Justus-Liebig-Universität Giessen
Fachbereich Agrarwissenschaften,
Ökotrophologie und Umweltmanagement
Institut für Ernährungswissenschaft

Dissertation

Ernährungssituation in Nord-Laos – Determinanten der Unterernährung und Veränderungen nach vier Jahren intensiver Interventionen

Eingereicht von:

Dipl. oec. troph. Silvia Kaufmann

aus Alsfeld

Betreut von:

Prof. Dr. Claus Leitzmann

Giessen, Oktober 2008

Justus Liebig University Giessen
Faculty of Agricultural Science, Nutritional Science and
Environmental Management
Institute of Nutritional Sciences

Dissertation

The nutrition situation in Northern Laos – determinants of malnutrition and changes after four years of intensive interventions

Submitted by:

Dipl. oec. troph. Silvia Kaufmann

Alsfeld

Supervised by:

Prof. Dr. Claus Leitzmann

Giessen, October 2008

Table of contents

List of tables

List of figures

List of abbreviations

ACC/SCN	United Nation's Administrative Committee on Coordination / Sub-Committee on Nutrition
ADB	Asian Development Bank
AIDS	Acquired immune deficiency syndrome
ANOVA	Analysis of variance
ANCOVA	Analysis of Covariance
ARI	Acute respiratory infections
BCG	Bacille Calmette-Guérin, vaccine
BMI	Body-mass-index
BMZ	Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung (Federal Ministry for Economic Co-operation and Development)
CDC	Centers for Disease Control
CDR	Child death rate
CFSVA	Comprehensive Food Security and Vulnerability Analysis
CIA	Central Intelligence Agency
CMR	Child mortality rate
DAFO	District Agriculture and Forestry Office
DEO	District Education Office
DGLV	Dark green leafy vegetables
DHO	District Health Office
DPT	Diphtheria, Pertussis, Tetanus
DSE-ZEL	Deutsche Stiftung für Entwicklung - Zentralstelle für Ernährung und Landwirtschaft
EPI	Expanded Programme on Immunisation
EC	European Commission
FANTA	Food and Nutrition Technical Assistance
FAO	Food and Agriculture Organisation
FIVIMS	Food Insecurity and Vulnerability Information and Mapping Systems
GDP	Gross Domestic Product
GoL	Government of Lao PDR
GTZ	Gesellschaft für Technische Zusammenarbeit (Agency for Technical Cooperation)
HAZ	Height-for-age z-score
HIV	Human Immunodeficiency Virus
HDI	Human Development Index
ICCIDD	International Council for the Control of Iodine Deficiency Disorders
IDD	Iodine deficiency disorders
IDR	Infant death rate
IFPRI	International Food Policy Research Institute
IFSP	Integrated Food Security Programme
IISD	International Institute for Sustainable Development
IMF	International Monetary Fund
IMR	Infant mortality rate
Inwent	Internationale Weiterbildung und Entwicklung
IRRI	International Rice Research Institute
IU	International unit
IUNS	International Union of Nutritional Sciences
IUCN	The World Conservation Union
IYCF	Infant and young child feeding

Lao PDR	Lao's People's Democratic Republic
LECS	Lao Expenditure and Consumption Survey
LNAS	Lao Nutritional Assessment Survey
LBW	Low birth weight
MDGs	Millennium Development Goals
MI	Micronutrient Initiative
MoAF	Ministry of Agriculture and Forestry
MoH	Ministry of Health
MSG	Mono-sodium glutamate
MSF	Médecins Sans Frontières
NAFRI	National Agriculture and Forestry Research Institute
NCHS	National Centre for Health Statistics
NNP	National Nutrition Policy
NSC	National Statistical Center
NTFP	Non-timber forest products
NWSEHP	National Water Supply and Environmental Health Programme
ODI	Overseas Development Institute
SCN	Standing Committee on Nutrition
SE	Standard error
SEAMEO	Southeast Asian Ministers Education Organisation
SD	Standard deviation
SIWI	Stockholm International Water Institute
SMART	Standardized Monitoring and Assessment of Relief and Transition
TBA	Traditional Birth Attendant (trained)
UN	United Nations
UNAIDS	United Nations Programme on HIV/AIDS
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFPA	United Nations Fund for Population Activities (since 1987: United Nations Population Fund)
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations (International) Children's Fund
UNSIAP	United Nations Statistical Institute for Asia and the Pacific
UNU	United Nations University
USAID	United States Agency for International Development
USA	United States of America
USD	United States Dollar (currency of the United States of America)
VHW	Village Health Worker
WAZ	Weight-for-age z-score
WFP	World Food Programme
WFS	World Food Summit
WHO	World Health Organisation
WHZ	Weight-for-height z-score

1 Introduction

1.1 Subject and objectives of the study

The purpose of the study was to identify determinants of malnutrition and analyse the interventions used for its alleviation in two districts in Northern Laos. The primary goal was to contribute to a better understanding of malnutrition, its causes and to identify effective interventions and, thus to contribute to more effective nutrition programming. To reach the goal, two major objectives were defined:

The first objective was to analyse the nutritional situation, i.e. the magnitude and severity of the nutritional problem and to identify the most important determinants of malnutrition. This was based on information derived from a field survey conducted prior to the implementation of community-based interventions. The accomplishment of the first objective involved:

- assessment and analysis of nutritional status;
- assessment and analysis of potential direct, indirect and basic causes of malnutrition;
- identification of the relationship between outcome (nutritional status) and causes of malnutrition (determinants).

The second objective was to analyse changes in the nutritional status vis-à-vis at direct and indirect causes of malnutrition. This was realised by comparing the situation before the start of the community-based intensive interventions with that four years later. The accomplishment of the second objective involved:

- analysis of changes achieved at the outcome level (nutritional status and mortality) and comparisons to national and international trends;
- analysis of changes achieved at the level of potential causes (e.g. food security, health status, healthy environment and access to health services);
- identification of interventions that were effective in contributing to the change in malnutrition rates.

The study was based on three assumptions: First, that malnutrition and poverty were widespread within the target area and that the situation was far worse than the national situation on average. This was to confirm that the nutritionally most vulnerable populations benefit from programme support. Second, that while poverty and malnutrition within the given environment were closely related, economic improvements would not automatically translate into better nutrition. Third, that malnutrition would be reduced significantly over the programme implementation period. The identification of interventions that contributed to those changes was important to gain understanding for improved nutrition programming but also to attribute changes to the impact of the programme.

Based on UNICEF's causal model of malnutrition (figure 1) a context-specific conceptual framework was developed, which provided the basis for the study design (figure 2, p. 15).

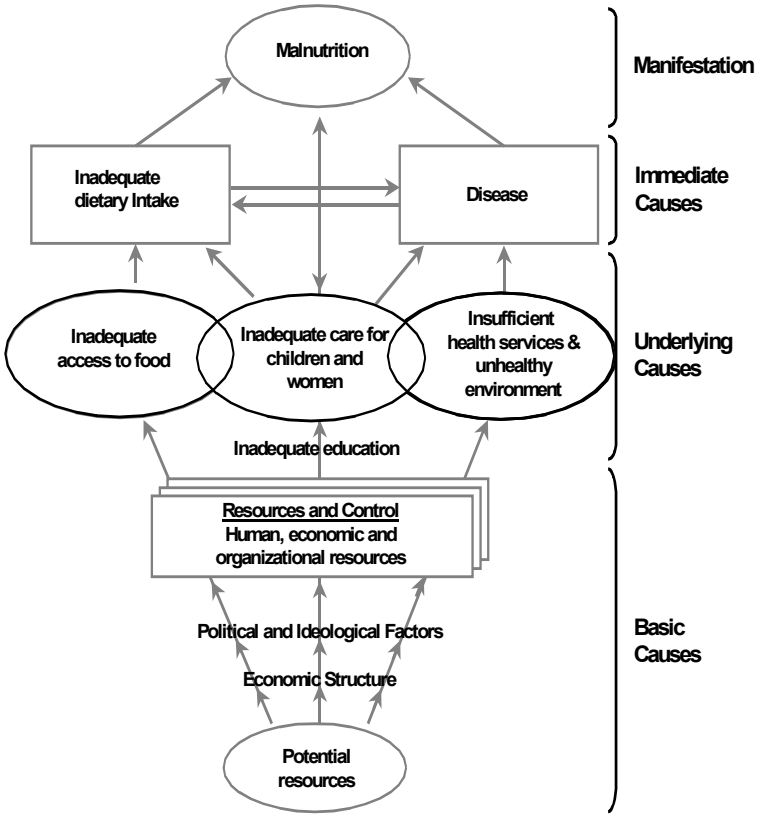


Figure 1: Conceptual framework of malnutrition (adopted from UNICEF 1990, p. 22)

1.2 Conceptual framework of malnutrition

1.2.1 Introduction to the framework

UNICEF developed and published the causal model of malnutrition in 1990 (UNICEF 1990, p. 19-22). It shows the multi-sectoral dimension of malnutrition and the different levels involved. The framework aims to structure potential causes to provide an explicit and unified perspective on the nature of malnutrition and to bring greater coherence and rationality towards the alleviation of malnutrition worldwide (World Bank/UNICEF 2002, p. 1-2). The framework provides guidance for the systematic analysis of the nutrition situation and underlying factors and areas for interventions as a basis for policies and actions (World Bank/UNICEF 2002, p. 16). Furthermore, the framework was also sought to guide the design of future case studies seeking to document and analyze the process of change (UNICEF 1990, p. 7; World Bank/UNICEF 2002, p. 1). The framework was not meant to be prescriptive but should provide a generic and a conceptual model (UNICEF 1990, p. 22; World Bank/UNICEF 2002, p. 15). This means that the relative importance of the various factors would differ by time and specific to the given context (figure 1).

The causal model classifies causes of malnutrition into immediate or direct causes, underlying or indirect and basic causes. Malnutrition and mortality indicate the manifestation of multi-sectoral problems (UNICEF 1990, p. 19-22). A person's food intake and health status are classified as the direct causes of malnutrition. Underlying causes are classified into three major categories 1) lack of availability or inadequate access to food or household food security, 2) inadequate care, which refers mainly to care for children and women and 3) insufficient access to health services and unhealthy environment (UNICEF 1990, p. 21; Shoham, Watson and Dolan 2001, p. 12; World Bank/UNICEF 2002, p. 2-3; FAO 2005, p. 8-12; UNICEF no date, p. 7-8). Causes determining the level of underlying causes are classified as basic causes, which mainly refer to resources made available by the different levels, household, community or a nation, to ensure good nutrition.

Relations and examples

Each level again is an outcome of other factors and the different factors are interrelated. This also implies that actions affecting one area may have significant consequences on others (UNICEF 1990, p. 22; FAO 2005, p. 10-11). I.e. inadequate dietary intake is seen as a direct determinant to malnutrition on the one hand. On the other hand, food intake itself is an outcome of various factors such as access to food or households caring capacity, also an individual's health status impacts on food intake. Interventions to increase efficiency of food production could contribute to an increase in access to food directly, but may also show a positive impact for example on the household's caring capacities through a release in time. The re-allocation of time on household matters, such as i.e. more time spend on proper food preparation or more favourable hygiene practices would impact on malnutrition as well. Also causalities can be in both directions, i.e. malnutrition increases the risk to infections, and, vice versa, infections contribute to malnutrition.

Strengthen focus on nutrition, poverty and policy change

Almost simultaneously to the discussion around the framework, internationally more attention was drawn to the integration of nutrition matters in development policies and strategies. The International Conference on Nutrition held in 1992, the World Food Summit (WFS) in 1996, the Millennium Development Summit held in 2000, all agreed on the common goal to combat malnutrition and formulated declarations and actions. The importance to address food security and nutrition in conjunction with poverty reduction measures was clearly emphasised. A consensus was achieved in halving poverty, hunger and malnutrition by 2015 (as formulated by the WFS and set as target under MDG 1, FAO 1997; FAO 2001, p. 2; UN 2008, p. 10). They also stressed the importance, for the nutrition sector, to break out of isolation and shift towards inter-sectoral approaches and better coordination to ensure sustainable results (FAO 1997; UN 2008, p. 50).

Consensus existed over the fact that planning and implementation of prioritised actions were required to face most dominant, often multi-sectoral problems, effectively. Structured, context-specific assessment and analysis of the different potential causes of malnutrition are a pre-requisite for such a focused process (Shoham, Watson and Dolan 2001, p. 20; World Bank/UNICEF 2002, p. 2). Furthermore, the summit and conferences emphasised the importance to monitor

progress of target achievements. The development and harmonisation of methodologies and strategies for the regular assessments of selected country and context-specific food, nutrition and poverty indicators are a first step towards a functional tracking and process monitoring (FAO 1997; FAO 2005, p. 1-6). Integration of nutrition indicators into monitoring and evaluation systems is a pre-condition to focus efforts, to use resources efficiently for better outcomes and impacts (FANTA 1999, p. 1-5).

Potentials of nutrition indicators

There is a relatively clear consensus on how to measure malnutrition. Measurements to calculate indices are taken at individual level, based on which the nutritional situation of a population is calculated and expressed mainly as the proportion of individuals being malnourished (FAO 2005, p. 8).

The relatively simple and standardised methodology allows obtaining the required information at reasonable quality and accuracy within a reasonable time span. The well-standardised methodology makes systematic comparisons of different data sets possible, hence allows for meaningful comparisons between population groups or nations. However, the use of international references that are valid for all countries and cultures is a pre-condition (Sainju 2001). Nutrition indicators have the potential to support the design of nutrition as well as multi-sectoral development or poverty oriented policies cost-effectively, they can help to set priorities and to advocate appropriate resource allocations (Setboonsarng 2005, p. 5-7). Selected nutrition indicators furthermore proved to be effective to track impacts of medium and longer-term development programmes (Devereux et al 2004; FAO 2005, p. 10-18; Setboonsarng 2005, p. 9-10).

