to post-intervention for both intervention and control groups.

Table 10. The effect of an NSA intervention on children's diets, anthropometry and household food insecurity

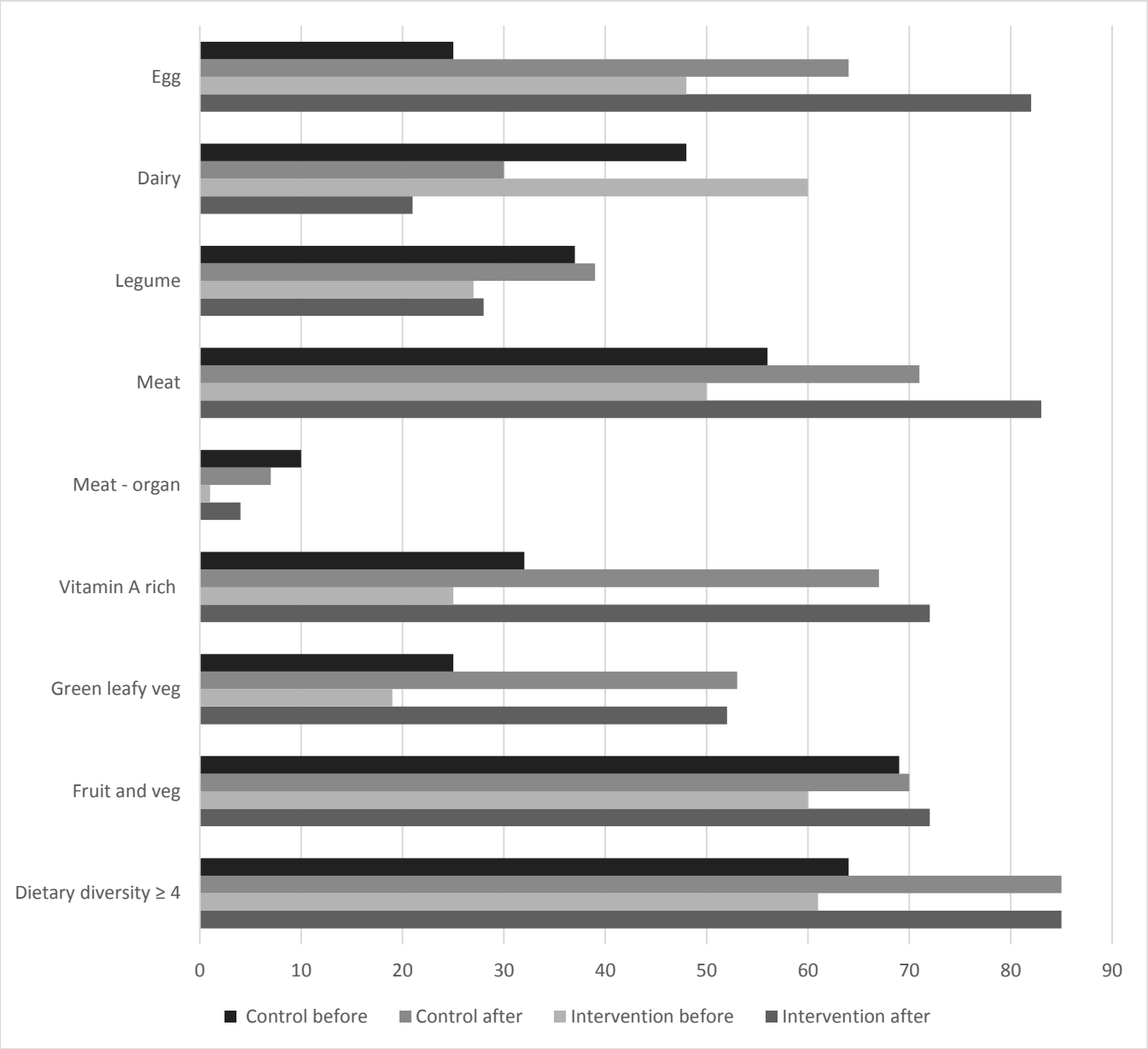
Variable	**Intervention** (n=125)	**Control** (n=106)	**Difference between intervention and control**	**95% CI**	**P**
Minimum dietary diversity	106 (85%)	90 (85%)	0.01	-0.10, 0.11	0.89∫
Total dietary diversity	5 (1-6)	5 (1-6)	-0.02	-4.07, 4.03	0.99§
Consumption of other fruit and vegetables	90 (72%)	74 (70%)	0.04	-0.10, 0.18	0.54∫
Consumption of green leafy vegetables	65 (52%)	57 (54%)	-0.04	-0.18, 0.11	0.61∫
Consumption of eggs	103 (82%)	67 (63%)	0.18	0.05, 0.30	0.01∫
anthropometric z-scores: wfhz	-0.25 ± 0.94	-0.18 ± 0.94	-0.11	-0.35, 0.12	0.34§
anthropometric z-scores: hfaz	-2.48 ± 0.98	-1.17 ± 0.76	-0.11	-0.54, 0.33	0.64§
anthropometric z-scores: wfaz	-1.79 ± 0.92	-1.61 ± 0.84	-0.14	-0.42, 0.14	0.32§
nutrition status: wasting	4 (3%)	2 (2%)	0.01	-0.04, 0.05	0.85∫
nutrition status: stunting	86(69%)	60 (57%)	-0.09	-0.22, 0.04	0.19∫
nutrition status: underweight	50 (40%)	38 (36%)	-0.06	-0.19, 0.07	0.39∫
household food insecurity	71 (57%)	60 (56%)	-0.13	-0.28, 0.03	0.11∫

§ Linear mixed effects Model, ∫ Poisson Identity Model

Intervention and control data shown as mean ± SD, or median (range) or number (%).

Adjusted for gender, age and the dependent variable at baseline, except for nutrition status: stunting (adjusted for variable at baseline and gender) and nutrition status: underweight (adjusted for gender and age).

Figure 7. The percentage of children consuming each food group before and after the NSA intervention (n=231)



Control group n=106 and intervention group n=125

7.4.2 Anthropometry

Table 9 shows that at the end of 12 months the anthropometric z-scores and the proportion of children stunted, wasted and underweight was similar for the intervention and control groups.

7.4.3 Household food security

Table 9 shows that at the end of 12 months the household food security was similar for the intervention and control groups.

7.5 Discussion

The primary aim of this trial was to test the efficacy of a planned NSA intervention to increase the proportion of hill tribe children aged 0–5 years (at baseline) meeting the minimum dietary diversity recommendation set by WHO. There was no clear evidence from the trial that the intervention would achieve this result. However, during the one-year intervention period, there was an increase in the proportion of children meeting minimum dietary diversity in *both* the intervention and control groups. There was also an 18% increase in the proportion of children in the intervention group consuming eggs compared with the control group. On the other hand, there was no evidence that the intervention made a difference to household food security or children's anthropometry.

7.5.0 Dietary diversity

Following the intervention there was no difference seen in dietary diversity between the intervention and control groups, although there was a large increase in the proportion of children in both groups meeting minimum dietary diversity. It is possible that the overall increase in dietary diversity made it difficult to detect subtle differences in this indicator. One feasible explanation for the overall improvement in dietary diversity could be the positive effects of nutrition-related activities that took place in both the intervention and control villages; these included regular visits from ICRAF, the baseline and endline surveys

and various educational workshops. Factors external to the intervention may also be related to the improvement seen in both groups, such as the Maternal and Child Health Booklet, which was given out though the public health system to pregnant women.

Another factor that arguably led to the overall increase in dietary diversity is the higher age of participating children at the close of the intervention. The median age of the children increased from 24 months at the baseline survey to 47 months at endline. It has been noted that as children get older dietary intake increases along with dietary diversity (266). This is supported by the baseline findings, as those children older than 12 months were six times more likely to meet the minimum dietary diversity compared to children under 12 months old (Section 4.6). Therefore, the longitudinal study design may have affected the findings of the study, even though adjustments for age were made.

7.5.1 Eggs

The greater proportion of intervention children consuming eggs suggests that the increased supply and promotion of eggs as a result of the intervention was effective. This is an important result based on the recent finding that daily egg consumption by 6-9 month old children increases linear growth (270). The increased proportion of children consuming eggs also agrees with previous studies that have reported increased egg consumption in children as a result of increased production and promotion of eggs (175, 253, 271). For example, in Bangladesh, Cambodia, Nepal and the Philippines, NSA interventions with hen raising led to an increase in children's consumption of eggs from one to two a week (251). In this NSA intervention, daily egg consumption appeared to be easy to achieve, perhaps due to eggs already being well accepted as a food for children (Section 5.7). The intervention also removed some accessibility and cost barriers, which may well have contributed to the increased consumption of eggs. It needs to be noted that despite the significantly higher proportion of children consuming eggs in the intervention group (82% intervention versus

64% control), the absolute increase in the proportion of children consuming eggs was higher in the control group (25% increased to 64%) compared to the intervention group (48% increased to 82%), perhaps due to the influence of the increased age of children from the beginning of the study to endline. This increased age effect may have been more evident in the control group due to the lower proportion of control children consuming eggs at baseline. It may also suggest a spillover effect of the intervention to control villagers. Finally, we do not have information about how control households obtained their eggs. It is possible that circumstances had changed in the control villages enabling households to purchase eggs for their children more readily.

7.5.2 Anthropometry

There was no difference seen in stunting, wasting or underweight between the intervention and control groups. This is consistent with previous evidence of NSA interventions on children's anthropometry suggesting they had limited effects (14, 144). Eleven reviews of the impact of NSA interventions on anthropometric outcomes in children were carried out between 2001 and 2013 (13, 14, 23, 42, 123, 141-146). All of the reviews came to the same conclusion, that there is little evidence that NSA interventions had an impact on anthropometry. However, the evidence base is small as only two reviews included stunting. The results may be dependent on the targets set for NSA intervention actions, success and uptake of interventions, durations of interventions, and the initial prevalence and severity of childhood stunting.

Reductions in stunting might be expected from this particular intervention due to the increase in the proportion of children consuming eggs; however, as seen elsewhere, dietary improvements do not necessarily translate to reductions in stunting (253, 254). An NSA intervention in Cambodia involving home gardening, poultry production and nutrition education reported an increase in dietary diversity and egg consumption in children, but no

effect on stunting (253). In a two-year integrated agriculture, nutrition and health program in Burkina Faso, IYCF practices improved, as well as child dietary diversity, but there was no reduction of stunting prevalence (254). The lack of effects on stunting despite dietary improvements being achieved has often been attributed to features of the study design, such as brevity of the study, lack of controls (146) or failure to measure confounding factors.

7.5.3 Food security

Food security did not improve in this NSA intervention, in contrast to findings of other nutrition-sensitive interventions (61, 251). An intervention in Ghana provided nutrition education and enterprise development services to improve women's income and remove barriers to improving food security. These activities resulted in a 50% decrease in food insecurity risk (272). An NSA program in Malawi included food preparation, agricultural production and diversification activities and, unlike the hill tribe intervention described in this thesis, it also addressed the topics of family planning and income generation (61). The use of strategies from other sectors and a focus on income generation may have been instrumental for the improvements in food security seen in these examples. Due to extreme poverty in the hill tribes, the NSA intervention alone was probably insufficient to improve food security. It is possible that other strategies such as income generation are needed to achieve that outcome.

7.5.4 Explanation of findings

7.5.4.0 Confounding factors

Beyond poor dietary diversity and food insecurity, other factors are commonly implicated in stunting, including poor hygiene and sanitation, lack of water management, gender inequality and poverty (15). If these factors are present but not addressed, there will be no improvements following the intervention (15). For example, in the case of parasite infection, there are reports that as many as 85% of the hill tribe children are affected (8). The current

levels of parasite infection are not clear, and so further investigations are advisable to determine if this is a factor affecting growth in the communities' children (8).

7.5.4.1 Intervention sustainability

Initially the NSA intervention led to an increase in eggs and garden produce; however, in the six-month period after intervention support had ended, the intervention households experienced a decrease in hens raised and garden produce (details to follow in Chapter 8) (19). The intervention's poor sustainability might explain the lack of improvement seen in overall results. Assessments taken at six months into the intervention may have been beneficial to capture any mid-term improvements and thus to highlight any immediate effects of the intervention as compared to the longer-term effects reported in this study.

7.5.4.2 Sample size

At the outset of the trial, HealthBridge had calculated the sample size needed to estimate a prevalence of 50% of children meeting the minimum dietary diversity. I did conduct my own post-hoc sample size calculation but using a more realistic target of seeing a 13% difference in the proportion of children meeting minimum dietary diversity (273) and taking into account clustering of siblings. The suggested sample size was found to be underpowered. In order to detail dietary diversity and anthropometry outcomes such as stunting, it appears that a much larger sample is required. Masset et al. (14) have argued that at least 4000 participants are needed to detect a medium effect of 10% reduction in stunting resulting from NSA interventions. Clearly, larger studies are required to detect significant changes in anthropometry but it is not always possible to obtain large samples. For example, some ethnic minority groups, including the hill tribes of Thailand, have only small populations. However, it is still important that we pay attention to the health needs of the hill tribes and people like them, despite the inevitable small sample sizes. In these situations collecting qualitative data (as occurred in this study) as well as quantitative data, can help provide complementary

information to determine the feasibility and acceptability of the intervention and finally to judge the likely benefit to the hill tribe children.

7.5.4.3 Target age

The majority of children were 12 months and above at the beginning of intervention and about half of the children were already stunted (Section 4.6). The greatest potential to prevent stunting is before children are stunted and therefore before 12–24 months of age (39, 267, 268). Targeting the children at an early age warrants consideration when planning future interventions within the hill tribe communities. Promising results have been seen in NSA and IYCF interventions when children were targeted before 12 months of age (56, 254). In an Ecuadorian intervention promoting daily egg consumption, children were targeted between the ages of 6–9 months. A 47% reduction in stunting was seen over the six-month intervention. The authors suggested that this success might be in part due to targeting children at an early age (270).

7.5.4.4 Duration of the intervention

NSA studies involving hen raising and home gardens to increase children's egg and vegetable consumption, usually range from 1.5 to 5 years in duration, but usually are less than 2.5 years (14, 251, 254, 256, 257). It has been suggested that the lack of significant reduction of stunting could be in part due to the short duration of NSA interventions (<2.5 years) (254), possibly explaining the limited improvements seen in this particular six-month intervention. Interventions that provide complementary food directly to children and that therefore omit preliminary steps have been associated with stunting reductions within 10 months (270). However, NSA interventions typically have several additional steps prior to the provision of complementary food to children. These steps include the engagement of community, stakeholder relationships, logistics management, food production and hen raising. Obviously, additional time is required to go through these steps. Each step requires careful planning,

acting, observing, reflecting and continual assessing and refining of the process (274). In many cases, such as in the current intervention, funding cycles also delay these preliminary steps. Time-saving strategies to reduce the preliminary steps could be a useful compromise when longer-term interventions are not feasible.

Several time-saving strategies could be applied when working with this hill tribe population. Firstly, gathering of data could be streamlined using existing local services; for example, anthropometry data could be collected by the PHO before and after the intervention. This would reduce time and costs of researchers going back into the field to collect anthropometry data. Another time-saving approach is to provide supplementary foods directly to those children at risk of stunting. There is strong evidence supporting the provision of food supplements in populations with insufficient food (23), such as the hill tribes. Supplementary food provision ensures that those children requiring nutritional support are reached in a timely fashion and the extra food supply is not reliant on the success of other activities, such as home gardens and hen raising (23). Supplementary feeding programs were previously implemented in some parts of Thailand (185), and the lessons learnt from these could be drawn on here.

7.5.4.5 Spillover effects

Limited differences of results between the intervention and control groups may be partly related to spillover effects from the intervention villages to the controls. Spillover effects due to the leakage of ideas and inputs to neighbouring villages has been reported in other NSA interventions (61). In the hill tribes, villagers often travel between villages (80), and it is likely that some cross-over of information occurred between the intervention and control villages. Thus, the increase in egg consumption seen in the control village children may be partly due to spillover effects.

7.5.4.6 Bias

Another consideration regarding the NSA intervention is related to study design and self-selection of participants into the intervention. Randomisation of intervention and control occurred at the village level; however, villagers who participated were self-selected. It is possible that those villagers who expressed interest in the project and who then participated were those with poor food security and limited resources (although having a control group should have eliminated bias).

7.5.5 Strengths

Limitations of the study have been detailed; however, there were also strengths that will briefly be mentioned. The randomised parallel design of the intervention helped compensate for confounding factors such as differences in cultural beliefs. The intervention also included baseline and endline surveys; this allowed for adjustment of baseline variables, a feature that has been lacking in other NSA interventions to date. The intervention began with an in-depth formative research process that built rapport with and gained input from the villagers (154). The formative research considered gender equality, food security, nutrition status and the agricultural situation — all of these are key components of NSA interventions (15). Gatekeepers of village knowledge or village leaders were brought on board early during the formative process, and this helped with advocating for the study. The regular contact over the first six months of the intervention between the participants and ICRAF allowed close monitoring of the NSA intervention and provision of support as required, leading to positive feedback from villagers (Section 8.6.2). Thus, this intervention represents best practice in terms of including and respecting participants.

7.5.6 Conclusion

This trial of an intervention that included home gardens, hen raising and nutrition education in the northern hill tribes of Thailand resulted in a greater proportion of children in

intervention households consuming eggs. These results highlight the positive value of the NSA intervention despite a lack of firm evidence for an improvement in dietary diversity, food security and anthropometry. Future research into NSA interventions is required over a longer period, targeting children less than 12 months of age and investigating other confounding factors, such as water sanitation and hygiene, parasite infection and poverty, to fully assess the value of NSA interventions in the hill tribes.

Summary of Chapter 7

Poor IYCF practices, poverty, limited assets and women's limited time to care were among the determinants identified in Chapters 4, 5 and 6 as contributing to the high prevalence of childhood stunting in the hill tribes. A trial NSA intervention was implemented in this region that included home gardens, hen raising and nutrition education. The intervention resulted in a greater proportion of children in intervention households consuming eggs. These results highlight the positive value of the NSA intervention despite a lack of firm evidence for an improvement in dietary diversity, food security and anthropometry.

Chapter 8

Local perspectives and prospects for sustainability of the nutrition-sensitive agriculture intervention

8.1 Preface

The aim of Chapter 8

To explore the locals' views of the implemented NSA intervention in the hill tribes and its prospects a further six months after support ended.

As outlined in chapter 4, 5 and 6, prior to the NSA intervention in the hill tribes, low rates of EBF, poor dietary diversity and high levels of food insecurity were recorded. Contributing factors were identified and included women's limited time to care, cultural beliefs and sporadic contact with the health system. This chapter contains the final study of this thesis which investigated the impact of the NSA intervention six months following formal support ending. Local perspectives on the NSA intervention and IYCF practises at this time are investigated. These findings can be used to increase understanding of NSA interventions in the hill tribes and similar communities and the sustainability of such interventions. This manuscript is under review at Maternal and Child Nutrition.

8.2 Statement of authorship

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Anna Roesler (Candidate)

Designed the study, collected the data, performed the analysis, interpreted the results and wrote the manuscript. Overall percentage of contribution 70%.

Signed: …… Date: ……18/04/18…….

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);

ii. permission is granted for the candidate to include the publication in the thesis; and

iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution

Lisa Smithers

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Signed: Date: …06/04/2018…….

Prasit Wangpakapattanawong

Contributed to the study design and reviewing the manuscript

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Vivienne Moore

Contributed to the design of the study and interpretation of the results, and reviewed the manuscript.

Signed: . Date: ……06/04/18…….

8.3 Abstract

To reduce undernutrition in children under 5 years in the ethnic hill tribes of northern Thailand, a nutrition-sensitive agriculture intervention involving hens and home gardens was implemented over six months. The aims of this research were to explore the locals' views of the intervention and its prospects a further six months after support ended. Twenty in-depth interviews were undertaken in November 2015. Participants included villagers who had been involved in the intervention. Dialogue occurred in Thai with assistance of a translator and was recorded, transcribed and translated to English. A detailed thematic analysis was undertaken. Eggs produced by the hens were appreciated and fed to children. Subsequently, the hens had ceased laying or died. The home gardens had suffered from seasonal scarcity of water and destructive insects. Greater engagement, support, time and funding are needed for NSA activities to be strongly connected to infant and child health and for a high priority to be accorded to community efforts required for sustainability. Investment in water infrastructure would improve sanitation as well as viability of home gardens and this endeavour would likely benefit from intersectoral collaboration.

8.3.0 Key Messages

- Villagers were able to keep laying hens and establish home gardens as part of a six month nutrition-sensitive agriculture intervention
- The villagers saw the intervention as beneficial and eggs were fed to children
- After a further six months, the hens stopped laying and either died or were eaten, and gardens suffered from seasonal lack of water and destructive insects
- Identified hindrances need to be addressed for the intervention to become sustainable
- Greater engagement, support, time and funding to emphasize child health benefits and change IYCF practices is likely to be required, and intersectoral collaboration to improve water infrastructure

8.4 Introduction

Undernutrition in children, including stunting, was recognised as a problem throughout Thailand in the 1980s (4, 72). Across a range of sectors, government plans were implemented to improve not only nutrition, but country development and economic progress (68). Improvements in the nutritional status of children occurred overall (4, 168), however, one third of northern Thai hill tribe children aged 0–5 years of Karen and Lua ethnicity are still stunted (9).

According to the UNICEF Conceptual Framework (Figure 3) (20, 31, 32), poor diet and disease contribute to stunting in children. Underlying these are feeding practices, household factors, sanitation and healthcare. At the contextual level, political power, the health care system and other infrastructure play a role (32, 33). Thus, to address child undernutrition in the hill tribes, interventions arguably need to go beyond narrow nutrition-specific interventions to change underlying and, ideally, contextual factors.

The hill tribes are located in a remote area where the nearest major town is one to four hours drive away. Only basic supplies are sold within the villages and seasonal fluctuations in rain affect food production and road access (154), consequently food insecurity is a major issue (79). Historically, the villagers survived by subsistence farming (154) with a variety of crops grown including legumes, rice, peanuts and shallots. In more recent times there has been a shift to 'cash crop' farming (mainly maize for animal feed), mono-cropping and fixed field farming (80) which is the repetitive use of one plot of land that leads to depletion of nutrients from the soil and a greater reliance on fertilizers (79). These shifts in agriculture practices place an extra strain on the Thai hill tribes due to increased costs and labour requirements of farming (79).

NSA interventions have been proposed in order to address poor nutrition attributed to food insecurity and increased agriculture costs (123). Such interventions have been implemented

in a number of remote farming communities (14, 251, 254). There is evidence that NSA interventions can improve intermediary outcomes, such as dietary diversity in children (251, 254, 256). However, there is only weak evidence of effectiveness for reducing childhood stunting (14, 253). It is not clear whether NSA interventions are not capable of reducing stunting, or whether findings to date reflect the relatively short time frame in which assessment has typically occurred (14), in which case sustainability is crucial for the full potential of NSAs to be realized. Local accounts of how activities proceed or regress are essential for understanding local barriers to sustainability (275, 276). In addition, initial consultation and collaboration should be followed with attention to local views about the value and impact of the activities, to determine the mechanisms of impact (277).

A NSA intervention was implemented in the Karen and Lua hill tribes of northern Thailand by ICRAF, at Chiang Mai University, and supported by the international research team. The aim was address food insecurity, poor IYCF practices, and the high rate of child stunting. Eight villages were involved, four being randomly designated as intervention sites and four as controls. Households were eligible to take part if they had children aged 0–5 years. Across the eight villages, 172 households participated in a baseline survey in November 2013. In consultation with the villages, a NSA decision framework (154) was used to determine the most viable NSA options which were implemented in November 2014. For details of the NSA intervention refer to section 1.3.1. Thereafter, monthly visits by ICRAF ceased and a further six months followed when villagers continued the actions on their own.

An assessment of the NSA intervention in terms of children's diet, food security, and growth measurements has been undertaken (Sections 7.4 and 7.5). However, those measurements do not allow insights about how the intervention was received by the villagers and how it fared after external support ended. Such in-depth understanding is important to scope sustainability, thus the aim of this study was to explore the locals' views on these matters.

8.5 Methods

8.5.0 Study setting

This study was conducted in the Chiang Mai province of Thailand, approximately 100 km from the Myanmar border. Four villages were involved, two of Karen and two of Lua ethnicity. The villages range in size from 50-150 households and are one to four hours drive from Mae Chaem, a city of approximately 2,500 inhabitants (278), in which food, household and farming supplies are available.

8.5.1 Study design

Twelve months following the implementation of the NSA intervention (six months after formal support ended), in-depth interviews were undertaken by the first author with villagers (n=20). The first author had built relationships with the villagers over a three year period and had previously conducted interviews in the same villages. Villagers were recruited by a 'random walk' door-to-door strategy, similar to that outlined by Flynn et al. (279), with a translator. Villagers were provided with a participant information sheet and a verbal explanation. All villagers approached who had participated in the intervention agreed to be interviewed.

8.5.2 Data collection and analysis

The interviews were semi-structured and guided by an interview schedule that had been reviewed by a local PHO and ICRAF. The following topics were covered: what is important to the villagers, malnourished children, awareness of the NSA intervention, how the intervention affected the villagers, and awareness and interpretation of IYCF messages. Interviews with the villagers continued until data saturation appeared to be reached. Interviews were conducted in Thai between the researcher and villagers and when required English was used between the translator and the researcher. Interviews were audio recorded.

The recordings were simultaneously transcribed and translated to English by a bilingual Thai/English translator and checked by myself.

Translated transcripts were coded and organised using NVivo 10 software (QSR International Pty Ltd, Doncaster, Victoria, Australia). A detailed thematic analysis was conducted by the first author. The analysis was guided by a social constructionist epistemology (157), and therefore attention was given to all voices. A coding frame was developed inductively. Themes emerged during an iterative coding process. The initial coding words included hens/chickens, eggs, seeds, gardens, feeding and children; around these, repeated patterns of meaning were sought. Other issues such as lack of water emerged through analysis. Themes, extracts and interpretations were continuously shared with co-authors, and cross-referenced with the first author's field notes and ICRAF.

8.5.3 Ethics

The research was approved by RIHES, Chiang Mai University, Thailand (No.40/2014) and the University of Adelaide, Australia (HREC# H-2014-51). Permission was also granted by the district PHO and individual participants provided written informed consent.

8.6 Results

In-depth interviews were undertaken with 20 villagers, 13 being women. Participating villagers were predominantly farmers (85%) ranging in age from 23 to 45 years. All but one was the parent of one or two children aged up to seven years (the remaining villager being an uncle) (see Table 11). The themes and subthemes identified in the analyses are defined and presented in Table 12.