Integration of nutrition into food security and development efforts internationally

During the 1990s the GTZ's food security programmes also included nutrition specific interventions and promoted the assessment of the nutrition situation to provide a baseline as well as a tool to measure impact (GTZ 1989, p. 21-31; Gross 2000, p. 13; DSE-ZEL 2000 p. 1-6; GTZ 2002, p. 5 and 19). At present, a number of donors and development organisations, among them DFID, ADB, EC as well as and Oxfam promote the inclusion of nutrition into food security, poverty and livelihood concepts and advocate proper and harmonised assessment prior to the start of such

programmes (Oxfam 1995, p. 686-87 and 898-905; Care International 1996, p. 5-10 and 168-174; Bouis and Hunt 1999, p. 168-172; Shoham, Watson and Dolan 2001, p. 17, 24 and 30; Devereux et al 2004, IISD 1995; EC 2008, p. 3-8). FAO recommends the inclusion of nutrition matters into the national food insecurity and vulnerability information and mapping systems (FIVIMS) and recommends the use of the conceptual framework (Shoham, Watson and Dolan 2001; Devereux et al 2004). WFP in collaboration with national governments and UN sister agencies take actions to mainstream nutrition and to define the reduction of malnutrition as a strategic objective (WFP 2004a, p. 5-12). Nutrition is integrated into their comprehensive food security and vulnerability analysis (CFSVA) system, nutrition indicators are applied to measure programme outcomes and for annual reporting as part of the results based management (WFP 2004b, p. 64-69; WFP 2005a, p. 14-15; WFP 2006a, p. 8-9). UNDP includes malnutrition in the calculation of the human poverty index (Shoham, Watson, and Dolan 2001, p. 27-28) and malnutrition is a key indicator to assess the situation and progress of the MDG 1 in reducing poverty and hunger by the year 2015 (UN 2008, p. 10).

1.2.2 The different levels of the framework – content and indicators

Outcome level

Nutritional status

The nutritional status, the physiological state of an individual, is the outcome and the manifestation of factors occurring at different levels. It is a function of energy and nutrient intake (supply) and requirements to ensure growth and maintenance. This includes the body's ability to digest, absorb and use the nutrients provided. Malnutrition is the cellular imbalance between supply and demand (FAO 2000, p. 26; FAO 2007).

Different nutritional indicators express different problems with regard to nature, severity and duration of the nutritional problems. Anthropometric body measurements are feasible, relevant and significant to support an inter-sectoral problem analysis and to evaluate changes. In contrast, assessing the micronutrient status is more demanding in terms of resources and also more invasive, and therefore less

advisable to be applied for community based cross-sectional studies (FAO 2005, p. 19-34; WFP/CDC 2005)

Chronic malnutrition (stunting)

Stunting or low height-for-age reflects failure to achieve normal linear growth. It is the result of a sub-optimal nutritional condition, health and/or food intake over a longer period of time. It is assumed that in children below the age of 2-3 years, low height-for-age probably reflects a continued process of 'failing to grow' or 'becoming stunted'; for older children, it largely reflects a state of 'having failed to grow' or 'being stunted' (WHO 1995, p. 164), while it is assumed that damages are not reversible beyond the age of 24 months (World Bank 2006, p. 55). High prevalence rates of stunting within a population are generally associated with poor socioeconomic conditions and increased risk of frequent and early exposure to adverse conditions such as inappropriate feeding practices and/or illness. Correspondingly, a decrease in the rate of chronic malnutrition is usually indicative of improvements in overall socioeconomic conditions and people's living standard. Therefore, it is frequently recommended as the key indicator to measure and express a population's general food insecurity and poverty level persistent over a longer period of time (Susilowati and Karyadi 2002; Martorell, Mendoza and Castillo 1988; Gross 1997; WHO 2001).

Acute Malnutrition

Acute malnutrition, wasting or low weight-for-height expresses 'thinness' of a child, and calculates weight in relation to its height. Acute malnutrition reflects a recent and severe process that has led to significant weight loss, usually as a consequence of acute or recent starvation and/or severe diseases. Low evidence of wasting does not necessarily imply the absence of a chronic nutritional problem, as chronic malnutrition or other nutritional deficits may exist simultaneously (WHO 1995, p. 164). Acute malnutrition is frequently used as the key indicator to assess the nutritional situation within the context of an emergency (Sphere 2004, p. 134, 138, and 183; SMART 2006, p. 12 and 26). The level of malnutrition serves as the basis for making decisions on design and implementation of immediate nutrition specific interventions (WHO 2000, p. 75; Sphere 2004, 134-138).

Underweight

Underweight or low weight-for-age is a result of either low height-for-age or low weight-for-height. It reflects body mass relative to age and is used to give an immediate overview of the nutritional status of an individual child. This indicator is frequently used for growth monitoring (WHO 1995b; WFP 2002, p. 33), thus, often easily available at national level and therefore frequently applied for situation analysis or comparisons. Underweight is the common indicator to track the achievement of MDG 1 target that aims to halve underweight by 2015 (UNSIAP 2004).

Mothers' nutritional status

Chronic dietary energy deficiency indicated malnutrition in adults and is classified as showing a body-mass-index (BMI) below 18.5 kg/m^2 (WHO 1995, p. 361). Malnutrition in adults impairs physical performance and affects working capacities (Soares et al 1991). Malnourished adults work fewer hours and show reduced productivity. Working capacity and productivity (output) decreases with a decrease in body weight while the risk for mortality and illnesses increases (Shetty and James 1994; ACC/SCN 2000, p. 18-19). Birth weight and neonatal mortality rates are related to maternal characteristics. I.e. neonatal mortality increases as maternal weight decreases (Sevenhysen and Gebriel 1988). Underweight women are at higher risk of giving birth to low birth weight babies (Naidu, Neela and Rao 1991). Particularly the BMI of women reacts sensitively to changes in the availability of food and physical activity levels and a change in BMI demonstrates social and economic transformation (Ferro Luzzi et al 1992; WHO 1995, p. 347 and 361), making it a useful indicator for assessing the situation of a potentially high-risk population. The BMI distribution within a population can provide valuable information for the planning, targeting and evaluation of long-term development programmes.

The present study applied chronic malnutrition of children as the key indicator. Potential causes are tested to show an effect on chronic malnutrition and it is used as the indicator to identify the impact of changes achieved over the four years of programme implementation. However, other nutrition indicators like acute malnutrition, underweight, chronic dietary energy deficiency of mothers as well as clinical signs of anaemia and iodine deficiency disorders are analysed to describe the nutritional situation of the population.

Mortality

Worldwide, it was estimated that at least half of all child death was attributed to malnutrition (Pelletier et al 1995; WHO 1997, p. 6; Black, Morris and Bryce 2003; Bryce et al 2005). Global changes in the prevalence of underweight show a statistically significant effect on changes in child mortality, independent of socio-economic and other conditions (Pelletier and Frongillo 2003). Malnutrition and infection is a synergistic vicious cycle (Tomkins and Watson 1989, p. 2; WHO 2001, Pelletier et al 1995). Malnutrition leads to prolonged and more severe infections, and repeated and prolonged infections cause malnutrition and increase the risk of mortality. The link between malnutrition and mortality is due to impaired immunity which results in a higher case fatality rate (Black, Morris and Bryce 2003). Malnutrition and child mortality is closely related, consequently mortality rates also allow conclusions about the nutritional conditions of children (Alam, Woityniak and Rahaman 1989).

Direct causes of malnutrition

Food intake

Following the conceptual framework, the lack of adequate dietary intake is defined as a direct cause of malnutrition. Methodologies and indicators to assess households or individual's food intake under field conditions are not yet well standardized. The assessment of energy intake derived from staple foods is simple in its application, hence feasible for community-based studies, but not sufficient to reflect about the quality of a diet. Established methods, such as a household's food frequency or a 24 hour recall would reflect well about the quality and adequacy of a diet. Such methods, however, are complex and resource intensive. If applied under difficult circumstances, results obtained are often too imprecise to reflect the situation adequately. Much research was carried out over the previous decade to elaborate, standardise and promote methodologies, specific and sensitive enough, and still feasible to be applied under field conditions (Hoddinott and Yohannes 2002, p. 3-4; IFPRI 2002, p. 6 and 42-47; WFP 2005b, p. 67-93; FAO 2005 p. 18-23 and 57-58; FAO 2007b; Dop et al 2007).

In the 1980s a method was developed which assesses dietary diversity. Dietary diversity is defined and assessed as the number of different foods or food groups

consumed over a defined period of time (Guthrie and Scheer 1981; Shimbo et al 1994). The 'dietary diversity', also known as the 'food diversity' is expressed as a 'score', the 'dietary diversity' or 'food variety' score. During sub-sequent years, the method of assessing food diversity was developed further. Evaluations showed that the methodology allows to draw conclusions on household as well as on individual food consumption. It is simple in its application and therefore highly feasible for field level assessments (Krebs-Smith et al 1987; Hodgson et al 1994; Hatloy, Torheim and Oshaug 1998; Hoddinott and Yohannes 2002, p. 4-5; IFPRI 2002, p. 32-35; Ruel et al 2004; Dop et al 2007).

Dietary diversity reflects well about the quality of a diet, and, hence, about a household's access to food. Furthermore, the method is simple in its application. As a result, the assessment of dietary diversity was strongly promoted by international lead agencies. In combination with additional information, such as the number of meals, food sources, household's food production and economic situation, a cause analysis on matters related to food security can further be enhanced (Swindale and Ohri-Vachapati 2004, p. 3-8; WFP 2005b, p. 68-91; FAO 2007b)

The present study used the food diversity methodology combined with information on food sources, the number of meals, quantity of staple food consumed and the diversity of side dishes to assess the family's dietary intake in 1997.

Morbidity

Infectious diseases cause malnutrition and malnutrition makes a person more susceptible to diseases and increases the risk of death (Mueller and Krawinkel 2005). Tomkins and Watson described this close interaction between malnutrition and infections as the 'malnutrition and infection cycle' (Tomkins and Watson 1989, p. 2; Pelletier et al 1995; WHO 2001). Inadequate dietary intake leads to weight loss, lowers the immune status, causes mucosal damage and impairs growth. Malnutrition increases incidence, severity and duration of diseases. A sick person's nutrition is impaired by malabsorption, loss of appetite, diversion of nutrients for immune response etc. which, in turn, results in a reduced dietary intake (Tomkins and Watson 1989; Katona and Katona-Apte 2008). It is also shown that fever increases energy and micronutrient requirements, that diarrhoeal diseases and parasite infections result in an additional loss of nutrients, hence increase requirements, and that

malaria and influenza have mortality rates proportionate to the degree of malnutrition (Mueller, Garenne and Kouyate 2003; Friedman 2005, Katona and Katona-Apte 2008). The four diseases, diarrhoea, pneumonia, malaria and measles, are strongly correlated with malnutrition, and account for 35% of child deaths worldwide (Bryce et al 2005, Black et al 2008). They are often fatal, particularly for the poor, because they do not have adequate access to proper care and health facilities that help reduce mortality (Kaler 2008).

Indirect causes of malnutrition

Food security and livelihood

In the 1970s and early 1980s food security was mainly understood as a matter of food supply and availability, attention was mainly drawn to the national dimensions of food security. In the mid 1980s a distinction of a more generic term of food security, the concept of household food security emerged. Here, the importance of access or entitlements to food was recognised as a critical aspect determining a household's food security situation (Maxwell and Frankenberger 1992, p. 10). There were numerous definitions for household food security, however, the common definition largely accepted was formulated by the World Bank in 1986: "*Access by all people at all times to the food needed for an active and healthy life.*" (World Bank 1986, p. 1). This would include elements of food availability and a household's access to food, comprising of agricultural production such as food as well as cash crop production, gardening, livestock, access to food markets, income opportunities, purchasing power etc. The definition and concept was broadened during the World Food Summit in 1996 by including the use of food at the household level as an additional dimension: *"food security, at the individual, household, national, regional and global levels is achieved when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.*" (Rome declaration, FAO 1997). This definition clearly includes the dimension of availability, access as well as utilization of food. It includes households continued access to food (stability), consumption of adequate food, food diversity, intra-household food distribution, seasonal changes, processing and storage, knowledge on nutrition and child caring as well as access to adequate health and sanitation services (Gross et al 2000; FAO 2005, p. 52-58).

Assessing food security is still a major challenge, and methodologically extremely difficult. Methods in use are highly subjective, as their accuracy depends on respondent's perception and willingness to record over sensitive matters such as household's assets or wealth. Consequently, food security information often lacks accuracy, which also makes comparisons of populations and nations more difficult (Jonsson 1997; FAO 2005, p. 32).

Poverty, food insecurity and malnutrition are closely interrelated; the conceptual framework defines poverty as a determinant of food insecurity and malnutrition (Frankenberger 1996; Smith and Haddad 2000, p. 5-7). A person is in 'poverty', when being unable to satisfy basic needs adequately. Here basic needs refer to food, health, water, shelter, primary education and the capability to participate in the overall development process. People in extreme poverty are unable to achieve food security; they lack adequate resources for care and are hindered to make adequate and sustainable use of their resources (Islam 1997; Smith and Haddad 2000, p. 7). However, in a vicious cycle, malnutrition also leads to poverty (Osmani 1997, p. 23). Malnutrition makes people more vulnerable, reduces their capability and productivity and is an additional economic burden for a family, i.e. through increased expenditure on medical treatment. Malnourished children suffer from damages in both, mental and physical development, with socio-economic consequences throughout their lives. Also, children growing up in poverty rarely have the chance to go to school, thus again, contributes to passing on poverty to the following generation (IFPRI 2000).

To describe the food security situation, the present study assessed the agricultural production system, rice sufficiency, livestock, gardening and fish farming as well as households annual cash income, additionally the possession of commodities and housing conditions were applied as proxy-indicators.

Water, sanitation, environmental hygiene and access to health services

This includes the availability of and access to sufficient water for drinking and household use, it includes a clean and hygienic environment, general aspects of people's life style, such as i.e. a household's sanitary and hygienic conditions. Furthermore it includes the access to and use of preventive and curative health care services effective to ensure a healthy development, i.e. prevention of diseases and early treatment easily available, immunisation, support to safe deliveries, deliveries

attended by trained health staff etc. (UNICEF 1990, p. 20; Jonsson 1997; FAO 2005 p. 10-11 and 62-66; UNICEF no date, p. 7).

The present study assessed aspects of access to purified water, a household's sanitary conditions and access to health services.