Table 11. Characteristics of the villagers post-intervention

Indicator	**Villagers**
	n (%)
Gender	
Female	13 (65)
Age group, years	
21-25	10 (50)
26-30	7 (35)
31-35	3 (15)
36-40	0 (0)
41-45	1 (5)
Occupation	
Farmer	17 (85)
School teacher	2 (10)
Shop owner	1 (5)
Number of children aged 0–5 years	
1	8 (40)
2	11 (55)
3	1 (5)

Table 12. Definitions of themes and their subthemes

Themes and subthemes	**Definition**
Hens and gardens - Hens	
Availability of eggs -Increased -Amount produced	During the intervention there was an increase in eggs available. The villager reported an amount of eggs produced by the hens each day
Egg consumption -same -increased	During the intervention the consumption of eggs by children stayed the same as prior the intervention or increased
Decrease cost of eggs	During the intervention the cost of eggs decreased
Hens died	The reasoning for the hens dying

-cooler	
-immunity	
-feed was no longer provided	
Hens died - when	How long the hens survived
Hens eaten	The reasoning for the hens being eaten by some families
-desired	
-food no longer given	
-old age	
Hens alive	Hens were reported as sill alive within their household or neighbouring households
-oneself	
-others	

Hens and gardens - Gardens

Planted the vegetables	Seeds given by ICRAF were planted
The growth of the vegetables	The growth of the vegetable seeds planted
-not at all	
-not a lot	
-good	
Vegetables eaten	How much of the vegetables planted were eaten
-sometimes	
-eaten	
Difficulties	The difficulties of growing vegetables as as either a lack of water or insects consuming the vegetables
-lack of water	
-insects	
Consumption of different vegetables	A benefit of the intervention was the consumption of different vegetables
Will plant again	Villagers would plant the seeds again
Vegetables finished now	The vegetables ceased growing

Infant and young child feeding

Understanding of EBF	If EBF (based on the recommendation provided by the Thai Public Health System and WHO) was understood or not by villagers
-understand	
-give water	
-give rice	
Start rice	At what age villagers believe that rice (and other foods) should be introduced to children
-2-3 months	
-after 3 months	
-6 months	
Reasons for ceasing EBF	The reasons given for ceasing EBF before 6 months
- rice	
-mother returned to work	
Addition to rice	Belief that adding meat and vegetables to rice is good
When meat and vegetables	The age when meat and vegetables are believed they need to be added to rice
-8 months	
-1 year	
-2-3 years	

Begin foods when -able to eat themselves -when they will not get diarrhea	The belief of when children can begin foods
Changes following ICRAF -delay rice -give vegetables	Changes in beliefs surrounding IYCF following the intervention
Intervention implementation	
Who attends meetings -grandparents -men -mainly women	Who was reported to attend ICRAF activities
Difficulty with messages -grandma -man -women	Who had difficulties with understanding the messages given in Thai by ICRAF during the intervention
Recognition of the intervention	
Taught how to feed children -taught -cannot remember	Intervention provision of IYCF messages
Message to feed an egg a day	The message to feed an egg a day to children was heard
Hens	ICRAF gave hens and taught how to look after them
Vegetables	Seeds were given to grow vegetables
Messages repeated	The messages given by ICRAF were repeated
Forms	Forms to record eggs and vegetables were collected by ICRAF monthly
Improvements	Improvements were noticed as a result of the intervention (hens, gardens etc.)
Hardships	Villagers reported hardships of living in the hill tribes

8.6.0 Hens and gardens

All villagers interviewed mentioned eggs as a beneficial aspect of the intervention. A number said that children had increased their egg consumption due to the increased availability of eggs.

> *'Before we had to buy eggs in the market, but since ICRAF came we now eat eggs every day. Before we did not eat eggs every day.'* (Poor, father)

Other villagers said they already fed their children eggs, but the benefit of the intervention was the daily supply of eggs. Avoiding costs associated with buying eggs and the need to go to Mae Chaem to purchase eggs were repeatedly highlighted.

> *'Before [during the six month intervention] we had chickens and eggs and we did not have to buy egg … Now we have to buy chicken eggs again as the chickens died.'* (Bot, mother)

> *'The eggs are costly so eggs from chickens are good and not need to go to Mae Chaem.'* (Nom, father)

Despite the positive view of eggs, the majority of villagers reported that the hens died or were eaten after 5-10 months. A common reason offered for this was the onset of cooler weather.

> *'Because the weather has changed the chickens died … they do not like the cold weather.'* (Poor, father)

Additional reasons for the demise of the hens included the desire to eat the chicken meat, the old age of the hens, and that the villagers' home-made feed was not adequate. This feed was observed to consist of food scraps and boiled garden greens and rice.

> *'For about 4-5 months the chicken did not give any eggs so then we ate them.'* (Bin, father)

> *'(ICRAF) gave chicken food and chickens then the chickens did not have eggs anymore because of their old age.'* (Apple, mother)

'The [chickens] all died a long time ago. Weno longer had chicken feed. The chickens died about one month ago.' (Fart, uncle)

There were mixed views on the value and viability of home gardens. A benefit indicated by some villagers was that they did not have to buy vegetables for a time.

'When they [ICRAF] came we planted [vegetable seeds] and did not have to buy [vegetables].' (Bin, mother)

The major inhibiting factor was the lack of water in the dry season, from November through to April, when the water supply from the mountain streams ceases. During this period, water is only available from taps in homes during certain periods of the day and is saved for drinking and sometimes showering. Washing clothes and other duties requiring water are limited and often done at a stream a considerable distance away (about a 20 minute drive or a 1.5 hour walk). Most villagers did not plant gardens around their homes during the dry season (although some planted seeds in fields where water was available).

'In the hot season we can use water only for drinking and showering. There is not a lot of water and we need that water to shower and for use in the house.' (Lore, mother)

'We planted the seeds in the garden and can pick sometimes ... fertilize but still not come. Difficult to plant [as)] hot in summer.' (Nom, father)

Two villagers reported that the plants did not grow and were eaten by insects.

'Planted the [seeds and] when [the vegetables] sprouted they were just small and then the insects came and ate all the vegetables. We did not eat the vegetables… the insects ate all of them… We planted the seeds and they did not grow.' (Pai, mother)

8.6.1 IYCF practices

One of the stated aims of the intervention was to promote EBF for six months. However, breastfeeding advice, as a part of the intervention, was rarely mentioned by the villagers. Identified practices and beliefs (Chapter 5) from pre-intervention continued to be articulated,

including providing water to the infant to clear the throat, a belief that breastmilk alone is insufficient after a few months, and that rice is required to strengthen the child from an early age. As described previously, these beliefs and practices are connected to the need for the mother to return to work in distant fields within a few months of giving birth.

> *'When [the] mother [is at] home [with the 2 month old child], the child had the milk of mother, but when the mother returned to work, we gave rice.'* (Tiangman, father)

Prior to the intervention, variety in complementary foods in infancy was low (Chapter 4). Afterwards there were frequent reports that vegetables, meats and other items should be added to rice given to children, but only a few villagers understood that this should occur from 6 to 7 months of age. One father indicated that from age 6 months: '*Give rice porridge and also put vegetables in it*.' (Hua, father)

In general, villagers expressed a belief that vegetables and meat cannot be introduced until at least one year of age, despite knowing the recommendations. When discussing the introduction of vegetables, May, a mother responded, *'the doctor said 6 months…. if [the child] can eat then can try to feed [vegetables]'.*

A father of a child two years and eight months old said:

> *'Oh age 3 years [introduce vegetables]. And this one [age 2 years and 8 months] sometimes eats a little [vegetable] now, eats small small little.'* (Tiangman, father)

The most common reason shared for low variety in infant diets was the belief that children begin foods *'when [they can] eat them themselves'* and some villagers expressed a fear of diarrhoea or stomach upset if a child was fed certain foods early. These views align with pre-intervention dialogue (Chapter 5).

> *'If [the child] can eat [vegetables] then can try to give them. … From two years this child able to eat [vegetables] easily ... When the child can talk they can ask for them*

[vegetables] when they want. Before [2 years of age they could] not understand what [the] child [was] saying.' (Apple, mother)

'[The child is] one year and one month and just started eating [vegetables] because able to.' (Neung, mother)

'Some people's child not yet one year and eats vegetables and gets stomach ache. So not give [vegetables] until after one year.' (Duo, mother)

8.6.2 Intervention implementation

The villagers said that women, primarily, had attended meetings related to the intervention, although grandparents and fathers were occasionally mentioned. For example: '*The mother went to listen'* (Fart, uncle). This accords with the intention of ICRAF to target women. However, information was in Thai, a language in which younger men were most proficient as they were typically responsible for any business in Mae Chaem, not women or older villagers.

'*[The messages are in] Thai, sometimes they [the grandparents] cannot understand, but we can explain, so when we go to the field they can make like that.'* (Neung, mother)

'Some people not understand … I understand Thai [and do] not have a problem. [Mother] not able to read and Thai also not know.' (Tiangman, father)

Regardless of who had attended meetings, most villagers were aware that '*a group from Chiang Mai'* came about a year ago and gave hens, seedlings and '*recommendations',* including the message to provide '*one egg a day to children'.* The process of communication and co-operation was described by one man as follows:

'When teacher came every month. They recommended often - repeat lots of times - listen and repeat until know. If reason given only one time the person will not understand and will understand a little but not all. Repeat one, two, three, times they

understand and open heart to try to do. Maybe follow maybe not 100 percent.' (Nom, father)

Villagers showed interest as to whether the intervention would continue.

'This year will they come to donate chicken eggs?' (Duo, mother)

'Funding finished or continue or have another project?' (Nom, father)

One of the PHOs interviewed lived some distance from the villages and was new to his role; he was not aware of the intervention. The other PHO was also a VHV and had been a participant in the trial and was strongly supportive of it. As well as a formal interview, the first author had many discussions with him over her visit of five days. It is noteworthy that despite his roles in the health system, he did not link the intervention to child growth or health.

8.7 Discussion

Villagers' perspectives on an NSA intervention were explored six months after the end of a six month formal trial phase. Overall, villagers expressed positive views about the intervention, but connections with child health appeared to be tenuous. Threats to sustainability emerged after external support had ceased, not unexpectedly given the resource constraints and the relatively short duration of the trial. Villagers' accounts of what ensued will be valuable as a foundation for planning enduring interventions.

The supply of eggs from hens was widely seen as a highlight of the intervention, said to translate to an increased intake of eggs by children. Quantitative data from the trial corroborates this, with an 18% increase in the proportion of children consuming eggs in the intervention households compared to children in control village households (Section 7.4.1). Hens and eggs have also been welcome in similar interventions in neighbouring countries (251, 253).

Before discussing specific findings in detail, some limitations of this work should be acknowledged. All researchers were outsiders, although the first author and the Thai co-author have spent considerable time in the hill tribe villages. Interviews were conducted in Thai, not the local dialect, and this may have limited expression of villagers' perspectives and exploration of their views. Family members and friends sometimes assisted with translation and/or interpretation and while this was welcome, it may have influenced the views expressed. However, interviews were not rushed and people were encouraged to take the time they need to think or explain. Due to time and finances there was only one coder for the analysis of the data. Double-coding would have increased the integrity of the coding, however, sections of the transcripts and codes were regularly shared with the last author. Interpretation of translations may have been influenced by our own perspectives although we aimed to reduce this form of bias by checking the meaning of specific words and phrases and attending to the coherence of the analysis. In addition, the analysis and interpretation was shared with members of ICRAF to cross-check.

8.7.0 Communication about IYCF

In-depth research undertaken with hill tribe villagers before the intervention suggested that the recommendation of eggs for infants and young children would resonate with existing views and practices (Section 4.6, 5.6). In contrast, directives to diversify vegetable consumption would not align with villagers' perceptions of appropriate complementary foods for infants, and this may explain the lack of change, both narrated and measured, despite an increase in the supply of vegetables. It is noteworthy that interviews rarely evoked any mention of EBF messages. Together, these findings raise questions about the nature and source of IYCF communication that should accompany a NSA intervention.

This research indicates that the simple clear and repeated message of providing an egg a day was successful. This is likely due to the pratice already being accepted in combination with

the NSA intervention improving the access to eggs. Other IYCF messages promoted, such as EBF and the introduction of nutritious foods from 6 months, were not well believed or adhered to. It is possible that the promoted IYCF practices were unfamiliar to the villagers. Evidence has shown that specially crafted messages have helped to improve uptake of unfamiliar messages (280) along with teaching new skills through demonstrations (131). In the hill tribes, villagers typically provided only a limited number of foods that had a soft texture and did not require extra preparation (e.g. banana) (Section 5.6.5). Demonstrating how to prepare meat and vegetables for infants may afford an opportunity for more complex communication, addressing misinformation and beliefs along with the visual representation of how to complete the skill (131).

Secondly, women were the focus of the intervention, and they were generally the household member attending intervention activities, although as previously noted (Section 5.7) mothers, fathers and grandparents are all collectively involved in child care and feeding. Only inviting women may have meant that those not in attendance continued to perpetuate old beliefs surrounding IYCF. There is a need to engage with villagers who care for children, including grandparents, mothers and fathers, to encourage changes to feeding practices.

Thirdly, villagers noted some language barriers due to messages being provided in Thai. Even small languge mis-understandings can prevent clear simple messages from being fully understood (131). In future interventions, presentation of messages in local language should be considered, to overcome language barriers.

Fourthly, some villagers did not appear to be aware of the IYCF messages. This may be related to the timing of the messages. A number of the children in the intervention were older than 12 months, and therefore the main IYCF messages, such as, the introduction of vegetables and EBF, were no longer relevant. The literature provides clear support for the effectiveness of education provided at the right time. Community health workers permanently

based in the village with resources and skills to support IYCF could be very beneficial to ensure timely nutrition education and counselling (53, 194).

8.7.1 Prospects for agriculture activities

After the trial ended and regular support from Chiang Mai University ceased, difficulties with NSA activities were encountered. The villagers widely reported problems feeding the hens, hens not laying or dying, and a lack of water in the dry season for gardening. These difficulties have been reported elsewhere (250, 281, 282).

At a minimum, an intervention involving laying hens would need to include roosters and a component on breeding hens to be sustainable (281). However, in the hill tribe villages, this would have added to the more immediate problem of what to feed the poultry. The Chiang Mai University provided commercial hen feed during the trial and recommended supplementing it with rice and greens to make it last longer, which some villagers did. Thereafter, feed prepared by villagers would not appear to meet the nutritional requirements of hens which need protein and fat as well as carbohydrate (rice), vitamins and minerals (greens, pumpkin, food scraps) (283). Poor nutrition is likely to at least partly account for the hens not thriving. Thus, appropriate, locally-sourced food for hens would need to be organised, possibly as a collective undertaking, in order for this intervention to continue independently.

The seasonal lack of water is a major issue. When ICRAF first proposed the NSA intervention, improvements to water systems were considered but were not feasible due to time and budget constraints (154). Water deficits have commonly been identified as a critical barrier in other types of agriculture intervention (256, 284). For example, in a home gardening intervention in Cambodia, only half of participants could maintain the garden year round (284). In response to seasonal variations in water, 'developed gardens' have been

implemented by HKI. These gardens comprise a variety of crops and techniques, including drought resistant crops, to produce a diversity of fruits and vegetables all year round (251). Beyond growing food, a poor water supply has been linked to undernutrition through other pathways (285), amplifying the need to attend to water infrastructure. It is estimated that half of child undernutrition is associated with repeated diarrhoea or intestinal worm infections due to unsafe water and inadequate sanitation and/or hygiene (32, 46, 285-287). In the hill tribes, a high prevalence of worms in children has been reported (8). Reductions in undernutrition have resulted from improvements in access to safe water, hygiene, and sanitation (45, 186, 288). It is noteworthy that HKI have introduced a component to their NSA interventions that includes diarrhoea prevention, handwashing stations, disposal of faeces, de-worming, water purification and proper food storage (11). It is possible that a NSA intervention may have, at most, a modest impact when water quality, sanitation and hygiene remain poor (11). Improving water infrastructure is a substantial undertaking, and engagement with the health system may be strategic to enable this, unlocking synergistic paths to improved child nutrition.

8.7.2 Community ownership and ongoing problem solving

Strong community ownership is needed for locals to be proactive in the process of making activities sustainable, recognizing that the community has a wealth of knowledge to draw on (17, 18). Since the Alma Ata Declaration and the Ottawa Charter, the principles of participation have been promoted as essential in health promotion activities (16).

The hill tribe villagers were involved in deciding on the specific NSA activities and VHVs were consulted about child nutrition and collected baseline and trial data, which accords with recommendations to involve locals in evaluation (289). A participatory process was built into the intervention, but it is not clear how actively villagers were engaged, acknowledging that participatory NSA interventions take time (290) and that ICRAF had time constraints.

In the formal trial phase, monthly technical support and guidance was provided by ICRAF and villagers said this helped to overcome problems as they arose. However, over the next six months the NSA activities degenerated. Villagers may have benefited from support throughout the annual seasonal cycle to assist as other issues arose, although that was beyond the resources of ICRAF.

Ongoing support of some kind appears to be essential for interventions to be sustained (256, 291, 292). An example of how to provide this is the village model farm (11, 292), headed by a villager who has received training in order to support his/her fellow villagers. HKI has implemented model farms in a number of southeast Asian countries (251, 254, 256, 284). In Nepal a positive association between technical support using this model and child dietary diversity has been demonstrated (256). Additionally, new technologies, such as mobile phones may facilitate ongoing support from external sources at relative low cost (293).

8.7.3 Elaborating on the role of the health system

Several studies indicate that the sustainability of community-based interventions depends on an enabling institutional environment (291). In the hill tribes the health system is almost the only component of the institutional environment with long-standing representation within the community. Aims of the health system in relation to child nutrition encompass those of the NSA intervention, further justifying intersectoral co-operation.

As outlined above, engagement with the health system would likely improve communication of IYCF recommendations and adoption of new practices that are made possible by the agriculture activities. Also discussed was leveraging the health system to improve water infrastructure, enabling improvements in child nutrition through both diet and gastrointestinal health.

Our previous exploration of barriers to EBF suggests that the recommended six months is unlikely to be achieved unless women can be given six months of respite from work in distant

fields (Section 5.7). Changing household economic organization is challenging, and would need to be sanctioned and supported by the community. While home-based NSA activities could be instrumental, special efforts are likely to be required to alter gender norms (294). It is arguably the responsibility of the health system to undertake advocacy and planning with local leaders, since time to care for children through EBF is well recognized in child health frameworks (29, 31)

We have previously described the vulnerability of the health system at this remote periphery (Chapter 6), so we are not suggesting that additional roles and responsibilities could be assumed without further resourcing. We specifically drew attention to a lack of support and resources for VHVs in the hill tribes that means an established growth monitoring program has not translated to improvements in child nutrition (Section 6.7). Steps to resource and embed nutrition counselling in that program are required. As part of this, NSA interventions could be endorsed and explained. This is important because interventions need to be culturally compelling, not just culturally appropriate, in order to be sustained (295). Since villagers conceptualize child health in terms of strength and alertness (akin to intelligence) (Section 6.6.0), by making connections between these attributes and specific IYCF practices, health workers could have a significant role in NSA interventions being prioritized and valued.

8.7.4 Conclusion

In the six months that a NSA intervention received external support, villagers were able to keep laying hens and establish home gardens. Villagers considered the intervention beneficial, especially eggs for children. However, the sustainability of the NSA intervention was poor, principally due to seasonal lack of water. Improving water infrastructure would enable improvements in child nutrition through both improved nutrition and improved gastrointestinal health. Collaboration with the health sector would likely improve the impact

of the NSA in a range of ways, in turn improving integration of nutrition in maternal and child health care.

Summary of Chapter 8

Chapter 7 displays that there was little change in dietary diversity, food security and anthropometry 12 months following the NSA intervention, however, there was a greater proportion of children in the intervention households consuming eggs. Which follows with the findings in this study that the villagers were able to keep laying hens and establish home gardens as part of a six month nutrition-sensitive agriculture intervention. The villagers saw the intervention as beneficial and eggs were fed to children. However, this study also found that after a further six months of the intervention, the hens stopped laying and either died or were eaten, and gardens suffered from seasonal lack of water and destructive insects. These findings identify that hindrances need to be addressed for the intervention to become sustainable.

Chapter 9
Summary and conclusion

The research described in this thesis aimed to gain an in-depth understanding of current IYCF practices and the underlying circumstances contributing to the high prevalence of stunting in Karen and Lua hill tribe children aged 0–5 years in northern Thailand. Secondly, the research aimed to assess IYCF practices, stunting and sustainability of a NSA intervention following its implementation in the Karen and Lua hill tribe communities. This final chapter provides a synthesis of the findings from the research conducted.

9.1 Review of research and future actions

The research employed qualitative and quantitative methods to investigate childhood stunting, IYCF practices and their broader determinants. While IYCF practices of Karen hill tribe villagers were described in 2009 (81), these practices have not been contextualised to provide an in-depth understanding of the reasoning for the persistence of suboptimal feeding practices in the hill tribes. The studies in this thesis provide a unique view of IYCF practices embedded in their social and physical context to help explain why stunting has persisted.

Despite WHO IYCF recommendations being promoted through the remote health system and having a government-supported growth monitoring program in place, stunting persists in the hill tribes of Thailand. A review of the growth monitoring program in Thailand occurred in 1997 (185), yet the current situation in the hill tribes is unknown. This research has highlighted that problem areas identified in the growth monitoring program in 1997 continue to be evident in the remote health system today.

To address the high stunting prevalence in infants and young children in the hill tribes, an NSA intervention was implemented. To date the impact of NSA interventions are unclear, therefore this research was conducted to increase our understanding of the efficacy of NSA interventions in the hill tribes and factors that need to be addressed for the sustainability of such interventions. Determinants of malnutrition (Figure 3) that have been investigated in this research, priority actions and potential future directions will now be detailed.

9.1.0 Cultural practices

Cultural patterns influence the IYCF practice of the hill tribe villagers. For example, elders often share both recommended and non-recommended IYCF practices within the village. A non-recommended IYCF practice shared by grandparents is the importance of feeding rice to infants within a few months of birth. The encouragement of this practice is likely contributing to its continuation in the community, despite public health recommendations to feed only breast milk in the first six months of life. Another cultural practice shared in the villages is the early introduction of water to infants. A priority for the hill tribes is the need to improve EBF and therefore delay the introduction of rice and water and introduce nutrient-dense complementary foods from 6 months of age. With such cultural practices firmly instilled in the community, not only knowledge but overall cultural change is required to shift current beliefs and IYCF practices. The health workers and researchers conducting activities in these communities need to counter this into their health activity planning as a priority.

9.1.1 Strain on farmers

Another barrier inhibiting following recommended IYCF practices is the increasing strain placed on subsistence farmers to maintain their livelihoods, including the hill tribe farmers (205). The introduction of cash crops and commercialisation of land are among globalisation factors contributing to a change in farming practices and increased pressure placed on farmers to meet basic needs. The variety in crops available for household consumption has diminished and costs associated with agriculture have increased as a result. These pressures prevent villagers from following recommended IYCF practices through intensifying the need for women to return to work, and making the purchase of nutrient-rich foods prohibitive. This research also supports that the increased strain on farmers, as seen via limited assets, is associated with increased risk of stunted children. Nutrition knowledge alone will not

improve IYCF practices in the hill tribe villages, but structural and cultural change is required. It is a priority to reduce the strain on the hill tribe farmers, particularly women within six months of birth. Policy makers need to ensure laws and incentives promote improved livelihoods for the farmers.

9.1.2 Water infrastructure

In the hill tribes, infrastructure limitations are clearly a major barrier impeding improvements in food security. Villagers' home gardens are limited by seasonal water constraints. During the monsoon season (summer) there is an excess of water while in the dry season (winter) there are water restrictions. Investigations of water storage options are required and have been seen as necessary elsewhere for improving water supply (107). Water storage would benefit the villagers by improving access to water and allow gardening all year round, leading to better food security. Water infrastructure is also required for a clean water supply that is necessary for maintaining sanitation and hygiene, infection control and therefore stunting prevention. A priority in the hill tribes is investigation of a year-round water supply to meet all villagers' water household needs. Another priority for researchers is consideration of water, sanitation and hygiene. It was not investigated in this research, however, there is evidence of a high prevalence of parasite infection in the hill tribes, however, its impact on child undernutrition is unknown (8).

9.1.3 Road infrastructure

Currently in the hill tribes road infrastructure is poor. Most roads are unsealed and at times unpassable, particularly during the monsoon season. Improvement in the roads could benefit villagers' movement between towns all year round, therefore increasing their access to a greater variety of foods and to markets to sell produce for income. In addition, sealed roads would also offer a quicker path between villagers and the health offices, likely aiding health visits and gains in villagers' health. A priority is to improve road infrastructure as

enhancements of this infrastructure would not only increase food accessibility, income and health benefits, but also free up villagers time for IYCF. Investment in the form of time and money has been noted as necessary to bring about infrastructure change (296) and therefore in the hill tribes this would call for support from organisations external to the villages. The Thai Government and other agencies may be required to partner with the villagers to provide support and funding. The government of Thailand and other Thai organisations have a track record of being involved in community development initiatives in rural Thai communities, such as the Royal Project and community nutrition programs (68, 76, 297). The knowledge gained from these experiences could be replicated and built on in this specific population.

9.1.4 Engagement and collaboration in NSA interventions

Involvement and collaborative efforts between stakeholders is required to see success in NSA interventions (15). This study highlights that at the village level greater involvement in the intervention was needed. Due to co-parenting practices, not only women, but also grandmothers, husbands and the entire village need to be involved in dialogue surrounding IYCF (208, 216). One reason for why the intervention was not sustainable and didn't have the expected outcomes could be that grandparents involved in childcare continued to share beliefs and enact practices which conflicted with the recommendations of the intervention, ultimately limiting the acceptance of recommendations. A priority rising out of this research is the importance of taking steps to engage all villagers in dialogue, starting with ensuring all the villagers involved can understand the intervention messages shared. The NSA intervention was provided in Thai, and this may have inhibited older villagers and women, who mostly use local language from meaningfully accessing intervention messages and being counselled.

9.1.5 Food insecurity and NSA interventions

Food insecurity is clearly one contributing factor impacting the villagers' situation. This research demonstrated that 75% of all households were experiencing some form of food insecurity at the time of the survey. However food insecurity is likely even higher during the lean period of the year (dry season, winter) when the survey data was not collected.

To improve food security, an NSA intervention was implemented, however, contrary to expectations, the intervention did not result in a measureable reduction in food insecurity. Acknowledging that NSA interventions hold potential to improve food security (15), some possible reasons for the limited improvements include that the intervention utilised minimal resources, including a small sample size, it was of short duration and may not have adequately addressed the contextual barriers. An important priority that this research highlights is the need to work with the hill tribes to find solutions to the wide spread food insecurity issue, acknowledging that this may take time, much longer than a 6 or 12 month long intervention. In future NSA intervention research, technical support for the villagers for at least 12 months, a larger sample size if possible and greater attention to contextual barriers need to be considered.

9.1.6 Women's time

As mentioned earlier, IYCF practices are often necessity driven. One of the major necessities for women that draws them away from their children and EBF is work in distant fields. Women return to work soon after birth to provide for the family, which in turn limits time available for breastfeeding. Carers save time on infant food preparation by providing foods with a naturally soft and minced texture, limiting dietary diversity. The NSA intervention had a loose aim to shift women's time from the fields to home-based agricultural activities, intending to free up some of the mother's time for EBF. However, this did not occur post-intervention and IYCF practices were unchanged. This may suggest that if women's time to

care for children is unchanged, feeding practices will unlikely change (15). It is a priority to free up women's time so that they have the opportunity to EBF. A greater emphasis on shifting women's time available for feeding and care of children, or a different intervention that creates this shift, appears to be required. At a policy level, policy makers can consider how to ensure that hill tribe women have access to maternity leave rights.

9.1.6.0 Support for women

Women need to be able to make decisions; be supported in their actions and have the time, knowledge and skills for IYCF, which is currently rarely seen in the hill tribes. A consideration for researchers is different approaches to help support women, such as the positive deviance approach. The positive deviance approach involves local people who are achieving recommended IYCF behaviours, sharing their skills and knowledge with others who are finding the same behaviour difficult. In the hill tribe villages, support groups may be a viable avenue to apply the positive deviance approach.

To date mother support groups in similar circumstance have been an effective avenue for applying the positive deviance approach (298). These groups involve mothers meeting regularly to participate in dialogue and problem solve IYCF issues faced by themselves and other women in the community (17). There is evidence that these groups can significantly increase EBF for 6 months and improve the timely introduction of complementary foods (229, 299). For example, in Vietnam, mothers sharing about growth promoting behaviours resulted in improved child growth (300). These findings suggest that mother support groups could be trialled in the hill tribes as an avenue to share local knowledge on recommended IYCF practices. The groups may not be exclusive to mothers, due to the co-parenting arrangements seen in the hill tribes. Searching out the most appropriate actions is a priority for the health workers in this region.