Care and caring practices

Caring capacity is another key factor determining child malnutrition. It usually refers to care for women and children (UNICEF 1990, p. 19-20; UNICEF no date, p. 7), because they are the most vulnerable groups. It includes a range of mother-child caring practices and a households caring capacity. The latter is primarily determined by the household's labour force available and time allocated to caring, and the level of education and knowledge in life skills. But it also includes attitudes and practices of other community members towards those most vulnerable. Where food security and access to health services are ensured and malnutrition still persists, it is often attributable to sub-optimal caring (UNICEF 1997; Engle, Bentley and Pelto 2000; Arimond and Ruel 2001, p. ii-iii; FAO 2005, p. 10). Generally, indicators on caring practices are difficult to assess through a cross-sectional and standardised quantitative study design, the assessment of practices and behaviours would require a more qualitative study design to show meaningful results (FAO 2005, p. 10).

The present study did not assess caring practices comprehensively, but focused on selected aspects of caring as a component of related sectors. I.e. Infant and young child feeding practices were assessed and presented as part of the food intake, hygienic behaviour and use of health services as part of the health sector, and the effect of literacy as part of basic causes.

Basic causes of malnutrition

Following the causality given by the conceptual framework, underlying or direct causes are an outcome of basic causes. Basic causes comprise aspects of access, use and control of resources. This refers to human, organisational and economic resources within a household, but also to the situation within a community or a nation. It also refers to the way such resources are used to ensure food security, care, a healthy environment and good services. It includes the existence of formal

and non-formal institutions relevant to community welfare, political and ideological factors, economic structure and potential of natural and human resources that affect the utilisation of food (Smith and Haddad 2000, p. 7; Hahn 2000, p. 6-7; Inwent 2005, p. 6-10). They include elements of good governance, such as management of population's access to resources, distribution of resources, efforts to alleviate poverty and social inequalities, governance of macro-economic growth, structural adjustment policies, urban migration etc. (UNICEF 1990, p. 21; World Bank/UNICEF 2002, p. 3; FAO 2005, p. 10 and p. 66-71). Within a given context the provision of services through the government also include education and health, but also agricultural sector support and marketing, and infrastructure investments might be the most relevant basic factors determining a household's food and nutrition situation.

The present study focused on the effects of basic causes within households. A systematic assessment of potential determinants at community level was not the objective of the study. Also, it was an assumption, that the population studied lives under traditional and stable conditions, transitions and changes happening, apart from the programme support, were of longer term and less dominant on the changes over the study period. However, secondary information was analysed and integrated in the discussion of results.

The generic conceptual framework, sectors and indicators presented above provided the basis for the design of the baseline survey in 1997. Additionally technical and context-specific information was applied to develop a context-specific model (figure 2). Food security, within the present study, refers to the physical and economic access to food sufficient in quantity and quality, which is a pre-requisite to ensure nutrition security. Nutrition security, within the present study includes access to food combined with adequate health, access to health services and a healthy environment, and when adequate caring capacities ensure a healthy life for all household members, while the nutritional status of children is the core indicator for nutrition security.

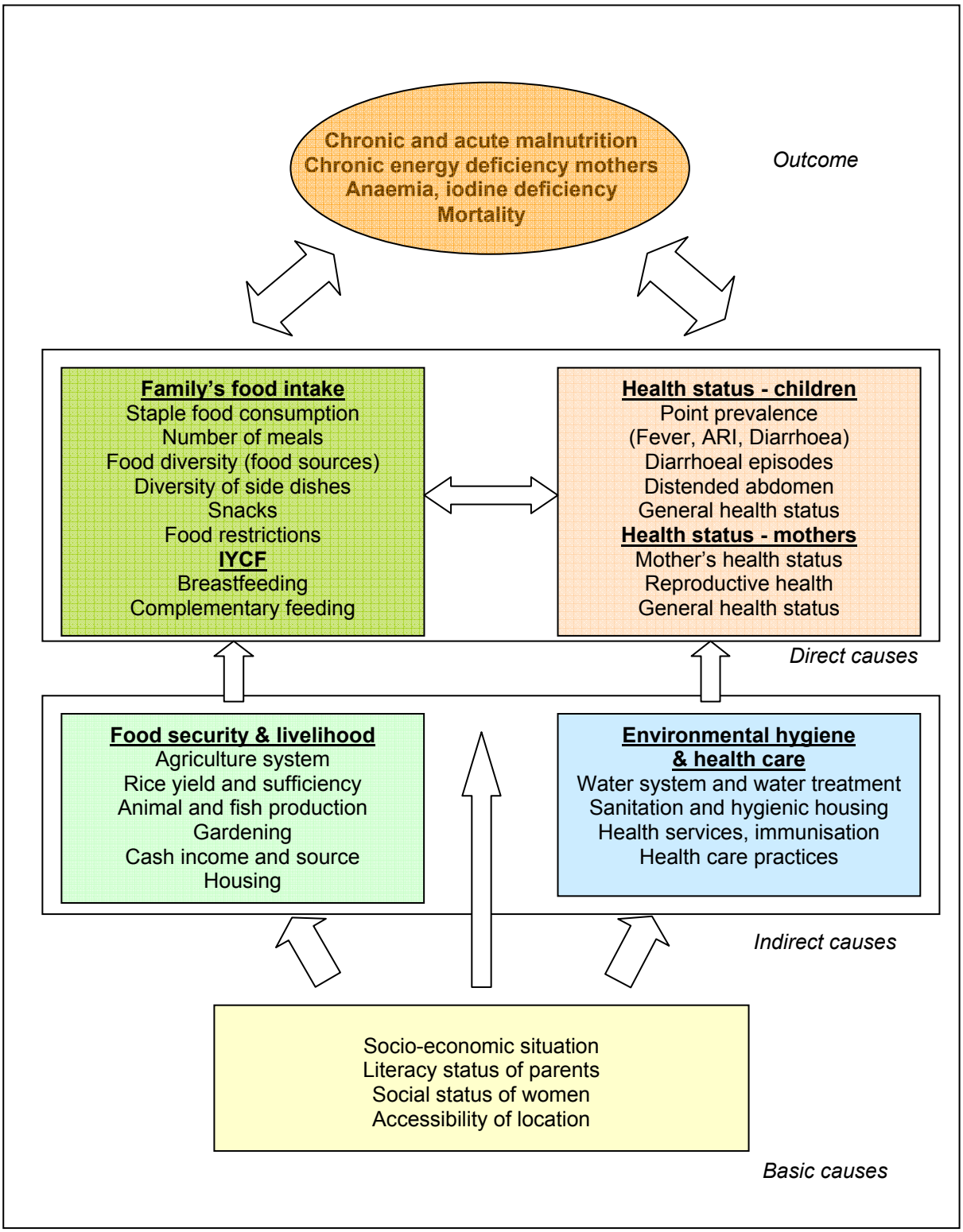


Figure 2: Context-specific conceptual framework, levels and sectors assessed (adopted from UNICEF 1990, p. 22)

1.3 The global nutrition and food situation and trends

Malnutrition

Despite the release of conventions and declaration during recent decades, malnutrition does not get the necessary public and political attention required for its effective alleviation (WHO 2001; IFPRI 2005, p. 16; EC 2008, p. 5). Even at present about one third of the pre-school children worldwide are chronically malnourished, about 10% suffer from acute malnutrition (Black et al 2008). However, a positive trend was observed since the 1980s when nearly half of the world's children suffered from chronic malnutrition. A reduction to one quarter by the year 2005 was estimated by WHO in 2000 (de Onis et al 2004). Despite the improvements since the 1980s, those targets were not achieved. Regional disparities are large and more than two-thirds of the chronically malnourished children live in Asia (table 1).

Table 1: Global and regional trends in chronic malnutrition from 1980 to 2005 (in %, absolute numbers in brackets, applying NCHS reference)

Regions	1980	1985	1990	1995	2000	2005[1]
Africa	38.8 (32.6)	37.8 (36.4)	36.8 (39.4)	35.8 (41.3)	34.9 (43.6)	33.9 (45.5)
Asia	54.1 (175.1)	48.4 (169.2)	42.8 (162.0)	37.3 (135.9)	32.2 (115.3)	27.4 (96.4)
Latin America & Caribbean	23.4 (12.2)	20.1 (10.8)	17.1 (9.4)	14.5 (8.0)	12.3 (6.8)	10.3 (5.7)
Developing countries	48.1 (221.3)	43.3 (216.3)	38.5 (208.6)	34.0 (182.2)	29.8 (161.0)	25.9 (140.5)

(Blössner, de Onis and Morris 2001; de Onis et al 2004a; de Onis et al 2004b).

[1] Applying the new WHO growth standards those rates translate into 40.1% for Africa, 31.3 for Asia, 16.1% for Latin America and 32% for all developing countries, more recent data were not yet available in 2008, Black et al 2008)

Forecasted trends for the next 20 years estimate that overall stunting rates will continue to decrease from 29.8% to 16.3% in 2020, but progress will be unequal in different regions. Asia and Latin America and the Caribbean are foreseen to improve at the highest rate, while minor improvements were predicted for Africa. The total number of malnourished children is expected to rise from 44 million in 2000 to 48 million in 2020 (Blössner, de Onis and Morris 2001). IFPRI gives, depending on projected changes in determinants, three scenarios on the change in malnutrition

rates. The status quo scenario projected 18% malnutrition in 2020 or 22% under the pessimistic scenario and 15% under the optimistic scenario (Smith and Haddad 2000, p. 77-82).

The global prevalence rate of acute malnutrition was 9.4% in 1995, when 50 million children were affected (ACC/SCN 2000, p. 11), recent estimates based on new WHO growth standards released similar numbers (55 million, Black et al 2008). Prevalence rates were similar for the African and Asian continent; the rate for South East Asia was estimated at 10.4% (ACC/SCN 2000, p. 11).

The rates for underweight declined steadily since 1980, when 37.4% of the children were underweight compared 31% in 1990 and 26.7% in 2000, thus, between 1990 and 2000 rates declined by about 4%. For 2005, a prevalence of 24.3% was predicted (ACC/SCN 2000, p. 10; Blössner, de Onis and Morris 2001). The recent MDGs report published in 2007 did not indicate any new development but reported 26% underweight for the year 2006 (UN 2008, p. 10). The absolute numbers were estimated to decrease from 150 million in 2000 to 138 million in 2005 (Blössner, de Onis and Morris 2001). Meeting the MDG targets requires a further reduction of 12% to 16% by 2015 (World Bank 2000; UN 2008, p. 10). Prevalence rates were almost similar for Africa and Asia, while the absolute numbers are nearly three times higher in Asia. Still the trend in Africa was an increase in prevalence and consequently in numbers as well, while prevalence rates declined substantially for Asia (ACC/SCN 2000, p. 10).

A cross-country analysis by IFPRI published in 2000 showed that among underlying determinants of malnutrition, increases in women's education contributed most to the recent reduction and accounted for 43%. Improvements in national food availability contributed 26% to the reduction in child malnutrition, and improvements in environmental health accounted for 19%. A little but substantial improvement was seen in women's status; still, its contribution was 12%. Income was an underlying factor, and it was calculated that 7.4% of the reduction in child malnutrition between the 1970s up to 1995 was attributable to the increased income (Smith and Haddad 2000 p. 55-56; FAO 2001).

Low birth weight (LBW, defined as < 2.5 kg body weight at birth) is an indicator of inadequate foetal intra-uterine nutrition and a strong predictor of subsequent growth and well-being (ACC/SCN 1997, p. 8). In 2004 about 13 million children were born with low birth weight due to intrauterine growth restrictions, accounting for 11% of all children born alive at full term (Black et al 2008). Rates are particularly high in South Central Asia and lower for South East Asia (20% and 7% respectively, Black et al 2008). Low birth weight is the main cause for stunting and a main factor contributing to the continued intergenerational cycle of poverty, disease and malnutrition (de Onis, Blössner and Villar 1997; ACC/SCN 2000, p. 5). Stunting, severe wasting and low birth weight was estimated to be responsible for 2.2 million child deaths per year (Black et al 2008).

Iron deficiency in infants and children is associated with impaired physical and cognitive development. Iron deficiency in adults leads to weakness and reduced physical capacity and productivity. In pregnant women it contributes to maternal and foetal morbidity and mortality, and increases the risk of low birth weight (ACC/SCN 1997, p. 34; UNICEF/UNU/WHO/MI 1999; MI and UNICEF 2001). Iron deficiency is the most prevalent nutritional deficiency worldwide, between 40% and 50% of pregnant women and pre-school children suffer from iron deficiency anaemia (Black et al 2008).

Iodine deficiency during pregnancy increases the risk to neonatal complications and mortality for the foetus, congenital anomalies, cretinism and psychomotor defects. Iodine deficiency leads to the development of goitre, hypothyroidism and retarded mental and physical development. About 15% of the population in developing countries lack adequate iodine (Black et al 2008), 43 million were estimated to be affected by some degree of brain damage (Delange p. 90, 2003). In South East Asia 12% of the population suffer from goitre (ACC/SCN 2000, p. 28).

Vitamin A deficiency causes changes in the surface of gastro-intestinal, respiratory, excretory and reproductive system, which leads to a disorder of the immune system and increases the risk of severe diseases and mortality. Consequences of severe deficiencies involve the visual system, lead to dryness and disruption of the conjunctiva and cornea (ACC/SCN 1997, p. 27; MI and UNICEF 2001). Clinical signs of vitamin A deficiencies are indicated by the presence of night-blindness, Bitot's

spots, corneal xerosis or ulceration and xerophthalmia related corneal scars. About 40% of children are growing up with insufficient vitamin A, about one quarter of the world's population is estimated to suffer from vitamin A deficiencies. Such deficiencies were estimated to be responsible for 0.67 million child deaths, which translates into about 6.5% (Black et al 2008).

The extent of folic acid deficiencies, expected to be a significant cause of anaemia in pregnant women, especially in Africa is not well known (ACC/SCN 1997, p. 40-41). Low levels of folate at conception increase the risk to birth defects (Black et al 2008).

The prevalence of zinc deficiency received more attention during recent years. The association between zinc deficiencies and chronic malnutrition was identified in the late 1990s but was discussed controversially (Hambidge 1997; Rivera et al 1998). Latest data from national studies show a correlation between inadequate dietary supply and prevalence rates of chronic malnutrition (Black et al 2008). Pregnant women in developing countries are likely to be at highest risk, particularly due to chronically low zinc intakes (ACC/SCN 1997, p. 42). Zinc deficiencies in children result in a higher risk for diarrhoeal diseases, pneumonia and malaria, zinc deficiencies are estimated to be responsible for 0.45 million child deaths, about 4.5% of all child deaths (Black et al 2008).