9.1.7 Strengthen the link with the health system

The findings of this study suggests that regular support from ICRAF was appreciated by the villagers and the intervention's cessation appeared to be associated with the waning of intervention activities. As ICRAF was only able to provide monthly visits for 6 months, the health system may be better placed or an adjunct to provide an improved connection over time with the villagers. Currently the health system is one of the few entities outside of the village which villagers communicate with, although the contact is sporadic (301). The aims of the local level health system are similar to those of the NSA intervention, as both aim to improve child nutrition and growth. Utilising this shared aim is a priority. This requires strengthening the link between the health system and the villagers to improve child health and the outcomes of the NSA intervention. Policy makers can ensure that there is support provided for the provision of growth monitoring, including nutrition counselling in the remote health system.

Consideration to not overburden the current PHOs with additional work is needed, due to their extensive existing workloads. In Vietnam a new nutrition role was introduced to support improvements in nutrition actions in the health system (302). The role allowed for the nutrition worker to ensure nutrition was integrated into the health service. Such a role maybe worth investigating for in the hill tribes.

9.1.9 Summary - Viable to sustainable

The NSA intervention was developed through a process of consultation with the hill tribe communities, selecting NSA activities that they considered most appropriate and helpful to their needs (154). Despite the formative process and the initial success of the NSA activities, their sustainability was limited, posing important questions about how to translate initial viability into long term sustainable improvements.

According to Adato and Meinzen-Dick (296) sustainability requires recognising and preparing for vulnerabilities such as seasonality and addressing barriers such as mothers limited time to EBF. Although some of these vulnerabilities and barriers were addressed by the NSA intervention, there were limitations in time and resources which prevented fully addressing barriers. Limitations in water, road and other infrastructure; infrequent support and connections from external entities such as the health system; and reduced time for women to care for children; continued to inhibit improvements in food security, IYCF and growth of children.

Priorities arising from this research for policy makers, health workers and researchers include; improve EBF through addressing cultural beliefs and women's time; reduce the strain on farmers, particularly women within six months of birth; improve food security; investigate a year round water supply; improve road infrastructure; learn from the NSA intervention implemented including engage with all villagers in dialogue surrounding IYCF and strengthen the link between the health system and villagers for sustainable solutions.

It is recognised that addressing the barriers to improve child nutrition and health in the hill tribes will take time and support (15, 291, 303). Short-term NSA projects may well bring initial improvements, however for sustainability of these improvements a well-planned, supported multi-sectorial intervention is required in order to help the villagers overcome the material hardships they currently experience and improve food security, IYCF and decrease stunting in the hill tribe children.

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Appendices

Appendix A: Dietary diversity and breastfeeding questionnaire

Question
Did [name] have any of the following a) plain water, filtered water or boiled water?
Sugar water?
Juice?
Herbal tea?
Rice water, soup water?
Baby formula or tinned or powdered milk?
If yes, then ask: How many times yesterday or last night did [name] consume infant formula?
Sweetened condensed milk?
If yes, then ask: How many times yesterday or last night did [name] consume any icondensed milk?
Fresh milk?
If yes, then ask: How many times yesterday or last night did [name] consume any fresh milk?
Any yoghurt?
Any tea or coffee?
Any other liquid such as XXXX? *(please specify)*
Honey consumed?
Soy milk consumed?
Soy plus legumes and nuts?
Any rice or rice products such as rice noodles or sticky rice?
Any other commercially fortified infant food?
Any vegetables that have a yellow or orange flesh such as carrots, sweet potatoes, yam?
Any other food made from grains or roots (bread, potatoes, cassava, cu nau, mon vang)?
Any dark green leafy vegetable like sweet potato leaf?
any ripe papaya, apricots, ripe cantaloupe, hog plum, loquat, ripe mango, musk melon, peaches, ripe persimmon, ripe passion fruit, pitango or tree tomato ?
Any other fruits or vegetables? (*please specify)*
Any other fruits or vegetables?
Any liver, kidney, heart or other organ meat?
Any flesh food (pork, chicken, beef)?
Any fish or seafood such as tetradon, carp or tilapia?
Any eggs?
Any peanuts, tofu or other nuts or legumes (green beans, red beans, sesame)?
Cheese?
Any sugary foods such as biscuits, candy or Banh?
Any foods made with oil, fat or butter?
Any other solid or semi-solid foods? (*please specify)*
any other solid or semi-solid foods
If yes, then ask: How many times did [name] eat solid, semi-solid or soft foods other than liquids yesterday or last night?
Has [name] ever been breastfed?
How long after birth was [name] first put to the breast?
Is [name] still breastfeeding?
Was [name] breastfed yesterday during the day or at night?

Appendix B: Additional methods

Focus groups

In order to help identify economically viable local farming practices and barriers, solutions and enabling factors for these practices, four focus groups were conducted by ICRAF. The focus groups were conducted in two intervention villages, one of Karen and one of Lua ethnicity. In each village separate focus groups for men and women were conducted. The focus groups explored factors outlined by Berti et al. (154) including gender dynamics (e.g. roles for men and women), social exchange practices (e.g. crop and labour exchange), household income generation, markets, infrastructure, natural resources, and motivating factors for adopting certain agricultural practices (154).

Developing and testing NSA activities

A paper detailing the process for development of the multi-site NSA initiative was published in 2016 (154). Briefly, following the survey and focus groups, two community workshops were held at central locations in the intervention villages, allowing local men and women, community leaders and relevant experts to discuss the baseline survey findings and appropriate NSA activities to implement. Hen raising, home gardening and nutrition education were agreed upon as the activities to trial. The ownership of chickens (hens) was already widespread, however, those chickens were mainly raised as supplementary food to be consumed on special occasions. Similarly, although households grew vegetables, this was generally in small amounts and made little contribution to the household's daily needs.

3.5 Evolution of the research

Consultative research

It was initially intended for the VHVs to receive training on a form of consultative research called trials of improved practices (TIPS). TIPS involves trialling improved nutrition

behaviours with a small number of households to see how the practices are accepted (226). However, after the first day of the workshop, when it was planned to provide training to the VHVs, it was clear that the VHVs would require more support than one training session. Given that TIPS would not be possible within the time and resources available for this work, it was decided that the training time would be better spent understanding the VHVs views on possible improvements to IYCF practices. If support for TIPS had been available, it is likely that the process of consultative research would have been beneficial both to better understand the barriers and promoters of practices being recommended and to further engage the community in the process of developing a nutrition education.

Changes to process evaluation

Initially a process evaluation was planned, however this was not possible due to a one-year break in my candidature at the time that the evaluation needed to occur. The benefit of a process evaluation is that information on the intervention is obtained while it is still occurring, allowing for improvements in the NSA intervention activities to be made early on for improved outcomes.

Appendix C: Participant information sheet

In this document, there may be messages that you do not understand. If so, please ask the research team or ask fellow participants who do understand, to explain until you can understand. This document is for you. Please read it and if you wish to consult with others about your decision to take part in this research, feel free to do so.

Project name Local insights underpinning the development and evaluation of a nutrition education strategy to improve child nutrition in northern Thailand ethnic minority communities

Name of the researcher

- Anna Roesler, Master of Philosophy research student from The University of Adelaide Australia supporting the Nutrition Sensitive Project implemented by Knowledge Support Center-Greater Mekong Sub-region of Chiang Mai (KSC-GMS) ศูนย์สนับสนุนความรู้อนุภาคลุ่มน้ำโขง คณะสังคมศาสตร์ มหาวิทยาลัยเชียงใหม่ อำเภอเมือง จังหวัดเชียงใหม่ 50200โทรศัพท์ 053- 357906(these are the details for KSC-GMS located at the Chiang Mai University)
- Dr Prasit Wangpakapattanawong, Assistant Professor, Chiang Mai University/ KSC-GMS
- Professor Vivienne Moore and Dr Lisa Smithers, The University of Adelaide

Funder Adelaide University (scholarship for Anna)

Overview of research

This research project has been developed to obtain insights about infant and young child feeding in the highlands of Thailand. Participants will have the opportunity to voice their, and/or their community's, opinions and concerns surrounding infant and young child feeding. They will have the opportunity to share thoughts on how to improve the situation, which will then be used to develop or modify nutrition education for the community.

You are invited to participate in the research. If you decide to participate in the research, the following activity will be asked of you: Participating in an in-depth interview with the researcher and a bi-lingual translator about your thoughts on maternal and child nutrition and health. The in-depth interview will take no longer than 60 minutes. It will be voice recorded. The dialogue from the voice recorder will be transcribed and translated.

The voice recordings and translated versions will be stored on the researcher's computer which is password protected. Only the researcher and supervisors, and the research advisory team, will be able to access the data. The information will be analysed and findings shared with ICRAF to inform the development and modification of a nutrition education strategy for the community. Research data will be kept for a minimum of five years with the University of Adelaide. Care will be taken so that you and any other individuals are not identified in the research. Care will also be taken to be aware of areas of specific sensitivity and cross-cultural issues.

If there is additional information on both the benefits and penalties related to the research you will be informed immediately. Research participants have the right to withdraw from the research at any time, and the information previously provided will not be used but will be destroyed. If you decide not to participate in this research, it will not affect any service that you should receive.

<u>If you have concerns or complaints</u>

This research has been reviewed and approved by RIHES, Chiang Mai University and the University of Adelaide. If you have any doubt about the research process, or wish to raise a concern or complaint about the project, you can speak to the **ICRAF team now here in the village**. You can also raise matters with the researcher Anna Roesler or with her supervisors Prof Dr Prasit at Chiang Mai University on the number 053-357906 or mobile number 084-222-0640 and Prof Vivienne Moore, University of Adelaide +61 08 8313 4605.

If you would like to speak to an independent person regarding your rights in the research, making a complaint, or raising concerns on the conduct of the project, you can contact:

- the Ethics committee at RIHES, Chiang Mai University Phone 053 - 945055 - 8 or 360 Fax 053 – 221849
- University of Adelaide Human Research Ethics Committee on +61 8 8313 5137 or hrec@adelaide.edu.au.

The Human Research Ethics Committee monitors all the research projects which it has approved. The committee considers it important that people participating in approved projects have an independent and confidential reporting mechanism which they can use if they have any worries or complaints about that research. This research project will be conducted according to the NHMRC National Statement on Ethical Conduct in Human Research (see http://www.nhmrc.gov.au/publications/synopses/e72syn.htm).

Appendix D: Informed consent

(Translated version of the informed consent letter to participate in the research)

Day, month,….

Identity card Age……House number….

Road….zip code….phone….

This letter is an indication of my informed consent to participate in this research titled "Engagement and sustainability of interventions to improve child nutrition. A case-study of ethnic hill-tribe minority communities in northern Thailand and Vietnam before and after the implementation of a nutrition-sensitive agriculture intervention". By signing this form I am indicating that I understand the details, and the purpose of the research to be performed and the benefits and risks expected to be received due to participation, as detailed in the participant's explanation sheet.

I am willing to participate in the research project.

I understand that I may not receive direct benefit from my participation, but I have been given the opportunity to voice my opinions on nutrition in the health system.

I understand that I can withdraw or refrain from participating in the research at any stage.

I provide my consent to the research team to record my voice in the in-depth interviews. I provide my consent to the research team to use voice recording for this research and understand that my personal information will not be released to the public or presented in such a way that I could be identified, the information that I provide will be presented as a whole within the research data.

If I have any doubt about the research process, or, if the unwanted side effects are caused by the research to me, I will be able to contact researcher Anna Roesler on 08 88831346 or Aranya Siriphon at Chiang Mai University on the number+ 66 53 943564 .

If I have not been treated in accordance with that stated in the participant's information sheet I will be able to communicate with the Research Institute of Health Sciences, Chiang Mai University on phone 053 - 945055 - 8 or 360 fax 053 – 221849, or contact Aranya Siriphon at Chiang Mai University on the number+ 66 53 943564 to speak on my behalf to the ethics committee. Additionally, if I feel that the research is not being conducted exactly as specified, I can contact the above people.

I consent

1.1 research participants name……Day……..

1.2 Researchers name…. Day

1.3 Witness/Translator name……. Date

2. I do not want anyone to witness the research process……date

3. A witness to support the participant (who is not associated with the research project) to assist with understanding the research content and translation signing to confirm their consent to participate in the project to assist the participant

Name and date….

Appendix E: Report

Local insights into improving child nutrition in northern Thailand: Findings and recommendations regarding breastfeeding

November, 2014

Anna Roesler
Doctor Lisa Smithers
Professor Vivienne Moore
The University of Adelaide, Australia

Doctor Prasit Wangpakapattanawong
The Knowledge Support Center for the Greater Mekong Sub-region (KSC-GMS), Chiang Mai University and the World Agroforestry Centre (ICRAF)

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This research was supported by: The University of Adelaide, The Prime Minister's Australia-Asia Scholarship, The Knowledge Support Center for the Greater Mekong Sub-region (KSC-GMS), Chiang Mai University and the World Agroforestry Centre (ICRAF) and the Research Institute of Health Sciences (RIHES), Chiang Mai University.

Summary

This report provides an overview of the local insights regarding child nutrition in the Karen and Lua hill tribe communities in Mae Chaem, Thailand. Before this project was undertaken, the communities were unaware of the high undernutrition rates in children aged 0–5 years and the importance of breastfeeding (and appropriate complementary feeding) to prevent this. Once raised, however, villagers were keen to engage in discussion of the matter and to find sustainable avenues for change.

Within the hill tribe communities, child care and feeding is shared, often between the mother and the grandparents (primarily the grandmother). Sometimes fathers undertake child care and chores in the home. Most children are not exclusively breastfed for the recommended 6 months, and rice is often introduced before 3 months. This is due to strong beliefs that children need rice for growth and strength, and circumstances that mean the mother must return to work in the fields (away from the villages).