In total, about 3.5% of child deaths were attributable to maternal and child malnutrition, this accounts for 3.5 million child deaths (Black et al 2008). The Lancet series evaluated a number of nutrition specific programmes for its effectiveness to alleviate child and maternal malnutrition. It was concluded that the promotion of breastfeeding, appropriate complementary feeding, vitamin A and zinc supplementation and the management of severe acute malnutrition were recommended as priority areas for future intervention. Pregnant women and children, starting from conception up to two years of life, were the recommended core-target groups to fight malnutrition and its consequences (Bhutta et al 2008; Bryce et al 2008). Allen and Gillespie reviewed the cost-effectiveness of approaches and recommended to intensify large scale community based programmes for growth promotion and the alleviation of micronutrient deficiencies as priority options, they, furthermore, stressed the importance for intersectoral approaches to achieve better and sustainable outcomes (Allen and Gillespie 2001, p. 89-93).

Hunger and food

Halving hunger by 2015 is one of the two targets of the MDG 1. It calculates the proportion of the population consuming less than the minimum energy requirements of 2100 kcal per day (UNSIAP 2004). Hunger remains a devastating problem for the majority of the poor nations and seriously affects their peoples' well-being (Blössner, de Onis and Morris 2001; Black et al 2008; EC 2008, p. 2). FAO's estimations show that there was no progress in alleviating hunger, the number of hungry people declined by only 3 million, from 823 in 1990-92 to 820 million in 2003, with the largest proportion in the Asian-Pacific region. Particularly most recent trends are of concern, between 1990/92 and 95/97 the number was reduced by 26 million, but increased by 23 million thereafter (FAO 2006, p. 8). Comparing the proportional trends instead of absolute numbers the picture is different. The proportion of undernourished people was reduced by 3% from 20% to 17% of the world's population, but the proportional decrease was not able to offset the population growth. Achieving the MDG 1 requires a reduction from 20% to 10%, reaching WFS targets would even require a reduction to 7% by 2015 (Wilcock 2001, p. 14-15; FAO 2006 p. 12).

Food situation

The calculation of people suffering from hunger is largely based on the food and energy supply situation at national level. Also, food is one of the three pillars to nutrition security, along with good care and health. In turn, improved nutrition supports the food production sector by enhancing people's capability, working capacity and productivity (Braun v 1999, p. 42; World Bank 2006, p. 66). Over the last three decades world food production has grown faster than the population, energy supply rose from 2110 kcal to 2680 kcal in developing countries and from 2410 kcal to 2800 kcal in the world as a whole but there are regional disparities (FAO 2001, p. 8). In 1992 a person in the developed world consumed one third more energy than a person in the developing world (FAO 1996, p. 11). Cereal production is the major component of food production and cereals provide 60% of the dietary energy in developing countries with even higher figures in poorest countries (Cohen 2000, p. 5). In 1999, for example, the cereal production was more than adequate to meet requirements (FAOSTAT 2000; Cohen 2000, p. 6; IFPRI 2001, p. 1-3).

In 2020 the world population is estimated to reach 7.5 billion, an increase of 25% compared to the 1999 population of 6 billion, 98% of the projected growth will take

place in developing countries (Carney 1999; IFPRI 2001 p. 1; Pinstrup-Anderson, Pandya-Lorch, Rosegrant 2001, p. 10). Urbanisation and rising incomes will lead to a shift from cereal and root/tuber based diets to more luxury foods such as meat, milk, fruits, vegetables and processed foods (Cohen 2000, p. 6). Between 1967 and 1997 the consumption of meat in developed countries rose from 60 kg to 76 kg per year. In developing countries it doubled from 11 kg to 24 kg per person and year (IFPRI 2001, p. 13) and there is strong evidence that it will progress rapidly (Cohen 2000, p. 7; IFPRI 2001 p. 130-134). Also livestock consumes a growing share of the food production worldwide (IFPRI 2001, p. 16 and p. 61). In 2001 it was projected by IFPRI that the global demand for cereal will increase by 45% and meat by 55% by the year 2020 (Pinstrup-Anderson, Pandya-Lorch and Rosegrant 2001, p. 11). About 90% of this increase will be required in developing countries; reasons are the growing population, increase in income and increased demand of animal fodder. Provided appropriate agricultural investments, political will and supportive policies, the food supply in 2020 can be adequate to meet the needs of the growing population (Cohen 2000, p. 16; IFPRI 2001, p. 147-151; Rosegrant 2002, p. 44-49).

However, since early 2008 the world food situation deteriorated and has resulted in a crisis around the globe. Food prices increased drastically, rice prices, for example, tripled between January and April 2008. Reasons for the global change are a sharp increase in demand, possibly due to the shift in dietary habits and also through the increased demand for bio-fuel, high energy and fertiliser prices, and a short fall in production in major export countries. Effects of climate change may also play an increasingly important role. False policy decisions seem to be the major underlying factor. Again, people particularly in low-income and food-deficit countries are suffering most. Immediate political decisions are required to correct the actual food situation and to avoid a rise of hunger and malnutrition in poorest countries. (EC 2008, p. 2-8; World Bank 2008, p. 5-9).

The overall projection is that global food supply can keep pace with nutritional requirements, but food insecurity will remain persistent in low-income countries unless equal access and proper utilisation is secured. International organisations responsible for matters related to food and nutrition security concluded earlier that concentrated efforts are required to improve the situation at local levels, investments in agriculture, irrigation, rural roads, markets, clean water and also education, health

and matters related to caring practices should receive highest attention (Rosegrant 2002, p. 48; FAO 2001; Cohen 2000, p. 8 and 15; World Bank 2007, p. iiv).

Poverty situation

The World Bank defined poverty as an inability to ensure a minimum standard of living (Felice 2003, p. 40). More broadly poverty is defined as the inability to satisfy basic human needs, whereas basic needs are defined as sufficient quality and quantity of adequate food, health care, including drinking water and basic sanitation, basic education, access to local resources, participation in cultural and social life and decision making (Donnison 1982; Gross 1997; Schöneberger 1999, p. 298). In 1996 the OECD/DAC adopted a set of targets focused on raising the standard of living, human development and well-being. The goal formulated was to half the number of people living in extreme poverty by 2015. Here, extreme poverty refers to the percentage of people living on less than 1 USD a day (Carney 1999, Hanmer, Healey and Naschold 2000). Progress of the last 30 years shows that the goal could be attained. Between 1990 and 1998 poverty reduced from 29% to 24% and is projected to decreased to 22% by 2008 under the less optimistic scenario and to 12% under the optimistic scenario (IMF 2000, p. 18). Substantial improvements in social indicators have accompanied growth in average incomes. Infant mortality rates have fallen from 107 per 1,000 live births in 1970 to 59 in 1999 (IMF 2000, p. 2). On average, life expectancy rose by four months each year since 1970. Primary school enrolment is increasing, also showing narrowed gender disparities, with the female-male difference in net enrolment rates decreasing from 11% in 1980 to 5% in 1997. Adult literacy also rose from 53% in 1970 to 74% in 1998 (IMF 2000, p. 2). In contrast, only one third of the world's population is on the track to achieve the safe water goal (UNDP 2006).

1.4 Food and nutrition security assistance within the German Development Co-operation

Food security and poverty reduction were priority areas of the German development policy in recent decades. Until the 1970s food aid was the most common approach of the German government to assist developing countries to tackle food shortages. During the 1980s food security measures began to focus on the household and individual levels, considering the dimensions of access, vulnerability and entitlement,

and calling for multi-sectoral and multi-level nutrition planning (Bellin-Sesay, Dresruesse and Pfeifer 1999, p. 602). Food security was no longer perceived as a shortfall in food supply only. Programmes of Food Security Policy Advise (FSP) assisted countries to formulate national food strategies with the aim to incorporate food security into the national development policies. Programme Aid was a food aid contribution to cover structural food deficits and was mainly carried out through the German Institute for Agriculture and Nutrition (BLE), WFP or GTZ. Emergency food aid was commonly used as first assistance when natural disasters, war or crisis appeared and was mainly implemented through German NGOs, GTZ, WFP or through the UNHCR. "Food Security Programmes" aimed to overcome an acute food crisis. During the 1990s, there was a shift to broaden the concept towards food and nutrition security. IFSPs were the common instrument to contribute towards those targets (Bellin-Sesay, Dresruesse and Pfeifer 1999, p. 610-13; Gross et al 2000). IFSPs were usually targeted towards disadvantaged population groups in areas of structural, chronic and/or acute nutritional insecurity and where local institutions were non-existent or too weak to re-act to the sudden crisis appropriately. Thus, IFSP's followed a twin track strategy. First, aiming to stabilise the nutrition situation through short-term and direct implementation. Second, ensure a continued and sustained development process through long-term measures (BMZ 1997, p. 7-9). According to context and problems identified a set of interventions were possible, including food/cash for work or labour intensive employment schemes, training or extension services, measures to increase and diversify food production, to increase off-farm income opportunities or to improve use and utilisation of food through support to health and educational activities (Bellin-Sesay, Dresrüsse and Pfeifer 1999, p. 610-613; BMZ/GTZ 1997, p. 25-26).

1.5 The situation in Lao People's Democratic Republic

Geography and population

Lao People's Democratic Republic (PDR), located in South East Asia, is a land-looked country covering 236,800 km^2 and borders on Burma, Cambodia, China, Thailand and Vietnam. The Mekong, the biggest river in the country, forms a large part of the western boundary with Thailand. Most of the country is mountainous and thickly forested, some plateaus and plains, showing extreme elevation between 2,817 m and 70 m at the Mekong River. Only 4% of the land surface is arable land, of

which 2,169 km^2 are under irrigation during the rainy season and 750 km^2 are under irrigation during the dry season. Floods and droughts are a hazard to the natural environment. Deforestation and soil erosion damaged the environment during recent decades. The country has a tropical monsoon climate with strong rainfalls from May till September/October followed by a dry period lasting from November till May/April cumulating in a very hot period. These variances allow only one annual harvest in large parts of the country (CIA 2002; EIU 1999).

The total population in Laos is estimated to be more than 5.9 million inhabitants (GoL 2008). Despite the high infant mortality rate (91 deaths/1,000 live births) and the low life expectancy at birth (53.9 years), the high fertility rate (5.03) results in a rapid population growth. The population is growing at an annual rate of 2.47% and is estimated to reach around 10 million inhabitants by the year 2030 (CIA 2002). Lao PDR is characterised by a young age structure, 43% of the population is younger than 15 years old (figure 3). A map of the country is presented in annex 1.

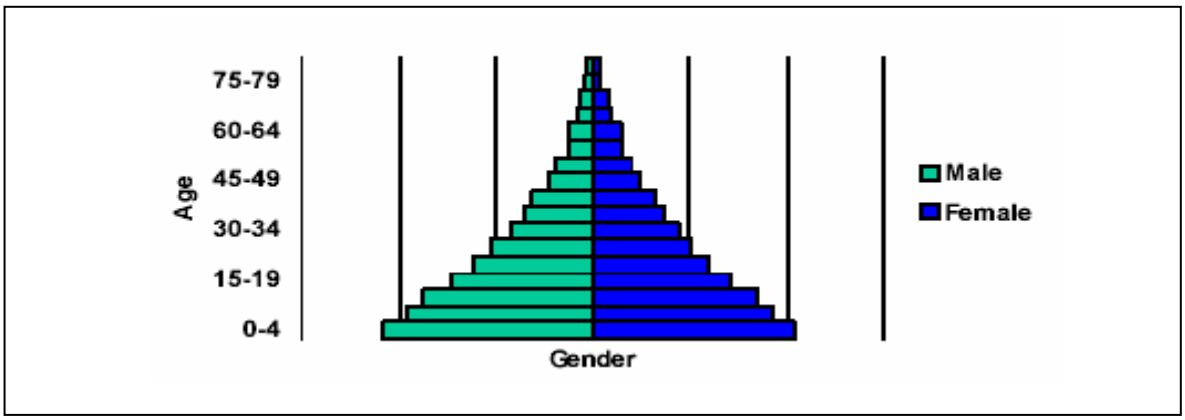


Figure 3: Population pyramid of Lao PDR (UNAIDS/WHO 2002, p. 3)

The country is sparsely populated with an estimated average of 25 persons/km^2 in 2000, 65% of the population lives in lowland areas, particularly along the Mekong (GoL 2008). The government recognises the existence of more than 100 sub-ethnic groups, the National Edification Committee classified 49 official groups in 2000. They are divided into 4 main ethno-linguistic groups (GoL and ADB 2006, p. 1-2):

1) The Lao-Tai, formerly classified as Lao Loum or 'low-landers', represent approximately 65% of the population. They live in lowland areas, mainly in the

Mekong basin, cultivate paddy, are integrated into the local economy and, largely, speak the official national language (Lao).

2) The Austro-Asiatic or Mon-Khmer group, formerly classified as Lao Theung or 'slope-dwellers', represent approximately 25% of the population. They live mainly at middle hill areas, practice shifting cultivation and their livelihood relies largely on forest resources. They are perceived as the original inhabitants of South East Asia and speak the Mon-Khmer language, some have a close relationship with the Lao-Tai culture. The 'Khamu' as well as the 'Lamet' are the largest sub-groups of the Austro-Asiatic group and are the major ethnic group in Nalae district, followed by the 'Lue' a sub-group of the Lao-Tai.

3 and 4) The Hmong-Mien and Sino-Tibetan groups, formerly referred to as the Lao Sung, or high-landers, represent approximately 10% of the total population (7.4% and 2.6%, respectively). They live on high mountain slopes, practice shifting cultivation and speak different languages belonging to the Tibeto-Burmese groups of languages. They originated from Southern China and Vietnam. Major sub-groups are the Hmong (or 'Meo'), the Yao ('Mien') and the Akha. The population living in mountainous location in Sing district belong mainly to the Akha ethnic group and, lower in number, also members of the Hmong group.

Agricultural production and food security

Agriculture remains the major sector of the economy, contributing 52% of the Gross Domestic Product (GDP), and providing more than 80% of the total employment. Rice is the main crop produced, 84% of the arable land is under rice production (UNDP 2001, p. 169-171; Boupha 2008). The majority of farmers are subsistence rice cultivators. Of a household's total rice stock, 87% were used for own consumption, 5% for seeds and roughly 8% for marketing (UNDP 2001, p. 13).

About 96% of the rice produced is glutinous rice, commonly called 'sticky rice', which has its centre of origin in Lao PDR and Northern Thailand (UNDP 2001, p. 42 and 76). Permanent agriculture is mainly practised along the Mekong river valley in central and southern areas, generating most of the national production. Here, the

introduction of improved higher yielding seeds, the increased use of agrochemical products and mechanisation is progressing. Still, irrigation areas are limited and three quarters of the rice is cultivated under rain-fed conditions (UNDP 2001, p. 168-169). About one third of the rice is cultivated in upland areas, within a traditional 'shifting cultivation' or 'slash-and-burn cultivation' system characterised by a rotation period of production and fallow (UNDP 2001, p. 171). Numerous different dry rice varieties are cultivated in the upland fields. Within in the last few decades, the average rotation cycle showed a significant decline from 10 to 20 years to 5 to 7 years. An inter-cropping system is applied and allows the simultaneous production of a wide range of other crops, fruits and vegetables, and herbs or spices (NAFRI, NAFES and NUOL 2005, p. 109).

The rice production practiced is susceptible to climatic variability and floods or droughts which are common in Lao PDR. Towards the end of the 1990s, the government frequently requested emergency food aid from international donors (UNDP 2007). Aiming to achieve self-sufficiency is a priority of the National Food Security Strategy (GoL 2000), small and large scheme irrigation were promoted and received proportionally large financial national and international support. Most important non-rice but food crops are maize, peanuts and soybeans. Most important cash crops are tobacco and coffee. Animal raising is practiced, for own use, consumption or ceremonials, or as an additional source of cash income, most common animals are cattle, goat, pig, sheep, and poultry (FAOSTAT 2002). In upland and remote areas the sale of opium is a source of cash income, while forestry foraging is also widely practised in these areas. Overall, the forestry sector contributed around 4.5% to the GDP in the early 1990s and was still a leading export earner by the end of the previous decade (EIU 1999).

Food security in Lao PDR is mainly described as ‘rice sufficiency’ (GoL and ADB, p. 80). The National Food Security Strategy (2000 to 2010) addresses rice production with the aim to increase energy intake, non-rice food production or food diversity matters are not part of the policy (GoL 2000). Also among villagers, ‘rice in-sufficiency’ is the most frequently expressed concern hindering their well-being. Population groups most susceptible to chronic food deficit are mainly located in upland areas, though there are also some vulnerable groups in the lowland (GoL and ADB 2000). The national annual food deficit amounts to approximately 1.5 months.

Unlike the large rice deficits in upland areas, the lowland people suffer from chronic food shortage only shortly prior to the harvest. In remote locations, household's access to food is extremely poor, accompanied by poor access to other resources to ensure adequate health and nutrition. Approximately 1.5 million people are chronically food insecure, the same numbers of people live below the food poverty line of 2001 kcal per capita and day (GoL-LECS 1999).

Poverty situation

The government of Lao PDR began decentralising control and encouraging private enterprise in 1986. The results were striking, growth starting from an extremely low base, but grew by an average of 7% between 1988 and 2001, following a steady trend, with an exception of a short-lived drop caused by the Asian financial crisis beginning in 1997. Despite this high growth rate, it remains a country with a simple infrastructure; it has no railroads, a rudimentary road system, and limited external and internal telecommunications. Electricity is available in only a few urban areas. The estimated per capita income was among the lowest in the East Asian region (400 USD per capita in 1997). Agriculture, services and industry were the major sectors making up the GDP (52%, 25% and 22% respectively, CIA 2002). Almost half of the population live below the poverty line (Kakwani 2001, p. 2). Poverty incidence in the rural areas is higher, and northern areas are more affected than central and southern areas (Boupha 2008, p. 5 and 8; Kakwani 2001, p. 6 and 9-10; NSC 2002, p. 18). In earlier times, inequality among population groups was lower than in other countries in South East Asia, but increased towards the end of the 1990s (Gini-coefficient 32.6% in 1992/93 and 37.1% in 1997/98, NSC 2002, p. 12). Thereafter disparities did not increase further (GoL 2001; Boupha 2008, p. 7-8). Still, the increase in inequality measured earlier showed that economic growth had not been spread across all population groups.

Social indicators in Lao PDR were among the lowest compared to other countries in the region. The literacy rate was estimated at 57% and gender gaps were significant (female 70% and male 44%, UNESCO 2006). Only 53% of the students have access to complete primary school education, and the gross secondary school enrolment rate was around 30% (UNESCO 2006). Quality of education is a concern, particularly for ethnic groups living in remote and mountainous areas (GoL and ADB 2006, p. 2). The coverage of medical facilities and preventive health care was limited and

remained of poor quality. The estimated number of people living with HIV/AIDS at the end of 2001 was 1,300 adults (15-49 years) with 350 being women and approximately 100 children under the age of 15 years (UNAIDS/WHO 2002, p. 2). Infant mortality (96/1,000 live births), child mortality (107/1,000 live births) and maternal mortality (530/100,000) rates were among the highest in the world. More than half (56%) of the population lack access to safe potable water supply, especially in rural communities (NWSEHP 2000, p. 2). Most of the people rely on surface sources or unprotected springs, which can easily become contaminated, with serious health consequences.

Malnutrition is a public health concern throughout the country and acute problems were on the rise by the end of the 1990s. It affects members of ethnic minorities and people living in rural areas more seriously than members of the major ethnic groups or those residing in lowland areas (Phimmasone et al 1996; WFP 2006b, p. 11 and 99; de Loof 2001, p. 81-107). Micronutrient deficiencies were common. About 27% of the school-aged children and 13% of women in the reproductive age are iodine deficient (GoL- NNP 2008). The production and use of iodised salt started in the 1990s, one third of the households used iodized salt in 1996 and almost all households consumed iodised salt early 2000 (Coppens, Phanlavong, Keomoungkhoune 1999; MoH 2001, p. 83; FAO 2003, p. 22). Almost half of the pre-school children were estimated to be vitamin A deficient (GoL-NNP 2008). Signs of vitamin A deficiency were prevalent in the past (nightblindness rate 0.7% for children 24 to 71 months, 5.0% and 5.4% for pregnant and lactating women, respectively, MoH 1995, p. 1 and 20). Low consumption of vitamin A-rich foods combined with low intake of fats were major risk factor for the development of such deficiencies, an association to chronic malnutrition was not evident (Schweigert et al 2003). The national vitamin A supplementation programme started in 1996. Anaemia prevalence was high in the capital of Vientiane (55.8% among women in the reproductive age, MoH 2000) as well as throughout the country (37% among women in the reproductive age and 41% of pre-school children, GoL-NNP 2008). Low bioavailability combined with high rates of infections, particularly malaria and parasite infections were assumed to result in higher rates of anaemia among rural populations (FAO 2003, p. 24).

For decades, a lack of institutional responsibilities was a major constraint hindering progress towards better nutrition (Kachondham and Dhanamitta 1992; WFP 2006b, p. 30). This combined with a lack of technical capacities might be the root causes for the low political commitment. A nutrition action plan as well as a work plan were drafted in 1996 and 1997 (GoL 1995; MoH 1997) but not followed up, which resulted in weak or partial implementation. The National Nutrition Policy (2008-2020), released in June 2008, is the first official document declaring to combat malnutrition. Based on the policy the national nutrition strategy and a nutrition work plan is foreseen thereafter (GoL-NNP 2008).

> In Lao PDR 46% of the population live below the poverty line, 30% below the food poverty line, 48% of the children suffer from growth retardation, 19% of the adults from chronic energy deficiency. Geographical and ethnical disparities are vast, while ethnic groups in remote areas are disadvantaged.

1.6 The Lao-German Integrated Food Security Programme (IFSP) Nalae and Sing district, Northern Laos

A sustainable upland development strategy effective to overcome food insecurity and, through that, to initiate a development process among disadvantaged population groups, was a rising concern of the Government of Lao PDR early to mid 1990s. Negotiations between the Lao and German Government in 1994 resulted in an agreement on an overall programme concept as well as technical and financial support. From 1995 to 2001, the German Federal Ministry of Economical Cooperation through the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) and the German Development Service supported the Ministry of Health (MoH) of the Lao PDR for the implementation of the Integrated Food Security Programme (IFSP) in Nalae and Sing district, in Luang Namtha province, Northern Laos (annex 1). Members of the Austro-Asiatic and the Hmong-Mien ethnic group formed the majority of the target group in Nalae and Sing district.

The IFSP followed a twin track strategy. First, the programme aimed to implement measures to directly alleviate malnutrition, to improve living conditions and to initiate

a sustainable development process among the vulnerable population groups. Second, based on evidence and experience gained through the direct implementation, the programme aimed to contribute to a national upland development strategy, effective and feasible for its transfer to and implementation in other areas of the country (GTZ 1994; GTZ 2002)

The multi-sectoral programme supported the sectors of agricultural production, primary curative and preventive health care, primary and non-formal education, as well as the construction of community and agricultural infrastructure. Reductions of opium demand and supply were additional components in Sing district (GTZ 1994; GTZ 2002). Chronic malnutrition of children as well as mortality were applied as the indicators to evaluate the outcome of the programme. A detailed description of the programme approach and implementation structure is presented in annex 2a.

A participatory planning approach was applied including representatives of the target group as well as government officials into the planning process and workshops. The results of the 1997 nutrition survey were applied to analyse the nutrition situation and helped to prioritise and adjust programme interventions. It also provided a baseline for programme evaluations (GTZ 2002; Bechstedt 2000). A logical framework was developed defining the overall goal, programme purpose, results and indicators for each level (annex 2b).

For evaluation purposes, a matrix was developed presenting the determinants of malnutrition identified at baseline and translated into corresponding interventions, indicators and the recommended methodology for monitoring and evaluation (annex 2b, matrix). The matrix structures the indicators of the different sectors by their level of impact intended by the programme. Those levels are described by the availability, access, utilisation and adaptation of services or interventions, its benefits and overall programme goal (annex 2b, figure 1).

2 Methodology

The study is based on data derived from two cross-sectional surveys. The first survey was conducted in 1997 before the start of IFSP's intensive inter-sectoral and community-based interventions. The second survey was conducted in 2001, at the end of the programme cycle and four years after the start up of the IFSP support. To minimise seasonal influences both surveys were conducted during the same season of the years, January to May. In order to minimise biases and variance in results, and by that, to increase the probability to detect changes that occurred over the study period, the same villages were surveyed.

2.1 Sample size calculation and procedure of data collection

The sample size calculation allowing to identify differences between two studies was based on a WHO recommendation (WHO 1983, p. 30-34; Fleiss 1981, p. 38-42; GTZ 1989, p. 65-70). Also more recently the formula is recommended for pre-post nutrition assessments aiming to identify differences in nutritional status (WFP/CDC 2005, p. 72-73). A one time survey aiming to present a given situation would require a smaller sample size only.

Sample size calculation applied for the present study:

$$n = \frac{DEFF \times 6.175 \times ((p_1 (1 - p_1) + p_2 (1 - p_2))}{(p_1 - p_2)^2}$$

n = number of individuals, sample size
p_1 = estimated prevalence at baseline
p_2 = estimated prevalence at endline
DEFF = Design effect

The calculation of a representative sample size was carried out for all three nutrition indicators, chronic and acute malnutrition in pre-school children as well as chronic dietary energy deficiency in non-pregnant women. The formula allowing detecting differences between the two studies requires the estimated prevalence of malnutrition at baseline and endline as well as the estimated design effect for each indicator. A factor of 6.175 was used as an estimate for the desired probability level

of 0.05 (p-value of significance) and a power of results of 0.8 as recommended for nutrition surveys (table 2).

Estimates for prevalence rates were based on results available from a national nutrition survey (GoL-LNAS 1995) and a pre-assessment conducted within the programme area in 1996 (IFSP/GTZ/Kaufmann 1998a, p. 57/4), the design effect was estimated based on experiences derived from larger scale national nutrition surveys.

Table 2: Sample size calculation

Indicator	Estimated prevalence First survey	Estimated prevalence Second survey	Design effect	Sample size required
Children <5 years				
Chronic malnutrition[1]	50%	40%	2.0	605
Acute malnutrition[2]	10%	5%	1.5	509
Non-pregnant women in child bearing age				
Malnutrition (BMI<18.5)	15%	7%	2.0	372

[1] Height-for-age < -2 z-score
[2] Weight-for-height <-2 z-score

A sample with a minimum number of valid values of 605 children and 372 women was required to allow for statistical reliable presentation of results. Assuming an average number of 1.3 children under 5 years per household a number of 466 valid household records are required. Anticipating a 10% drop out, a number of about 510 households should be sampled for both, the first and the second survey. The 1997 survey included 497 and the 2001 survey included 652 household records (table 3).

Table 3: Number of households, mothers and children studied by district in 1997 and 2001

District	1997				2001			
	Hh[1]	Women	Children		Hh[1]	Women	Children	
			Studied	Valid			Studied	Valid
Nalae	253	240	317	307	310	300	469	465
Sing	244	236	297	293	342	315	423	417
Total	497	476	614	600	652	615	892	882

[1] Hh=Household
[2] Non-pregnant women

Demographic information used as basis for sampling of locations derived from the provincial accessibility study carried out in Luang Namtha province in 1996 (GoL 1996). The Districts' Administration Office provided further statistical information for the preparation of the 2001 survey (Administrative Offices of Nalae and Sing district, personal communication January 2001). Demographic information and number of sampled units are presented in table 4. Annex 3 (table 3.1. and 3.2) presents the information by geographical zone and ethnic group.

Table 4: Demographic information by district in 1997 and 2001

	District population				Studied population				
	Population	Village	Hh[1]	Children[2]	Population	Village	Sub-village[3]	Hh[1]	Children
Nalae									
1997	20,617	65	4,393	3,505	1,732	12	17	253	317
2001	22,345	65	4,019	4,453	2,264	12	16	310	469
Sing									
1997	22,559	65	3,749	3,835	1,400	12	18	244	297
2001	25,553	61	5,111	4,344	1,915	12	17	342	423
Total									
1997	43,176	130	8,142	7,340	3,132	24	35	497	614
2001	47,898	130	9,130	8,797	4,197	24	33	652	892

1 Hh: Household
2 Calculated as 17% of the entire population derived from national averages for both districts in 1997 and 20% for Nalae in 2001 based on the 2000 population census.
3 The 24 administrative villages sampled were distributed over 35 sub-villages or locations (also perceived as traditional villages).