In general, women know very little about expressing breast milk, and if they do, it is not seen as an option without a fridge. On the other hand, although unnecessary, formula milk is seen as desirable to feed children for good health.

To address the undernutrition problems the villagers are interested in knowledge about child nutrition being shared with the entire community. This aligns with the widely distributed responsibility for caring for children. The knowledge communicated should emphasise why the villagers would want to change their child feeding practices. It should provide specific advice, community examples, and opportunities to share knowledge about breastfeeding to promote change. For the specific communities there is a clear need to start by providing information while recognizing that other steps will be required to achieve change, particularly surrounding the women's role in regards to work post partum.

Introduction and background

Evidence from a number of surveys conducted over several decades in ethnic communities in Thailand, including the Karen and Lua tribes, indicates a high prevalence of undernutrition in children.

Current reports for the Karen and Lua communities in the Thailand district of Mae Chaem show that approximately one third of the children in these villages are stunted (9), which is much higher than the national rural average of 8% (7). Food insecurity and poverty have been identified as the underlying cause of undernutrition in these communities (304). Therefore, a program is underway to devise and trial agricultural options to create sustainable long-term improvements in local food availability, food consumption, and ultimately nutrition status of populations living in rural upland areas.

The agriculture intervention is being implemented by The Knowledge Support Center-Greater Mekong Sub-region of Chiang Mai (KSC-GMS) / International Centre for Research in Agroforestry (ICRAF), Chiang Mai University. This team is undertaking the work as part of a multi-site initiative, with two additional sites in Vietnam, the Hue University of Agriculture and Forestry and the Hanoi University of Agriculture. In addition to the three Universities, HealthBridge, Canada is providing technical research support and wider expertise. The broader project is being funded by Canada's International Development Research Centre.

Evidence suggests that for an agricultural program to be successful in improving nutritional status it should be accompanied by a nutrition education strategy (13, 14). Therefore, the Chiang Mai University team wished to embed nutrition education within the intervention. The research described in this report has been conducted by a qualified community dietician, Ms Anna Roesler, as part of her Masters of Philosophy degree at the University of Adelaide.

Ms Roesler was hosted and supported by the Chiang Mai University team, particularly Dr Prasit Wangpakapattanawong who is the principal investigator of the agricultural program. This report focusses on the research findings regarding community understandings of breastfeeding practices in Karen and Lua communities in the Mae Chaem district. Recommendations for improving breastfeeding rates are also offered. A separate report will address complementary feeding.

Throughout this report, exclusive breastfeeding is defined as feeding only human milk - no water or rice - for the first 6 months of the child's life.
This is the recommendation made by WHO (96) and is also recommended by the Thai Government health authority (305). It is recommended that complementary foods are not introduced until the age of 6 months. Only at this time does breast milk alone become insufficient to meet the total nutritional needs of the growing child. However, even after 6 months, breast milk remains a very healthy food which is recommended for the child until 2 years and beyond.

Methods

A two-day workshop and 28 in-depth interviews were undertaken in June 2014, involving individuals with key roles in four communities in the Mae Chaem district and villagers themselves. Two communities were of Karen ethnicity, and two were of Lua ethnicity. The overall purpose of the discussions was to understand key factors that may encourage or constrain the adoption of healthier feeding practices for children aged 0–5 years.

Among the participants of the workshop and in-depth interviews, there were three subdistrict public health officers, four community public health officers, eight community health volunteers, two nurses, and 22 villagers. Four Thai experienced facilitators were involved in conducting the workshop.

Public health officers work for the government as health representatives (and have training in public health). At the subdistrict level, the public health officers manage the community public health officers and complete reporting on health indicators for the region. Community public health officers do not have clinical training (although two of the four who were interviewed had studied public health at university), and they receive training on the job. These officers provide basic health care (such as providing worm treatment or other medications) at public health centres stationed in the community. Community health volunteers assist the community public health officers to share and collect information and materials regarding health in their community. Nurses are available at Mae Chaem Hospital, where approximately 90% of the women from the communities give birth. The two nurses in charge of antenatal/delivery and postnatal care were interviewed. All participating villagers were carers of children aged 0–5 years.

The workshop was undertaken with the eight community health volunteers. It was divided into the following five topics:

1. Understanding health

2. Feeding practices for children under 5 years of age
3. World Health Organization nutrition recommendations
4. Possible nutrition recommendations to be shared in the community
5. Activities to share the recommendations

Prior to the workshop the facilitators and the researcher discussed the most appropriate ways to conduct the workshop to ensure that all community health volunteers' opinions were heard and that all perspectives were welcome. The questions (and prompting questions) around each topic were then mapped.

With consent of the participants, all discussions were recorded and later transcribed independently by two of the facilitators from Thai into English. The transcriptions were later reviewed by the researcher for consistency. At various stages throughout the workshop, the group was divided into two, to allow for more in-depth discussion. This was followed by the participants sharing the small group discussion content with the larger group. At the time of the workshop, the researcher (who speaks basic Thai) spent time with each group to understand proceedings. At the end of the first day of the workshop, the researcher met with the facilitators to gain a more detailed understanding of what was discussed and areas to clarify.

Participants comprised five men and three women. All participants had been carers of children under 5 years of age, with five currently doing so. Some of the above topics were discussed as a whole group, while others were discussed in two smaller groups before thoughts were shared with the whole group.

Subsequently, 30 in-depth interviews were conducted in Thai. With consent, the interviews were recorded and later transcribed by the researcher with the assistance of three native Thai speakers (all experienced in interpreting but without formal training). The interviews were semi-structured and dialogue between the researcher and participants was in English and

Thai, with the assistance of a Thai/English interpreter. An interview guide that was developed after the workshop. This guide was followed flexibly, with questions skipped or added depending on their relevance.

In an initial analysis, data collected was analysed using the Framework approach (306). This approach was chosen as it can be used to describe and interpret what is happening in a particular setting within a relatively short timeframe (307).

Specifically, this first round of analysis used the five steps in the Framework approach, including: familiarization with the data; identification of themes (corresponding to headings in the pages that follow); identification of data relating to a particular theme; placement of the data into the themes; and creating a summary of the data. More detailed analysis will be completed later as part of the researcher's Masters of Philosophy.

The purpose of the first round of analysis and this report is to share the findings with relevant stakeholders to support the development of nutrition education.

The mountains where the Karen and Lua hill tribe communities live in Mae Chaem, Thailand

Findings and recommendations

Findings 1: Understanding of healthy child

A healthy child is one that is strong and grows well

Workshop participants agreed that a healthy child is one that is strong and grows well. To be healthy, children require food (rice was specifically mentioned), lots of varieties of food, along with boiled water, play, and warm clothes.

Participants gave the following descriptions of children who are not healthy: lack of interest in food; not active; sleeping all the time; crying without meaning; and skin sores. They felt that their children were generally healthy, and the main cause of health problems was eating the culturally forbidden foods for children. Participants generally thought that what their children ate was adequate. Participants were generally not aware of any undernourished children in the community.

In the workshop the community health volunteers were provided with information on the prevalence of child stunting and underweight in their community. After presentation of the data, workshop participants were not sure of the causes of the high rates. After prompting, participants agreed that poor feeding and poor breastfeeding could be the cause of the high rates of undernutrition.

In the interviews undertaken following the workshop, villagers were asked about their opinions on the adequacy of the diets of the children in the community. Most villagers believed that the diets were adequate and that the children were generally healthy.

A public health officer, when asked in a personal interview whether underweight children is an issue in the local communities, said that underweight issues generally surfaced when breastfeeding ceased, typically around 12 to 18 months of age.

Recommendations 1

Raise awareness about undernutrition

Members of the community do not link child size to health in the ways this is done for growth monitoring. They appear unaware of the extent of the problem of undernutrition among children living in their communities. Ways to address this include:

- Sharing information with the community about the link between a healthy child and adequate nutrition in their terms (e.g. smart child).
- A focus could be the first 1000 days of life (from pregnancy to age two), in which longer-term effects of undernutrition can accumulate and have life-long impact (308).

Findings 2: Understandings of exclusive breastfeeding

When workshop participants were asked about the benefits of exclusive breastfeeding (EBF), the responses were as follows: connecting with the child; warmth for the child; prevention of painful nipple; protection against disease; it provides all nutrition ('sarboom' – a Thai word for all encompassing health); it is clean and economical and it helps give the child a smart brain. However, discussions in the workshop, and later with villagers, revealed that there is no clear distinction between EBF and breastfeeding. As long as a child is provided with some breast milk, the child is understood to be receiving all the benefits of breast milk, therefore EBF is not seen as necessary.

Discussion of EBF practices was somewhat difficult, given the wide lack of appreciation that this meant no rice or water. There appeared to be a common understanding that breastfeeding should continue to be the mainstay until the child was 3 months of age, although water or rice was given to some children before this age. Some villagers were aware that breast milk

should be the only food until the child was 6 months old, but almost all gave water and rice from three months. Three people interviewed had not fed children rice until 6 months, but they had given them water.

The three parents who adhered the closest to the EBF recommendation were all educated to high school level and had spent time in either Mae Chaem, Chiang Mai or another community. This exposure may have influenced their practices. However, two of the three parents indicated that EBF was possible because their child was strong, while other parents may need to feed rice to strengthen their child.

Rice, but not other foods, is commonly fed to children before 6 months of age. There appears to be two main reasons for this. Firstly, there is a strong belief that the child needs the rice for growth and strength. The second reason is so that the mother can return to work (with alternative carers able to feed rice to the child while she is away). A third reason, not as often reported, was the mother experiencing pain due to breastfeeding. Other responses included: the grandparents recommending rice; the child opening his or her mouth for food; it makes the child full and sit still and to have the child practice eating. When explored in more detail, the underlying reason indicated was often the need to feed rice for strength and growth. These findings are consistent with previous studies in Thailand indicating that complementary foods are generally introduced at around three months (4, 81, 90, 108) and the Thailand National Statistical Office reported that the exclusive breastfeeding rate was 7.6% (228).

Many mothers return to work within six months of the birth, and the child will often be cared for by a grandparent

The majority of villagers were unaware that water is not recommended during the first 6 months of life. Water is often given prior to 6 months of age, supported by a belief that the child's throat needs to be cleared.

In the past, rice was given as soon as the child was born, and the elders in the communities continue to endorse this practice. Until 2004, EBF was recommended for only 3 months in Thailand, but now the recommendation is for 6 months. To some villagers, the change from immediately feeding rice to delaying for six months appears too large.

After workshop participants had deliberated about nutrition education specific to EBF, they felt that information should be shared with both men and women, so that men understand the importance of EBF and could therefore provide the support needed to achieve EBF for longer. In previous studies women who do not have support and need to return to work, have a much lower rate of breastfeeding compared to those whom are supported (90). Saving money on food and improving the baby's health were highlighted as benefits of EBF which could be used to promote EBF, specifically to men. Women participants at the workshop believed that education and support were important, as women need encouragement and support so that they can breastfeed for six months exclusively.

Recommendations 2

Promote EBF recommendations

As identified in the 11th Thai National Health Development Plan (305) the community needed to be provided with information so that they are in a position to jointly determine solutions. This information should involve consistent and clear messages about EBF, including an explanation that EBF means only breast milk for six months, not even providing a little rice or water (but see below on using small amounts of clean water, which needs to be taken into account). An emphasis on clear message is important as although the exclusive breastfeeding recommended period has increased the slow change of mothers across Thailand to adhere (4)

might suggest that the public health messages may have been confusing and the traditional practices may be hard to change. An explanation of why EBF is important should be provided in the villagers own terms. An example may be to emphasise the importance of breastfeeding so that children grow smart and strong (e.g. concept of 'sarboom').

The importance of EBF should be highlighted, including that it is recommended not only in the Mae Chaem communities, but across the entire country, and even the Royal Family have set up the Saiyairak program promoting EBF.

Develop educational messages to address the barriers to EBF for 6 months

Explain that even if the mother does not eat that well herself, breast milk is still the best and only food the child needs in the first 6 months (as the nutrients in the mother's stores will go into the breast milk).

For prevention and treatment of breastfeeding pain, appropriate advice should be given, including:

- Preventing or dealing with painful nipples, including correct attachment.
- Frequent breastfeeding and expressing of milk to stop breast engorgement.

Provide information on why rice and water should not be given before 6 months, including:

- Lack of nutrients in rice
  - Rice makes the child full and sit still, but if you want your child to grow smart and strong, then they need to have breast milk only.
  - When the child is given rice, the child is missing out on the important nutrients (which the villagers refer to as 'saanahaan') in breast milk which rice does not have. The child needs to drink breast milk only so that they get all the nutrients they need.
- Lack of immune properties in rice and water, and the cleanliness of water

  - Rice and water do not have the immune factors which breast milk has to keep the babies stomach strong from illness, so a child who is fed rice and water will more likely to get sick than a child who is fed breast milk only.
  - Water can make children sick if it is not clean.
- Lack of nutrients in water
  - Water (like rice) fills the child up without providing the nutrients they require that breast milk provides.
  - Note that if the amount of water given is small and water has been boiled, this traditional practice poses minimal risks to the child's health. EBF messages needs to take this traditional practice into account.

The above information is useful for everyone to understand the benefits of EBF for six months. However, in some situations the mother will need to return to work. In this case, information about what is best is not enough, a social determinants of health perspective indicates that we also need to address why mothers have to go to work. Further exploration is required to determine appropriate methods so that women can have respite from work for the first 6 months. The Labour Protection Act of 1998 in Thailand ensures that employed women receive three months paid maternity leave, however, this is not available for the hill tribe communities, as they do not work on an employment contract, but through family ties. Addressing this issue is not an easy task, but needs attention if the nutrition knowledge is to be translated into actions, and resulting positive nutrition outcomes.

Additionally, ways of maintaining breastfeeding while working are also considered.

Findings 3: Expressing breast milk

There was only one woman from the communities whom any participant had heard of who expressed breast milk. It was said that the woman expressed with her hand then leaves the milk out for 3 hours.