A two-stage random sampling procedure was applied to draw the sample. Villages were selected at random using the district administration office's list of villages. Within each village a minimum of 20 to 25 households having children under five years were randomly selected using the village chief's household list. Within a household all children under 5 years as well as their mothers or care-takers were included in the survey.

Survey team and data collection

The survey team consisted of ten interviewers and two supervisors (including the author). Each interview and measurement was taken by a team of two, one of them being a health professional and one of them possessing the required language skills. Half of the team were IFSP employees, the others were external development workers and hired for the purpose of the survey. Four interviewers and the two

supervisors were involved in both studies, six interviewers were replaced between 1997 and 2001. For both studies, field-testing of the questionnaire and required adjustments was carried out in early January, followed by a three days interviewers training and a one day village visit. One team completed on average four to five interviews per day. Supervisors were present during the field visits and checked questionnaires for completeness and plausibility, and corrective measures were taken if required. The survey was first conducted in Nalae (January to March) and than in Sing district (March to May). Data entry started simultaneously and was completed mid-June, followed by the preliminary analysis and presentation of results to local and national authorities involved. The second survey was completed by the end of July 2001.

A household interview was conducted by two enumerators and took on average 40 to 65 minutes, depending on the number of children under five years and the additional translations required. After the interview, mother's and children's weight and height was measured by the team members trained on taking anthropometric measurements taken at a central place in the village. At this occasion the questionnaire was checked for completion and plausibility as a quality control measure by the supervisor.

Semi-structured interviews and collection of secondary information was performed by the author supported by translators. Annex 3, table 3.3 presents the list of villages and households studied by location and ethnicity.

2.2 Methods of data collection

Different methods were applied to collect the required information:

- Standardised household interviews with the head of the household and the mother or the caretaker of the child,
- observations of the health status of children and mothers and housing conditions,
- anthropometric measurements of children under five years and their mothers,
- focus group discussion with village representatives including women's groups,
- secondary information obtained from district health statistics.

Household interview and questionnaire

A standardized questionnaire was used to conduct the household interviews. The questionnaire was initially in English and was translated into Lao language, which was the only common language among the team members. If required, questions were translated into the local language verbally during the interview.

The standardised questionnaire consisted of four sections. Section one and two contained questions addressed to assess the household situation. Section three and four assessed the situation of the mothers and the children, respectively. The questions cover the following study subjects and matters:

Household level:

- demographic situation of the household, including occupation, source of income, literacy status of mother and father, housing conditions,
- water source, sanitary facilities, hygiene conditions,
- food security situation, food production, food shortages, possession of livestock, home gardening,
- food intake (24 hour recall on number of meals, staple food consumption, number of meals and number of food items, source of food, snacks),
- decision making over household resources and most common problems in daily life (respondent's self assessment).

Individual level:

Mothers:

- basic bio-data and anthropometric measurements of the mothers (weight, height, age),
- health situation of the mothers, maternal characteristics (pregnancies, deliveries, number of children, child mortality, etc.),
- food habits and taboos during pregnancy and lactation.

Children under five years of age:

- basic bio data (sex, number of younger and older siblings, age difference to the next younger and older sibling, etc.),
- anthropometric data (weight, height, age),
- breastfeeding and weaning status,

- immunisation status,
- nutrition related diseases, general health status of the child.

The questionnaire consisted mainly of pre-coded questions. Each set of answers included a category as 'others', to capture answers outside the given codes. Categories such as 'don't know' and 'no answer' were included to minimise possible errors if respondents could not recall the correct answer or were not able to respond. Selected nutrition or health problems were assessed through pre-coded questions as well, but verified through observations by the enumerators (bilateral oedema, distended abdomen, abnormalities on the cornea, skin infections and general health status of children as well as swollen thyroid glands and health status of mothers). Housing conditions and hygiene situation was also verified through observations.

Dietary intake and food diversity score

A combination of different variables was assessed to describe a household's food intake. All of them were assessed during the standardised household interview. Questions were addressed preferably to the person responsible for the preparation of the meal. The interview assessed the consumption over the 24 hours period on the day before the interview. The eating occasions joined by all family members were the base for the assessment. If mother's consumption differed considerably, her intake was listed and analysed separately applying the same methodology:

1) Number of meals, number of different side dishes complementing the main meals and the ingredients (list of food items) and their source.
2) Quantity of rice consumed. The quantity shown by the respondent was measured using a weighing scale. Energy intake calculated as kcal per capita derived from rice consumption.
3) Assessment of the number of food items was the method selected to assess the dietary diversity.

The methodology of Hodgson et al (1994) was used to assess the food diversity by using a food diversity score. The methodology is based on earlier publications on assessing the quality of the diet applying simple but effective approaches (Guthrie and Scheer 1981, Krebs-Smith et al 1987, Shimbo et al 1994). The food diversity comprises the number of food items or food groups consumed over a defined time

base. The 24 hours at the day before the interview was the defined time base for the present study. The food diversity score does not include the frequency of consuming a particular item, nor its quantity.

During the household interview's, respondents were asked to list all dishes and ingredients of all eating occasions on the day prior to the interview. This included the main meals and the light meals or snacks, the main and side dishes per eating occasion as well as the list of all ingredients. The list of meals, dishes and ingredients was noted on the questionnaire. After the interview, this list was converted into a list of items consumed over the whole day. Each possible item listed at the electronic household record received a value, '1' for yes and '0' for no. In addition, the number of meals and the different side dishes served per meal were analysed. The later aimed to analyse the differences between the servings. Values ranged from '0' where all meals contained the same type of side dishes to '3' where every meal had different side dishes.

All different items consumed had a potential value of one. The method was extended to calculate a food group score. Major groups were formed according to type of food (staple, animal products, non-green leafy vegetables, dark green leafy vegetables, fruits, herbs and spices, other foods), and sub-groups were formed according to the origin, such as i.e. vegetables cultivated or gathered. Furthermore, minor items were summarized as one if the quantity was low. The different food groups and their respective food items are presented in annex 6.

Mortality

To evaluate the child mortality two indictors were applied, the first is the death rate and the second one is the mortality rate. The death rate is generated from results obtained from the household survey. Consequently, the death rate reflects the situation of the sample drawn (households, villages) and covers the reproductive age period of the mother prior to the survey. Here, the average age of mothers studied was 31 years, the estimated reproductive time period was 10 years. Infant and child death rates (IDR, CDR) were calculated for both districts for 1997 and 2001.

The infant and child mortality rates (IMR, CMR) applied here equal the under five-mortality rate and are generated from district's health statistics. They cover a period

of one year prior to the data collection and are therefore more specific to evaluate changes within a defined period of time (January to December). The calculation of the mortality rates is not based on a drawn household sample but includes total number of births and deaths district-wide. Mortality rates are the preferred indicators commonly used to describe a national situation or to compare internationally and also applied by the Lao Government to describe the health and human development situation (MoH 2001, p. 40; UNDP 2001, p. 158).

Calculation of death and mortality rates

$$\text{Death or mortality rate}^{1} = \frac{\text{Children died (< 1 year or <5 years)}}{\text{Live births}} * 1{,}000$$

[1] Death rate: numbers generated from household survey.
Mortality rate generated from district wide health statistics.
IDR and IMR include children below 1 year of age, CDR and CMR include children below 5 years of age.

In Nalae district, the availability of health and population statistics, established during the project implementation, allowed the calculation of the IMR, CMR. This was not possible for Sing district.

It was assumed that social services and the standard of living did not change dramatically over the ten years prior to the first survey. Health services were not available in villages prior to the start of the IFSP, the first vaccination campaigns were carried out only in 1995. Therefore, changes within the mortality rates over the years prior to the start of the programme were assumed to be minor. Hence, the death and mortality rates were expected to be more or less equally high at the time the IFSP started. This assumption was confirmed by the data obtained (table 5).

Table 5: Comparison of death and mortality rate, Nalae district

Time of data collection	Reference period	Methodology	CDR/ CMR	IDR/ IMR
1-5/1997	1987 - 1997[1]	CDR/IDR: Household based survey	263	229
3-6/1997	01/96 - 12/96	CMR/IMR: district-wide health statistics Analysis of data in 6/1997	259	235

[1] Estimated as approximately 10 years (mean age of studied women = 31 years)

2.3 Anthropometric assessment

Measuring children and mothers

Solar operated SECA weighing scales were used to measure the weight of the children and their mothers (accuracy of 0.1 kg). Children and women were weighed wearing a minimum of clothes (estimated at about 100g). Children too small to stand on the scale without help, were weighed together with their mothers. The subtraction was carried out directly after weighing. Calibration of scales took place after arrival at the new location before the start of the weighing procedures. Standard weight stones were used for calibration.

The height measurement of children older than 2 years was taken from a specially constructed measuring board (accuracy 0.5 cm) in standing up position. The same measuring board was used to measure the length of children under 2 years in lying position. Mother's height was measured by using a height measuring tape for adults (micro-toise) fixed at a wall of a house. If no straight wall was available, a stick was used to fix the tape that leaned against the mothers back.

Age determination was a particular challenge[1]. Therefore, a calendar of local seasons and annual events was developed during the training and applied by the enumerators during the interview. With the help of this calendar children's exact birthday was determined or verified. Still, within the 1997 sample the age of 28 children had to be re-checked, still, 4 children had to be excluded from height-for-age and weight-for-age analysis due to inappropriate age estimates only.

In 1997 10 respondents out of the 497 did not accept to take the height measurements of their children, even after the interview was completed. They were hesitant to put the child in lying position and/or the board was associated with the shape of a coffin, additionally 2 denied the participation in the weighing sessions. This was not an issue for drop-out any more in 2001, most properly due to an improved confidence and trust into the IFSP's community based staff. Number of children and women studied and valid anthropometric data are presented in table 3.

[1] Children did not possess birth certificates and most of the children did not have a weighing card either. Also the calendar used locally differed from the national/international calendar. In addition, there were cultural differences in counting a child's age. In the Akha culture, a child between 0 and 12 months was counted as of the age of 1 year, a 13 months old child counted as of 2 years of age.

Calculation of anthropometric status

So far only a few documentations are available demonstrating changes achieved within a programme cycle of a comparable time span. Also, there is no evidence yet on the extent of changes in nutritional status possible even under most optimal implementation conditions (Martorell 2006; CDC/Woodruff 2006; personal communication). Consequently, the analysis and discussion of changes over time and in relation to national or international trends is commonly recommended to evaluate the nutritional outcome or achievements of community based nutrition programmes (Martorell 2006, personal communication).

The actual study compared changes in the nutritional situation within the programme region to internationally recommended benchmarks and classification, to the national and regional situation and to the changes measured at during the similar time period. Achievements were also compared to those measured in other programmes of similar design and duration. The assessment methodology, calculation and classifications of malnutrition followed international recommendations, references and standards (WHO 1983, p. 12-28; GTZ 1989, p. 45-185; FAO 1990, p.39-55 and 117-138; WHO 1995; WHO 1997, p. 45-53), which was a precondition for meaningful comparisons.

Anthropometric indices – children

A child's weight, height and age were used to calculate the height-for-age and the weight-for-height and the weight-for-age indices to express chronic and acute malnutrition as well as underweight.

Children's individual values were compared to the values of a healthy and well-nourished reference population, the NCHS reference population and their nutritional status calculated and expressed as z-scores. A z-score is a statistical unit also called a SD-score (WHO 1983, p. 24; WHO 1997, p. 49; WFP 2002, p. 33).

$$\text{Z-score (or SD-score)} = \frac{\text{observed value - median value of the reference population}}{\text{standard deviation value of reference population}}$$

The WHO recommends the use of the 'new' reference population, the 'WHO Growth Standards', to calculate the nutritional status of children since 2005 (WHO 2006a, p. 307; WHO 2006b). Still, the actual study applies the NCHS reference to calculate malnutrition, because the survey was conducted prior to the development of the new WHO growth standards. References and computer software were not yet available at the time the survey took place. In addition, the use of the new WHO growth standards for actual analysis would not allow for a comparison to other study results available, i.e. the national nutrition surveys, regional and global databases or results from other GTZ supported IFSPs.

A z-score below -2 was taken as a cut-off point to identify malnutrition within an individual child. A cut-off point of -3 z-score is used to identify severe malnutrition. Degrees describing the severity of malnutrition within an individual are presented in table 6.

Table 6: Degree of malnutrition in children (WHO 1997, p. 50; WFP 2002, p. 34)

Normal:	≥ -2 z-score
Malnutrition (global):	< -2 z-score
Moderate malnutrition:	< -2 to -3 z-score
Severe malnutrition:	< -3 z-score

Categories published by WHO and used internationally were adopted to describe the severity of the nutritional problem among the population studied (table 7). Those benchmarks were developed to categories countries by their nutritional vulnerability, to prioritize for interventions and to guide programming.

Table 7: Classification of severity of malnutrition within a population by prevalence rates of children under 5 years (WHO 1995, p. 208 and p. 212; WHO 1997, p. 52)

Indicator	Severity of malnutrition by prevalence ranges (%)			
	Low	Moderate	High	Very high
Chronic malnutrition	< 20	20 - 29	30 - 39	≥ 40
Underweight	< 10	10 - 19	20 - 29	≥ 30
Acute malnutrition				
Non-emergency context	< 2	2 - 3 (low)	4 - 7	≥ 8
Emergency context	< 5	5 - 9	10 - 14	≥ 15

Following these categories, a prevalence rate of more than 40% chronic malnutrition within a defined population group would indicate a very high nutritional vulnerability.

Also a prevalence of acute malnutrition of more than 8% under normal circumstances and more than 15% within an emergency context is referred to as a very high prevalence (WHO 1997, p. 51; WHO 2000, p. 75; WFP 2002, p. 74; de Onis et al 2004b). The set of interventions required to tackle either acute or chronic malnutrition would differ. I.e. the start up of comprehensive and immediate nutrition interventions, such as blanket supplementary feeding would be recommend as a life saving measure, if the prevalence of acute malnutrition is beyond 15% (MSF 1995, p. 26; WHO 2000, p. 75).

Anthropometry – mothers

The body-mass-index (BMI) is the internationally recommended index to calculate the nutritional status of adults (WHO 1995, p. 364). It is calculated as:

$$\text{Body-mass-index (BMI)} = \text{Body weight (kg)} / (\text{body height (m)})^2$$

The study assessed the nutritional status of non-pregnant women being the mothers or caretakers of the children studied. Their weight and height was assessed to calculate their BMI. A BMI below 18.5 kg/m^2 was used as cut-off point to classify between normally nourished and malnourished as recommended by WHO. Persons with a low BMI are underweight in relation to their height (Ferro-Luzzi et al 1992; WHO 1995, p. 364; Collins, Duffield and Myatt 2000, p. 3). Underweight in adults is frequently also referred to as 'chronic under-nutrition' or 'chronic dietary energy deficiency'.

To evaluate the degree of malnutrition the internationally recommended classification was employed (table 8). The application of this recommended methodology also permits the comparison to other larger scale data sets of different origin.

Table 8: Degree of chronic energy deficiency in adults (Ferro-Luzzi et al 1992; WHO 1995, p. 364; Collins, Duffield and Myatt 2000, p. 3)

Normal:	$\geq$ 18.5 kg/m^2
Grade I, mild:	17.0 - 18.4 kg/m^2
Grade II, moderate:	16.0 - 16.9 kg/m^2
Grade III, severe:	< 16 kg/m^2

Generally, even within a normally nourished population a proportion of 3% to 5% of the adults have a BMI below 18.5 kg/m^2. WHO would consider a prevalence rate below 10% as of low nutritional risk, while a prevalence between 10% and 19% would indicate a medium level problem, meaning a poor, but not a serious or critical nutritional situation (WHO 1995, p. 361).

2.4 Qualitative information and secondary data

In addition to the standardised and quantitative assessment focus group discussions were conducted in all villages (annex 3, table 3.3). Qualitative information obtained through focus group discussions aimed to complement and support interpretation of data obtained through the standardised household interviews.

The discussions were semi-structured, guided by a checklist of key questions, and conducted with a group of key informants in all villages (3 - 10 villagers, traditional and administrative leaders, teachers, health workers). The average duration was about 2 - 3 hours, usually conducted in the morning or in the evening. Focus group discussions were held on the following subjects: living conditions and major constraints, perceptions on the changes over the previous years and the effects of IFSP support. Moreover, separate women's focus group discussions were held on seasonality of diseases, causes of malnutrition, food habits during pregnancy and post partum and infant feeding practices.

Secondary data were obtained from district administration and health offices in both districts (demographic information, health statistics). Information obtained from national nutrition surveys and programme documentation supported the preparation of the study and development of the context-specific framework of malnutrition. Programme specific information required for preparatory purposes was obtained from a programme appraisal report (GTZ 1994), a socio-economic assessment (IFSP/GTZ/Gebert 1995) and the rapid nutrition assessment (IFSP/GTZ/Kaufmann 1996).

Two national surveys, the 'Laos nutritional assessment survey (LNAS)' carried out early 1994 (GoL-LNAS 1995) and the 'National Health Survey' carried out in 2000 (MoH 2001) form the base for comparing national trends to changes in malnutrition

measured within the IFSP area. Both surveys are cross-sectional national sample surveys, with a representative sample size for each of the three regions in Lao PDR applying a two-stage random sample procedure for household selection. Among other indicators they assess the anthropometric status of children 0 - 59 months and mothers. Methodology as well as analysis of the anthropometric status was comparable to the present study (i.e. use of NCHS reference values, BMI, cut-off points etc.).

2.5 Statistical analysis

The NCHS reference standards were used to analyse the anthropometric status of children, the Epi-Info 6.03 software programme was applied for computerized analysis of anthropometric indicators, and SPSS 11.0 was used for further statistical procedures. Micro-soft excel was used for the design of figures.

Statistical analysis was structured into levels and sectors following the organisation of the context-specific conceptual model of malnutrition developed (figure 2, p. 15). The statistical analysis consisted of two parts: first, the analysis of the nutrition situation and determinants of malnutrition. Second, analysis of changes achieved at the level of outcome and direct or indirect causes of malnutrition as well as identification of determinants associated to the differences in malnutrition between 1997 and 2001.

1) Descriptive statistical methods were applied to analyse and present the nutritional status and potential causes of malnutrition (frequencies, means for normally distributed data, i.e. z-scores, BMI, median for data not normally distributed, i.e. income, cross-tabulations). Chi-square tests, 'Analysis of Variance' (ANOVA) and regression analysis, uni- and multifactorial were applied to test statistical associations between malnutrition (mainly 'height-for-age' z-score, HAZ as dependant variable) and potential determinants (direct and indirect causes of malnutrition as independent variables). The presentation of prevalence of chronic malnutrition (dichotome) was used to highlight selected results or to compare the situation to other study results. In a next step, in order to control for correlations between variables of the same sector, for each sector (intra-sectoral or sector-wise) a multifactorial analysis was carried out (ANOVA and linear regression). The multifactorial analysis only included non-

redundant variables. Determinants showing an association when applying the sector by sector analysis, were selected for an inter-sectoral multifactorial linear regression analysis. This model included determinants of the two levels, indirect causes and basic causes of malnutrition.

2) Results of the two field studies were compared using descriptive statistical methods (cross tabulation, means, median). Differences in malnutrition or its causes between 1997 and 2001 were tested applying Chi-square tests (Fisher's exact test or Pearson), as well as ANOVA or ANCOVA where results were confounded (i.e. age, income). Twofactorial analysis of variance (determinant and year) was applied as a first step to identify the bivariate relation between a selected determinant and differences in malnutrition over the years. In a second step, a sector by sector multifactorial analysis of variance identified potential determinants of the differences over the years. A final, inter-sectoral multifactorial analysis of variance included determinants that showed an association to malnutrition applying the sector by sector analysis.

A probability value (p-value) was applied to express the level of statistical significance of associations between malnutrition and its determinants or differences between groups. Statistical analysis of determinants was explorative. Levels, sectors and determinants included in the sector by sector uni- or multifactorial analysis model are presented in figure 2 and annex 4.

3 Results

This results chapter depicts causes of malnutrition and changes following the structure, levels and sectors, given by the conceptual framework of malnutrition (UNICEF 1990, p. 19-22). Causes and changes are presented in relevance to their impact on the nutritional status. Changes were evaluated comparing the results of the two cross-sectional surveys conducted in 1997 and 2001. Children and mother's nutritional status as well as mortality rates were analysed to present changes at outcome level. Chronic malnutrition is the key indicator selected to identify determinants and changes. The nutritional status is expressed as mean height-for-age z-score (HAZ), the prevalence of chronic malnutrition (dichotome) is applied to highlight most important results. Where relevant, the relation to acute malnutrition, anemia and mothers nutritional status is presented as well.

3.1 Outcome level

3.1.1 Nutritional status of children and mothers

Chronic malnutrition (stunting)

Before the start of the IFSP the chronic malnutrition or stunting among children under five years of age was very high. Comparing the situations in 1997 and 2001, the height-for-age z-score as well as the prevalence rate for chronic malnutrition improved significantly for both districts (ANOVA, $p < 0.005$). In 2001 the prevalence of chronic malnutrition was 10.7% lower than in 1997 ($p < 0.001$, table 9).

Table 9: Chronic malnutrition by district in 1997 and 2001

District	1997			2001		
	n	Mean HAZ ± SD	%	n	Mean HAZ ± SD	%
Nalae	307	-2.63 ± 1.37	69.1	465	-2.25 ± 1.16 [1]	58.3[2]
Sing	293	-2.64 ± 1.37	69.6	417	-2.32 ± 1.49 [2]	58.8[2]
Total	600	-2.63 ± 1.37	69.3	882	-2.28 ± 1.32 [1]	58.6[1]

[1] $p < 0.001$, [2] $p < 0.005$

Severe chronic malnutrition was reduced by 11.1% (< -3 HAZ, p < 0.001). The prevalence of moderate chronic malnutrition did not change (figure 4). Reduction in global chronic malnutrition was an effect of the decrease in its severe forms (< -2 HAZ).

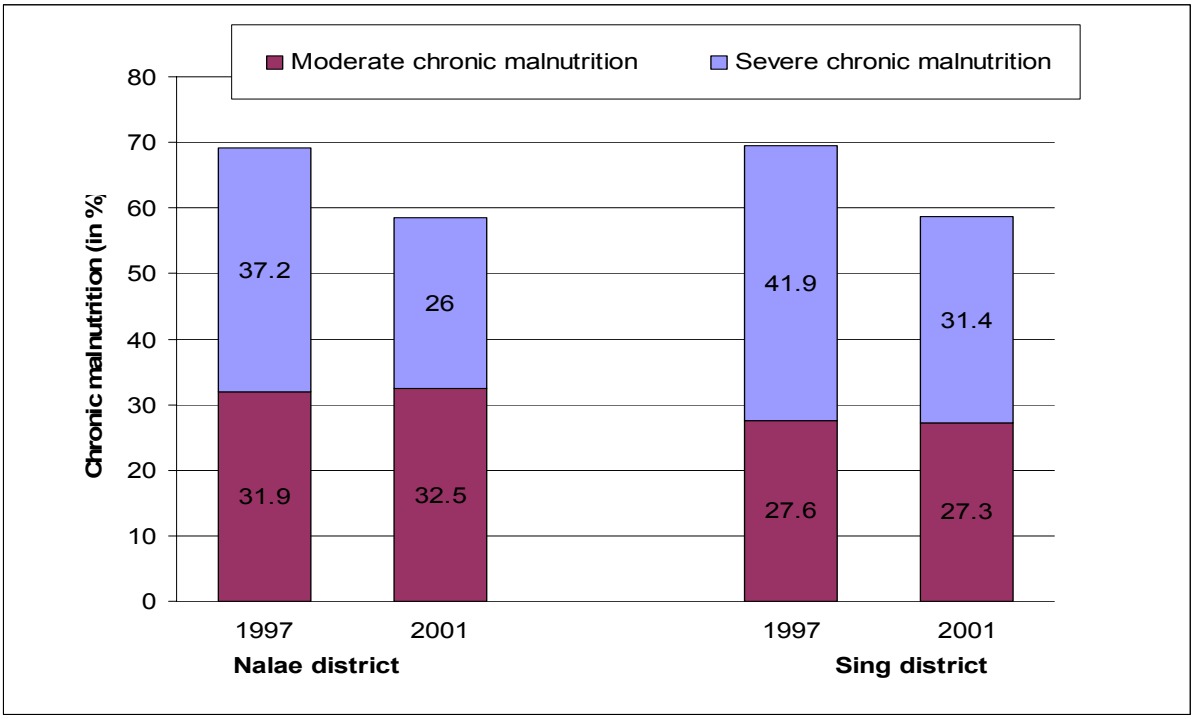


Figure 4: Changes in moderate and severe chronic malnutrition by district in 1997 and 2001 (in %)
(moderate: -3 to < - 2 z-score, severe: height-for-age < -3 z-score,
p = 0.001 for Nalae district, p = 0.01 for Sing district)

Prevalence rates and changes were similar for both districts; still there was a geographical disparity within districts. About two thirds of the households were located in remote areas, at least one hour away from a transportation network or a semi-urban area, here the nutritional status was worse than elsewhere (ANOVA, HAZ -2.50 $\pm$ 1.26 compared to -2.74 $\pm$ 1.44, p = 0.035). Changes between 1997 and 2001 were significant for remote as well as nearby villages, but greater for the latter (Nalae district: reduced from 67.0% to 53.3% in nearby locations and 71.2% to 63.2% in remote locations, with a p = 0.02 for both locations; Sing district: 65.7% to 53.7% in nearby and 69.0% to 64.8% in remote locations).

Changes by age

For both years chronic malnutrition increased with age; from 36.3% for the children younger than 12 months up to 89.7% for children older than 48 months in 1997, and from 30.2% to 79.7% in 2001, respectively (figure 5). The HAZ mean value

decreased from -1.56 ± 1.23 for the youngest to -3.37 ± 1.09 for the older than 48 months (ANOVA, p <0.001 for linearity).

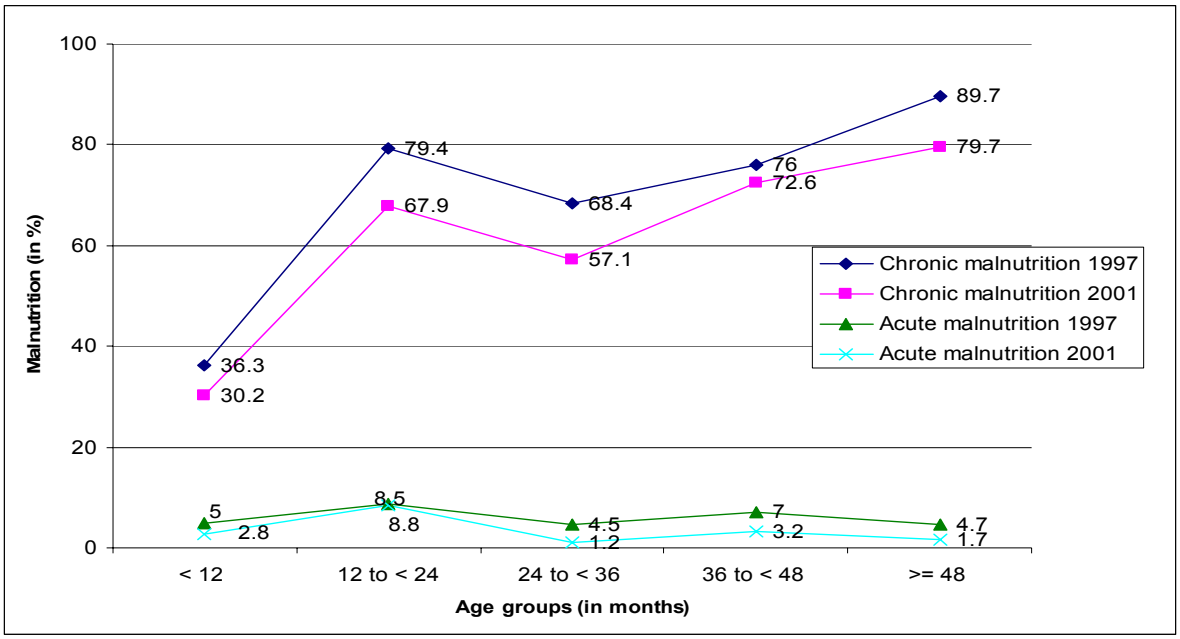


Figure 5: Chronic and acute malnutrition by age groups in 1997 and 2001 (1997: n = 600, 2001: n = 882).