Most interview and workshop female participants, had never been taught how to express breast milk. When asked if they could try to express breast milk to keep and feed to the child later, the general response was that this was not viable as they did not have a fridge. No one was aware that expressed milk could be left outside of the fridge for up to 4-8 hours, depending on the temperature. When women were given this information, they did not believe that breast milk could remain unspoilt outside the fridge for this time period and were therefore not confident to feed expressed breast milk to their child.

The hospital and the community public health centres have some teaching resources and information on expressing breast milk, as follows:

- The pink Maternal and Child Health book, which all pregnant women receive. The book contains five small pictures of the process of expressing and storing milk in a fridge, but there is no information on storing the milk outside the fridge.
- Mae Chaem Hospital has a flipchart on breastfeeding which includes a page on expressing milk, and includes information that breast milk can be kept at room temperature for 6-8 hours.

A breastfeeding resource kit at one of the community public health centres in Mae Chaem

- The most detailed resource is in the Public Health Centre at Hin Fon. They have recently received a kit that contains breastfeeding related materials including an imitation breast, bottles to store expressed milk, and an information booklet with details on expressing and storing milk. The booklet recommends that breast milk can be stored for 6-8 hours at less than 25 ^{o} Celsius.

Temperatures may exceed 25 ^{o} Celsius in the communities. An interview with the district public health officer revealed that the practice recommended is for breast milk to be left out for a maximum of 6-8 hours in the cold season and 4 hours in the hot. This recommendation is consistent with that published by WHO/UNICEF, in which breast milk can be kept for a maximum of 4 hours at 25-37 ^{o}C (309).

Recommendations 3

Improve acceptance of expressing breast milk

It appears that expressing breast milk is not currently accepted by the villagers, and this may be partly explained by the lack of knowledge on and experience with this technique. Suggestions for improved acceptance of expressing breast milk are therefore provided below, however, we strongly advocate that the community are involved in the entire process from determining the feasibility of this practice, both with the facilities they have and within a women's current work patterns all stakeholders, need to be involved in discussions on this topic to see what is viable.

Suggestions to improve acceptance of this technique include:

- Identify role models from within the community to demonstrate the technique and provide positive experiences about expressing milk.
- Give women the opportunity to try expressing milk with support and guidance from the community including the community public health officers, nurses, community health volunteers and villagers. This will allow the women to see for themselves how it works and how long the breast milk can remain unspoilt outside the fridge.
- Villagers should be given the opportunity to learn how to feed children from a cup.
- Expressing, storing and then feeding the expressed breast milk should be trialled, with a small number of women prior to community wide promotion of the technique, to ensure the process results in the desired outcomes.

Improve information about expressing, collecting and storing breast milk

In addition to the above, supportive information should be made available, and included in all relevant resources. This should include information on:

- How to express breast milk
- How to collect expressed breast milk hygienically
- How to store breast milk outside the fridge.

Information could be adapted from the Hin Fon breastfeeding kit. It contains very good information on expressing breast milk but no advice for storage of breast milk at temperatures greater than 25 ^{o} Celsius. Therefore it would be important to adapt this to:

- Add a recommendation to store breast milk for 4 hours at 25-37 ^{o} C in the hot season.
- Add a recommendation to feed breast milk using a cup or spoon. Explain that feeding with a cup and spoon takes a little more time than feeding from a bottle, but it is much more hygienic, better for learning mouth control and encourages closer contact between the carer and child (309).

Information needs to be provided after birth at the hospital, but reiterated to the mother and father during subsequent visits to the community public health centre. The WHO's Baby Friendly Hospital Health intervention, which is based on the 10 steps to successful breastfeeding, indicates that among other things, the health care staff need to have skills to show mothers how to breastfeed and how to maintain lactation if they should be separated from their infants (i.e. express breast milk) (309). Together these two points mean that:

- Public health workers should take responsibility for arranging that mothers are shown how to express milk. Where the public health worker is a man, he may not be the most appropriate person to explain, but it is his responsibility to arrange someone who is appropriate.

Findings 4: Formula milk

The general opinion is that formula milk is full of nutrition and needs to be given to the baby. The public health officers, and some villagers, are aware that breast milk is better. Some villagers think breast milk and formula are of similar nutritional value.

Formula milk is commonly given to children in the villages

A number of families feed their children formula while others could not afford to but wish they could, as they believe that it should be given. The majority of villagers had heard about formula from others in the community and on visits to the city.

The public health officers also talked about formula as though it was an alternative to breast milk which could be recommended to mothers if they had breastfeeding problems such as low milk supply or painful breasts.

Most villagers do not feed formula as a milk drink (i.e. breast milk substitute). Instead, they use it to thicken and enrich meals of rice.

All children observed drinking formula, were fed from a teated baby bottle which is inconsistent with the UNICEF and WHO recommendation of how to feed either formula or expressed breast milk using a cup and spoon (309).

Recommendations 4

Develop educational messages to reduce the use of formula milk

The message needs to be clear in all information sources:

- Breast milk has many advantages and it is not necessary to feed formula milk.

Providing a strong message that formula milk is not necessary may help people to stop feeling that they need to buy formula. In addition, formula milk requires a reliable supply of clean water, which is not always available.

It could also be helpful to disseminate the following information:

- It is uncommon for women to be unable to breastfeed or express breast milk. By introducing formula, women are suppressing their supply of breast milk.
- Formula does not have the beneficial factors for the immune system that help stop colds and sickness in children.
- If formula is prepared with water that is not clean, children can become sick.

Not preparing the formula as per the directions can also cause problems. Formula that is too dilute will contribute to undernutrition (the baby gets full but without enough nutrition). Concentrated formula can dehydrate the baby, and cause diarrhoea. Care needs to be taken with messages about correct preparation of formula, as they could be interpreted as promoting the use of formula over breast milk.

Findings 5: The mother's eating

Responses indicated that a mother's eating is tied to cultural beliefs of what can and cannot be eaten during a child's early life. These findings are consistent with previous research in Thailand revealing that women avoid certain foods during and following pregnancy due to prohibitions and beliefs. These practices could be a major barrier to achieving adequate maternal nutrition (310, 311).

The dietary beliefs in this study varied from community to community and house to house. For instance, in one community mothers cannot eat the eggs from their own house until the child is one year old (which may impact on the amount of eggs the mother consumes).

The restrictions on the mother's eating generally apply during the first month following birth and may include prohibition of eating certain green vegetables, or certain fish, pickled items

and chilli. Some mothers cannot eat meats and are restricted to a rice soup for a month or even longer. The longest these heavy restrictions lasted was three months.

In general, the diet of women is low in variety and includes rice and one other item (usually a vegetable). The lack of food means that often there are three or four meals in a week where rice alone is eaten. In some cases, community public health staff have provided vitamins to pregnant mothers, which some mothers are consuming during pregnancy and after birth.

The villagers have small gardens during the wet season, but in the dry season many gardens do not survive

Recommendations 5

The availability of food alternatives that the villagers can plant and consume in the dry season is vital, as it is during this season that the families are often without vegetables, and often need to eat rice alone. This major issue is already being addressed through the ICRAF agriculture intervention.

While a mother is breastfeeding (including the first month following birth), it is important that she consumes a variety of foods to maintain her health and enrich her breast milk.

- Ideally, lactating mothers need to eat vegetables, fruit, meat or meat alternatives and rice every day.
- Meats include chicken, eggs, pork, fish, bird, fish, frog etc. Vegetables and fruit should include green and orange types daily.

The child needs to receive vitamins from these food sources through breast milk to grow well. The demands of pregnancy and lactation can gradually deplete the mother's stores of nutrients. Despite this, the nutrient quality of breast milk remains very high, under most circumstances (312, 313). It may be interesting in the future to obtain an in-depth

understanding of the mother's nutritional status in the hill tribe communities, and to determine to what extent this impacts on the nutritional status of children.

Low food variety is compounded by cultural beliefs of what can and cannot be eaten, often restricting breastfeeding women to very few food options during the breastfeeding period.

- A culturally appropriate diet during this period should be identified and discussed with the community.

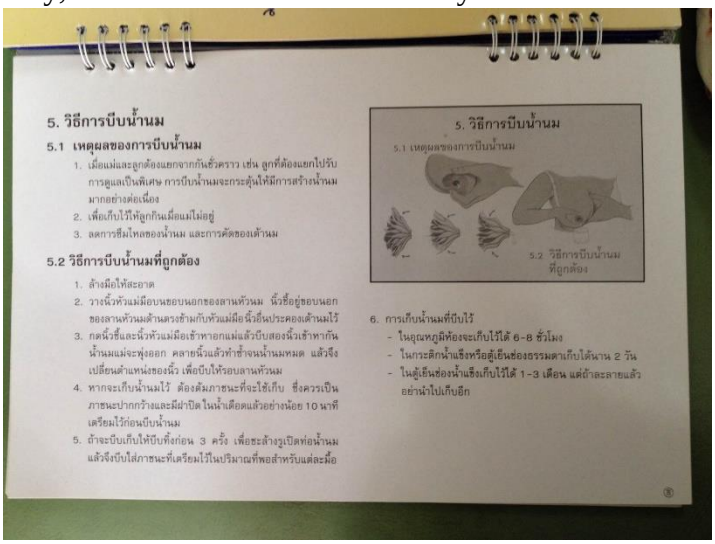
Findings 6: Nutrition information

Further information about nutrition was desired by all villagers. The villagers preferred information to be given in a community meeting rather than in individual or family meetings. They wanted everyone to be able to hear. Brochures, both written and with pictures, would also be appreciated.

When asked what language information should be in, most people said Thai was acceptable. However, some women said that they preferred their local language.

From observations of the villagers, some women speak very little Thai. Most people over 40 or 50 years cannot speak Thai. This is important to consider as parents often ask for or receive advice from their own parents (the child's grandparents), who are also involved in caring.

When asked who should provide the education, most people did not mind if it was a local person or someone outside the community, or whether it was a community health volunteer or a doctor, as long as the person had information to give and knew the topic.



A breastfeeding education flipchart used at Mae Chaem hospital

Some community health volunteers indicated that they would need further training and information brochures if they were to give breastfeeding advice to the villagers.

Workshop participants indicated that some local men may not be interested in nutrition education. They also said that drinking alcohol is a problem in some men, which can affect support in relation to child feeding.

The community health volunteer and the community public health officer are both important information sources for mothers, as their roles involve providing assistance to pregnant and lactating women.

When mothers were specifically asked who they would like to provide breastfeeding information, all women indicated a woman. Currently there are few women community health volunteers. In some communities, there are no women community health volunteers.

Recommendations 6

Nutrition information needs to be provided:

- In such a way that villagers will believe it and it is consistent with their lifestyle and beliefs.
- In order to empower women so that they can provide their child with breast milk only for 6 months, then continue to provide breast milk for 2 years and beyond.

Information on breastfeeding needs to be provided:

- By a number of sources, including both at the health system and local level.

Aspects or members of the health system that could be developed for these purposes include:

- Doctors and nurses in Mae Chaem hospital who are in contact with pregnant, postnatal, and breastfeeding women.
- The community public health officers, including visiting nurses.
- The implementation of the Saiyairak Intervention which follows the WHO/UNICEF Baby Friendly Hospital Intervention and requires that health care staff have the skills to show woman how to breastfeed and how to maintain lactation if the mother is separated from their infant.

Locally, sources that could be developed include:

- Community health volunteers, who would need training and practice. Furthermore, including at least one woman volunteer.
- Exemplar families (those who have followed close to 6 months EBF or expressed breast milk to feed the child) who are interested in supporting breastfeeding education.
- Community figure heads, such as community head men.

The ratio of men and women in the role of community health volunteers should be addressed, so that mothers are given the opportunity to speak to another woman about health issues. For those communities where there are no women community health volunteers, an appropriate woman should be identified.

Education at the community level should initially also be provided in a community meeting with the following elements:

- A figure such as a doctor, if possible, to heighten the power of the messages.

- Potentially any other figure heads (monks, priests) who are respected and supportive of the messages.
- Information to be provided in local language, to enable the entire community to hear the messages (also reinforced through brochures).
- Examples of people who have exclusively breastfed and expressed breast milk.

Finally, many of these issues are similar to those that have been documented elsewhere in Thailand. This means there are many opportunities to learn from interventions that have (and have not) been successful elsewhere. Finding ways to access and share this knowledge would be valuable.

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Appendix F: Chapter 4 further table

Table A1. Households and children from the eight villages and proportions participating in the survey

Village	Households with children 0-5 years	Participating households		Children 0-5 years in villages	Participating children	
	n	n	%	n	n	%
Ban Mae Hae Tai	93	24	25.8	87	30	34.5
Ban Pae	43	21	48.8	48	29	60.4
Ban Kong Kai	29	17	58.6	29	22	75.9
Ban Kok Noi	28	17	60.7	37	20	54.1
Ban Ho	36	22	61.1	53	28	52.8
Ban Mued Long	21	14	66.6	22	16	72.7
Ban Mae Khi Muk Noi	32	22	68.8	46	23	50.0
Ban Tung Kare	46	34	73.9	56	40	71.4
Total	**328**	**172**		**368**	**208**	

(Data source Mae Chaem Council, unreferenced)

Appendix G: Statistical analyses plan

Written by: Anna Roesler, Lisa Smithers, Vivienne Moore

Date: 27th August 2017

Overall research question

To determine if a nutrition-sensitive agriculture intervention was effective at improving dietary diversity and thereby undernutrition status of children under 5 years of age in the target villages.

Aims

The primary aim is to investigate whether there was a difference in the proportion of children meeting the recommended dietary diversity intakes between households from villages involved in the nutrition-sensitive agriculture intervention and households in control villages, at 12 months following the implementation of the intervention.

The secondary aims are to investigate whether there are differences between children in the intervention compared with the control villages 12 months following implementation of the intervention for the following; 1) the mean number of food groups consumed by children 2) the proportion of children consuming the food groups, egg, other fruit and vegetable and green leafy vegetables; 3) the mean anthropometric z-scores (height-for-age [HAZ], weight-for-age [WAZ] and weight-for-height [WHZ]) of children; 4) the proportion of children stunted, wasted and underweight; 5) the proportion of households with little or no food insecurity

Hypotheses

It is hypothesised that there will be a greater proportion of children meeting the minimum recommended dietary diversity in participating households from intervention villages compared to control villages.

It is hypothesised that there will be a greater proportion of children eating a greater variety of foods in participating households from intervention villages compared to control villages

It is hypothesised that there will be a greater proportion of children in the participating households from intervention villages consuming eggs, other fruit and vegetables and green leafy vegetables.

It is hypothesised that children in the participating households from the intervention villages will have healthier anthropometric outcomes (indicated by a higher mean height-for-age, weight-for-age and weight-for-height z-scores and proportion of stunted, wasted and underweight children) than children in the participating households from control villages.

It is hypothesised that participating households from intervention villages will have improved food security compared to control villages.

Outcome variables

The primary outcome is the proportion of children meeting minimum dietary diversity of ≥4 food groups.

The secondary outcomes will include: 1) The mean number of food groups consumed; 2) The proportion of children consuming eggs, other fruit and vegetables and green leafy vegetables 3) The mean WAZ, HAZ, WHZ using the WHO growth standards as the reference; 4) the proportion of children stunted, wasted and underweight using -2SD as the cut off; 5) and food security, measured as per the Household Food Insecurity Access Scale and prevalence (HFIAS/HFIAP) (152).

Study methods

Study design

This was a field trial comparing children and households in intervention and control villages, following implementation of nutrition-sensitive agricultural interventions. Villages and siblings were clustered. There were a total of eight villages. All eight villages were selected based on accessibility to researchers, perceived potential for change and ethnicity. There were four intervention and four control villages randomly allocated.

Pre-test of the survey instrument

To test the suitability of the survey instrument, a workshop was conducted with VHVs followed by a pre-test of the instrument in five households in a Karen village, Pang E Ga, located 86 km north of the study site.

Recruitment, inclusion and exclusion

To be eligible to participate, adults needed to be a carer of a child aged up to 5 years old, give consent for involvement, and be willing to participate in other aspects of trial/experiment. Lists of households with children under 5 years of age were provided by local governments. In order to obtain participants, village announcements were made by village health volunteers inviting carers to attend a central location in the village (accompanied by the children for anthropometric measurements). Mothers were specifically encouraged to participate, however, fathers and some grandmothers who were carers of young children also responded. The survey is thus based on convenience samples, however, the process meant that over half of children under 5 years were included in all but one village, and the anthropometric data closely align with that for all children as reported by the health office. Households were followed longitudinally and data collected 12 months following implementation of the intervention.

Intervention

In consultation with the villagers, agricultural solutions were implemented in participating households in the intervention villages in October 2014. Each household was provided with five hens (ISA-Hisex Brown), instructions on how to build chicken coups, five types of vegetable seeds (Ivy gourd, Yard long bean, Pakchoi, chilli, eggplant) for home gardening, and a nutrition education session and posters. These interventions were decided by the community in consultation with ICRAF (154). ICRAF visited participating households monthly for six months to provide agriculture and nutrition advice, and chicken feed.

Data collection

The baseline household survey and anthropometric measurements were taken in November 2013. In November 2015 a survey 12 months following implementation was conducted and anthropometrics were collected. Data was collected at the same time of year to baseline to avoid seasonal effects.

Funding

Funding was provided by a grant from the International Development Research Center to conduct a multi-site initiative in Mae Chaem plus two additional sites in upland Vietnam. The aim of the multi-site initiative was to identify local and practical solutions to improve nutrition and food security amongst smallholder farmers in rural upland communities in Thailand and Vietnam through nutrition-sensitive agriculture solutions.

Ethical Approval and consenting process

Ethical approval for the research was provided by Human Experimentation Committee Research Institute for Health Sciences, Chiang Mai University No.40/2014 (Project No. 6/57). Permission was also granted by the community via the local community leaders. The

research and the participants involvement was explained to participants prior to involvement and signed informed consent was obtained.

Trial registration and protocol

The trial was not registered however the ethical submission provides outlines of the protocol and statistical plan for analysis that were submitted and approved in May 2013.

Funding

IDRC grant number 107324

Method of treatment assignment and randomisation

Villages were chosen to be a part of the study based on proximity to Mae Chaem and ethnicity group (Karen and Lau). Random numbers were generated and assigned to each village via a computer algorithm by ICRAF staff. The two lowest random numbers assigned to a village per ethnicity group were assigned to intervention.

Intervention Masking (blinding)

It was not possible to blind the delivery of the intervention (provision of chickens etc). Staff collecting data were not blinded to whether the village was intervention or control.

Final analyses and reporting

No statistical analyses will be performed until the final version of this SAP has been approved. Any post-hoc, exploratory analyses which were not identified in this SAP will be clearly identified as exploratory.

Samples size

At the outset of the trial HealthBridge calculated the sample size needed to estimate a prevalence of 50% of children meeting the minimum dietary diversity. Due to not having any data for the population a prevalence (p) of 50% was chosen as it would provide the largest

sample size. The following formula described by Kish was used to calculate the sample size based on a prevalence of 50% (136):

$$n = (Z_{1-\alpha})^2[p(1-p)/\epsilon^2]$$

A total of 151 households were required to estimate the prevalence of minimum dietary diversity of 50% with 8% error (ϵ) and 95% confidence interval (CI) ($Z_{1-\alpha}$). To account for refusal or absence, 10% (15 households) was added resulting in 165 households.

Although the sample size was limited to 165 households for detecting the prevalence of minimum dietary diversity, HealthBridge also calculated that 165 households would be able to detect a 20% difference in minimum dietary diversity between the treatment and control groups (alpha 0.05, power 80%).

Data management

Household survey data were entered using a standardized data entry form created in EpiData version 3.1 software (EpiData Association, Odense, Denmark). ICRAF staff entered the data. The entered data was randomly checked with hard copies of the survey by AR for 10% of all surveys.

Data cleaning

Missing data was verified by double-checking survey sheets. Frequencies and histograms of data were conducted and any outlying data was verified by double-checking survey sheets, corrected any data entry errors and retained all true extreme values. For all entered data 10% of the inputted data was checked with survey hard copies by ICRAF and AR.

General issues for statistical analysis

Analysis approach

The planned analyses will be performed using intention-to treat principles. There were 16 households that did not have data collected at follow up. There were 15 households without

data at baseline (households that missed the baseline survey but received the intervention). Multiple imputation will be used to construct complete data sets.

Missing data

Multiple imputation will be undertaken using chained equations method. Fifty datasets will be created and combined using Rubin's rules (261). The treatment and control groups will be imputed separately (262), therefore calculations for determining auxiliary variables will be completed separately for both treatment and control groups. For baseline variables only the endline counterpart of the variable will be included as an auxiliary, based on previous findings (263). The suitability of auxiliary variables will be assessed using ordinal logistic, binary logistic or linear generalised estimating equations (GEE) models as appropriate. The number of auxiliary variables included in each univariate imputation model was determined based on the prevalence of the endline variable. Those variables that have the same values missing as the outcome to be imputed will not be included as auxiliary variables (314).
In the case that the potential auxiliary variable does not converge in the GEE model then a Chi square test will be used to assess association with the outcome variable. We are aware that this test does not take into account clustering, but it will give us a general approximation.
Multiple imputation will be conducted at the item-level (separate item) and not score level (composite), as item-level has been associated with increased power relative to scale-level (264). Clustering will not be taken into account in the imputation as there is little evidence that this improves the outcome estimates (265). Items that need to be imputated include (with auxiliary variables written in brackets);

- 9 food groups (9 food groups collected at other time);
- Weight and height (height and weight collected at other time, and gender and age now);
- 9 food security items (household food security items measured at other time).

The results of the imputed analyses will be considered the primary findings.

Outliers

For anthropometric z-scores anything more extreme than ±5 SD are excluded from the calculation on the basis that these values are not consistent with life (260).

Protocol violations and deviations

No household will be excluded from the intention-to-treat analyses due to not implementing the intervention or following protocol.

Potential confounders

By randomising, any imbalance at baseline must be due to chance. It is known that as children age they consume a greater diversity of foods and boys generally consume more than girls (266). To account for this we will include age and gender as confounders in analyses where diet diversity and food group consumption are outcomes. Delayed growth and risk of undernutrition (stunting, wasting, underweight) increase between 18-36 months (39, 1267, 268), to account for this age and gender have been included as covariates when anthropometric z-scores or stunting, wasting, underweight are the outcomes.

Village clustering and Sibling pairs

The analyses will take into account clustering by village and household. Although the villages are from the same region, there are differences between villages that could impact on outcomes such as the geographic location (e.g. access to water), cultural beliefs and religions. As values for siblings are correlated, children's anthropometric z-scores, diet diversity, and all other outcome data will be adjusted for clustering within household.

Descriptive statistics

Baseline characteristics

The baseline characteristics of participants, households and children will be presented in a table according to intervention and control group. For continuous variables, data will be

reported as means and standard deviations, or medians and interquartile ranges, depending on the distribution. Histograms will be generated to determine the distribution of each variable. For categorical data, number and percentages will be reported.

Baseline characteristics include:

- **Village** - Households per village included in study and not included in study; children per village included in study and not included in study;
- **Respondent** - ethnicity, age (mean), educational level (categorical- nil/primary vs above); occupation; head of household a woman
- **Children** – gender, age (mean)
- **Household (HH)** –HH size, how many children under 5 years
- **Agriculture – plant**
- Total growing area; variety of crops grown per house; number of households with each of the main three crops
- **Agriculture – animals**
- Variety of animals; number of households with each of the main three animals
- **Food security** – prevalence and scale scores
- **Dietary diversity** – For children aged 6-59 months the dietary diversity score
- **Food Groups** - Food groups based on the FAO 9 category food groups and also the percentage of children consuming formula and sugary foods.
- **Breastfeeding** - The percentage of children still breastfeeding at 6, 12 and 24 months.
- **Anthropometrics –** z-scores (mean, SD), and % wasted, stunted and underweight
- **Nutrition knowledge –** score

Calculating variables

Anthropometric z-scores: Heights of each child were converted to height-for-age z-score (HAZ), using the WHO growth standards as the reference, version 3.2.2 WHO Anthro 2011 software (WHO, Geneva, Switzerland).

Household food insecurity: Household food insecurity was categorised according to the HFIAP (153). Categories were collapsed for further analyses, with 'food secure' and 'mild insecure' combined to form 'little or no food insecurity', and 'moderately insecure' and 'insecure' combined to form 'modest or marked food insecurity'.

Dietary Diversity: For each child, foods consumed over the past 24 hours were obtained utilising a locally adapted version of Kennedy's dietary diversity questionnaire (94). A dietary diversity score was derived according to the method outlined by Kennedy et al. (94). One point was given for each of the nine food groups consumed. A cut point of ≥4 food groups indicates minimum dietary diversity (96).

Nutrition status: Dichotomise z-scores into stunted and not stunted, wasted and not wasted and underweight and healthy weight. Where less than -2SD of the reference population indicates the cut off.

Software:

All analyses will be conducted in SPSS statistics 24 (SPSS Inc., Chicago, IL, USA).

Analyses

We will use a binomial/identity mixed-effects models (and linear mixed effects models) that adjusts for follow up score on their baseline score and is unaffected by baseline differences. In the case that log/identity binomial mixed-effects model does not converge a modified Poisson approach will be used.

Primary outcomes

Dietary diversity

Outcomes: The proportion of children meeting minimum dietary diversity

Effects: The difference in the proportion of children meeting minimum dietary diversity between intervention and control groups

Analysis: log/identity binomial mixed-effects model, adjusting for clustering by including random effects for villages/HH. Predictor is the intervention group. Outcome will be meeting or not meeting minimum dietary diversity at baseline and 12 months. Covariates include age and gender. Accounting for baseline.

Secondary Outcomes

Total intake of each of the 9 food groups

Outcomes: The mean intake of the 9 food groups

Effects: The difference between baseline and 12 months of mean food groups consumed between intervention and control

Analysis: linear mixed-effects model adjusting for clustering by including random effects for villages/HH. Predictor is the intervention group. Outcome will be intake of 9 food groups. Covariates include age and gender. Accounting for baseline.

Other fruit and vegetables, green leafy vegetables and egg

Outcomes: The proportion of children who have consumed the following food groups: other fruit and vegetables, green leafy vegetables and egg

Effects: The difference in the proportion of children consuming a food from each of the food groups between intervention and control

Analysis: log/identity binomial mixed-effects model, adjusting for clustering by including random effects for villages/HH. Predictor is the intervention group. Outcome will be consumed or not consumed and covariates of age and gender. Accounting for baseline.

Anthropometric z-scores

Outcome: The mean z-scores at 12 months (assumption: normal distribution).

Effect: The difference in the mean z-scores for intervention versus control.

Analysis: linear mixed-effects model adjusting for clustering by including random effects for villages/HH. Predictors will be intervention. Outcome will be mean z-score. Covariates include age and gender. Accounting for baseline.

Nutrition status

Outcome: The proportion of children stunted, wasted and underweight at 12 months

Effect: The difference in the proportion of children stunted, wasted and underweight in the intervention compared to control.

Analysis: log/identity binomial mixed-effects model, adjusting for clustering by including random effects for villages/HH. Predictors will be intervention. Outcome will be stunted and not stunted and covariates of age and gender. Accounting for baseline.

Household food security

Outcomes: The proportion of children from households with household food insecurity of 'little or no food insecurity' and 'modest or marked food insecurity' at 12 months.

Effect: The difference in the proportion of households who are food secure and food insecure in the intervention group compared to control.

Analysis: log/identity binomial mixed-effects model, adjusting for clustering by including random effects for villages/HH. Predictors will be intervention. Outcome will be 'little or no food insecurity' and 'modest or marked food insecurity' and accounting for baseline.