Changes were equally distributed over all age groups, a difference between the districts was indicated. In Nalae district the younger children improved proportionally more than the older children. This was adverse for Sing district, here changes were greater among the oldest age group (annex 5, table 5.2). However, number of individuals assessed was too few to allow for statistically reliable interpretation of changes within the different age groups by district.

Acute malnutrition (wasting)

Within the overall sample, the percentage of acute malnutrition decreased from 6.0% in 1997 to 3.8% in 2001, but changes differed by district (table 10).

In Nalae district the mean weight-for-height z-score (WHZ) increased from –0.56 to –0.48. The percentage of children being classified as acutely malnourished decreased from 9.7% to 3.5% (Chi-square, p = 0.001). In 2001 only 0.4% suffered from severe acute malnutrition (< –3 WHZ) compared to 1.3% in 1997. In 1997 even 0.6% of the children fell below -4 z-score, while the percentage decreased to zero in the year of 2001. Changes were even more substantial for children from remote locations (reduced from 10.3% to 2.2%, p < 0.001).

In Sing district the mean weight-for-height z-score improved slightly by 0.04 units. This would indicate that there was a very slight shift towards a better average across the entire sample. However, at the same time, the prevalence rate increased (from 3.5% to 4.5%). This increase was noticed for the group of children suffering from moderate acute malnutrition, while percentages of children suffering from its severe forms remained the same. In both years, only one child was below – 3 z-score, and no child was below – 4 z-score (0.3% in 1997 and 0.2% in 2001). Changes were equally distributed for locations remote or nearby.

Table 10: Acute malnutrition by district in 1997 and 2001

	1997			2001		
District	n	Mean WHZ ± SD	%	n	Mean WHZ ± SD	%
Nalae	310	-0.56 ± 1.19	9.7	461	-0.48 ± 0.98	3.5[1]
Sing	293	-0.41 ± 0.94	2.0	416	-0.37 ± 0.99	4.1
Total	603	-0.48 ± 1.08	6.0	877	-0.43 ± 0.99	3.8

[1] Changes statistically significant, Fisher's exact test, $p < 0.01$

Changes by age

Changes of prevalence rates were more or less equally distributed between age groups (figure 5). In Nalae district the greatest differences were observed among the children 24 to 36 months as well as among the children younger than 12 months. Results for Sing district were less conclusive with regard to the evolution by age (annex 5, table 5.3).

Chronic and acute malnutrition

In 1997 the percentage of children suffering from both, chronic and acute malnutrition at the same time, was 3.1%. The percentage was reduced slightly to 2.2% in 2001. In 1997 and 2001, the occurrence of chronic and acute malnutrition was statistically not correlated. In other words, those children suffering from chronic malnutrition had the same probability to suffer also from acute malnutrition compared to those children not chronically malnourished.

Underweight (chronic and/or acute malnutrition)

In 1997 more than half of the children (54%) suffered from underweight. The prevalence rate within the programme area was reduced significantly. Changes were

more significant for Nalae district (table 11). This is an effect of the greater changes in acute malnutrition in Nalae district, while changes in chronic malnutrition were similar for both districts.

Table 11: Underweight by district in 1997 and 2001

	1997			2001		
Districts	n	Mean WAZ ± SD	%	n	Mean WAZ ± SD	%
Nalae	311	-2.06 ± 1.21	55.9	466	-1.76 ± 0.93	43.3
Sing	295	-1.93 ± 1.05	51.9	419	-1.70 ± 1.18	44.6
Total	606	-2.00 ± 1.13	54.0	885	-1.73 ± 1.05	44.4

Differences in chronic as well as acute malnutrition by sex

No significant differences were observed between the nutritional status of girls and boys for all three indicators (table 12). However, in 2001 in Nalae district boys had improved slightly better with regard to chronic malnutrition. Contrary, in Sing district chronic malnutrition improved better for girls. These differences were statistically insignificant.

Table 12: Prevalence of malnutrition by sex and district in 1997 and 2001 (in %)

	Nalae		Sing		Total	
	1997	2001	1997	2001	1997	2001
Chronic malnutrition						
Boys	71.9	57.8	70.9	61.3	71.0	59.4
Girls	67.1	59.3	68.0	55.9	67.5	57.7
Acute malnutrition						
Boys	10.0	4.4	2.4	4.1	6.0	4.2
Girls	9.4	2.4	1.6	4.1	5.9	3.2

Boys: 1997 n = 323; 2001 n = 474 Girls: 1997 n = 291; 2001 n = 403

Nutritional status of women

Women's body-mass-index (BMI) was applied to calculate their nutritional status. The prevalence of malnutrition was high at the start of the programme, but was reduced significantly (table 13). The prevalence rates of moderate and severe malnutrition decreased considerably as well. In 2001, none of the women suffered from severe malnutrition any more compared to 0.8% in 1997 (BMI < 16kg/m^2). In 2001 only 0.8% of the mothers were classified as suffering from moderate malnutrition compared to 2.5% in 1997 (BMI 16.9 kg/m^2 to 16.0 kg/m^2).

Table 13: Malnutrition of mothers by grade in 1997 and 2001

	1997 n = 476	2001 n = 665
Mean BMI ± SD (kg/m^2)	20.9 ± 2.2	21.7 ± 2.0[1]
	%	%
Underweight (BMI < 18.5 kg/m^2)	13.2	5.1[2]
Mild (BMI 17.0 - 18.4 kg/m^2)	9.9	4.4
Moderate (BMI 16.0 - 16.9 kg/m^2)	2.5	0.8
Severe (BMI < 16.0 kg/m^2)	0.8	0.0

[1] ANOVA, $p < 0.001$ [2] Chi-square, Fisher's exact test, $p < 0.001$

Improvements were equally distributed and significant in both districts. In Nalae district the prevalence rate of underweight was reduced between 1997 and 2001 from 14.2% to 6.1% (Chi-square, Fisher's exact test, p = 0.001), the BMI mean value increased from 20.9kg/m^2 to 21.3kg/m^2 (ANOVA, p = 0.02). Here malnutrition rates as well as changes were almost evenly distributed for remote and easily accessible villages (remote 16.1% to 7%, p = 0.043; nearby: 14.8% to 5.4%, p = 0.006).

In Sing district the prevalence decreased from 12.3% to 4.2% (Chi –square, Fisher's exact test, $p < 0.001$), the BMI mean value increased from 20.9 kg/m^2 to 22.0 kg/m^2 (ANOVA, $p < 0.001$). Malnutrition was higher for remote locations where a significant reduction was noticeable (remote villages: 13.9% to 5.3%, p = 0.02; nearby villages: 3.6% to 1.9%)

Mother's nutritional status by age

In 1997 and in 2001 the prevalence of underweight increased consistently with age. This holds true for its moderate and severe forms, but not in its mild forms. In 1997 no mother younger than 30 years of age was below a BMI of 16 kg/m^2. In contrast, in the age group older than 40 years 2.1% of the mothers were below a BMI of 16 kg/m^2. The BMI mean value decreased statistically significantly from 21.2 kg/m^2 BMI for mothers below 20 years to 20.3 kg/m^2 BMI in the age group older than 40 years (table 14). Changes between 1997 and 2001 were evenly distributed over the different age groups meaning that all mothers, regardless their age, improved equally.

Table 14: Malnutrition of mothers by age in 1997

		Age groups (in years)			
		≤ 20	21 - 30	31 - 40	≥40
	n	n = 25	n = 155	n = 166	n = 47
BMI median ± SD (kg/m^2)[1]	393	21.2 ±1.2	20.8 ±2.0	20.8 ±2.4	20.3 ±2.3
Grades of malnutrition		%	%	%	%
Normal (BMI ≥18.5 kg/m^2)	338	100	88.6	81.9	83.0
Mild (BMI 17-18.4 kg/m^2)	41	0	8.9	14.4	8.5
Moderate (BMI 16-16.9 kg/m^2)	11	0	2.5	2.5	6.4
Severe (BMI <16 kg/m^2)	3	0	0	1.3	2.1

[1] ANOVA combined: p = 0.058, ANOVA test for linearity: p = 0.007

In 1997 mothers' and children's' nutritional status were positively associated: better-nourished mothers had better nourished children, this held true for chronic as well as acute malnutrition (table 15). The trend was the same in 2001; however, in 2001 the association was not significant any more.

Table 15: Mothers and children's nutritional status in 1997

	Children's nutritional status			
Mother's BMI	n	Mean HAZ ± SD	n	Mean WHZ ± SD
Normal (BMI ≥18.5 kg/m^2)	403	-2.66 ± 1.33	406	-0.41 ± 1.02
Mild (BMI 18.49-17 kg/m^2)	46	-2.90 ± 1.42	47	-0.73 ± 1.04
Moderate (BMI 16.9-16 kg/m^2)	12	-3.34 ± 1.32	11	-0.90 ± 0.66
Severe (BMI <16 kg/m^2)	4	-3.21 ± 1.57	4	-1.00 ± 0.53
Level of significance		p = 0.036[1]		p = 0.008[1]

[1] ANOVA, test for linearity

Micronutrient deficiencies

In 1997 one tenth of the children showed clinical signs of anaemia (table 16). The percentage increased with age and was highest for the 2 - 3 year old children (0% below 6 months, 11.2% for 24 - 36 months old, 8.5% for the children older than 48 months). Children identified as anaemic at baseline were smaller, they had a significantly lower height-for-age z-score compared to those not showing such symptoms (ANOVA, HAZ -3.13 ± 1.12 compared to -2.58 ± 1.39, p = 0.007). Signs of anaemia were not associated with weight-for-height. In 2001, the percentage had reduced significantly; improvements were almost similar and significant for both districts.

Table 16: Prevalence of anaemia by district in 1997 and 2001 (clinical signs, in %)

	Nalae		Sing		Total	
	1997 n = 315	2001 n = 467	1997 n = 294	2001 n = 422	1997 n = 609	2001 n = 889
Anaemia	10.5	0.9	6.4	0.5	8.5	0.7

Prevalence of goitre among women, the clinical symptom of iodine deficiency, did not change over the programme implementation period (3.6% in 1997 and 3.5% in 2001).

3.1.2 Child mortality

Infant and child death rates[2] (IDR and CDR) were extremely high in the programme area in 1997. On average one quarter of all children born alive past away before reaching the age of five. About three quarters of the total child death occurred during the first year of life. The CDR was more or less equally high for both districts, but the IDR, including neonatal death, was much higher in Nalae district (table 17). Here, neonatal death accounted for more than 40% of the child and for almost half of the infant deaths.

Table 17: Child death[1] by age and district in 1997

	Nalae		Sing		Total	
Age group	Number of deaths	%	Number of deaths	%	Number of deaths	%
< 1 months	52	22	175	33	123	41
1 – 12 months	79	34	196	37	117	39
12 - 58 months	101	44	163	31	62	21

[1] Number of deaths reported by the mothers studied, n = 476

Based on the household survey results the CDR reduced noticeably between 1997 and 2001 (by 10% for both districts, 13% in Sing district, table 18). IDR and CDR in Sing district reduced almost at the same proportion (IDR/CDR ratio was 57% in 1997 and 54% in 2001).

[2] The death rate is based on the household assessments, thus represents the situation within the households and villages sampled. It covers the reproductive life span of the studied mother (average age: 31 year, estimated average reproductive lifespan: 10 ten years).

Table 18: Infant and child death rate by district in 1997 and 200)

	Nalae		Sing		Total	
	1997 n = 240	2001 n = 329	1997 n = 236	2001 n = 336	1997 n = 476	2001 n = 665
CDR[1] (deaths/1,000 live births)	263	240	251	219	257	231
IDR[1] (deaths/1,000 live births)	229	180	142	119	186	151

[1] Number of live births and deaths reported by the mothers studied, n = 476

Health statistics required calculating the mortality rates[3] (IMR and CMR) were only available for Nalae district. Here, mortality and death rates were more or less equal when the IFSP started, but the mortality rate reduced more significantly thereafter. By the time the 2001 survey was conducted, the district-wide CMR was reduced for more than halve. Rates within those villages sampled for the household study reduced by about two thirds. At the same time, IMR or CMR in villages that started to benefit from the IFSP in 2/2000 only was as high as within the intervention area in 1997. But those villages also improved significantly soon after the start of the programme (table 19). Changes were even more substantial for the children below one year of age. The proportion of IMR to CMR was about 90% initially and reduced to 78%.

Table 19: Evolution of mortality rates in Nalae district from 1997 to 2001 (health statistics, DHO, Nalae district)

Data collection	Reference period	Number of villages	Coverage	CMR	IMR
6/1997	06/96-06/97	65	All villages within the district	259	235
2/2000	01-12/99	55	Villages benefiting from IFSP since 1997	126	107
		10	Villages not benefiting (starting to benefit by 2/2000)	284	230
2/2001	01-12/00	65	All villages	109	95
		17	Villages sampled for the household survey	83	65

[1] CMR and IMR presented as the number of deaths per 1,000 live births

[3] The mortality rate is generated from district wide health statistics It covers a period of one year prior to the data collection. It is therefore more specific to evaluate recent changes than the death rate.

Causes of child death

Methodological limitations

One has to bear in mind that the identification of causes of infant or child death through the interview of caretakers, even after four years of interventions including community based health education, remains unreliable. About one quarter up to one third of the respondents reported causes of their children's death as 'unknown' (31.6% in Nalae and 24.2% in Sing district). More than a quarter listed 'fever' as the cause of death. Fever, however, is only a symptom of infectious diseases, but not the fundamental cause of death. About 10% of the answers fell into the category of 'others', such as sepsis, unspecified infections, tetanus infections, including neonatal tetanus, accidents, etc. In summary, more than two thirds of the causes were not identified reliably enough to draw meaningful conclusions. Nonetheless, results are presented to provide an indication of possible causes, but need to be interpreted with care. Unspecified fever, diarrhoeal diseases and ARI were the major causes reported, whereas unspecified fever was reported most frequently (figure 6). No remarkable change was observed for the year 2001.

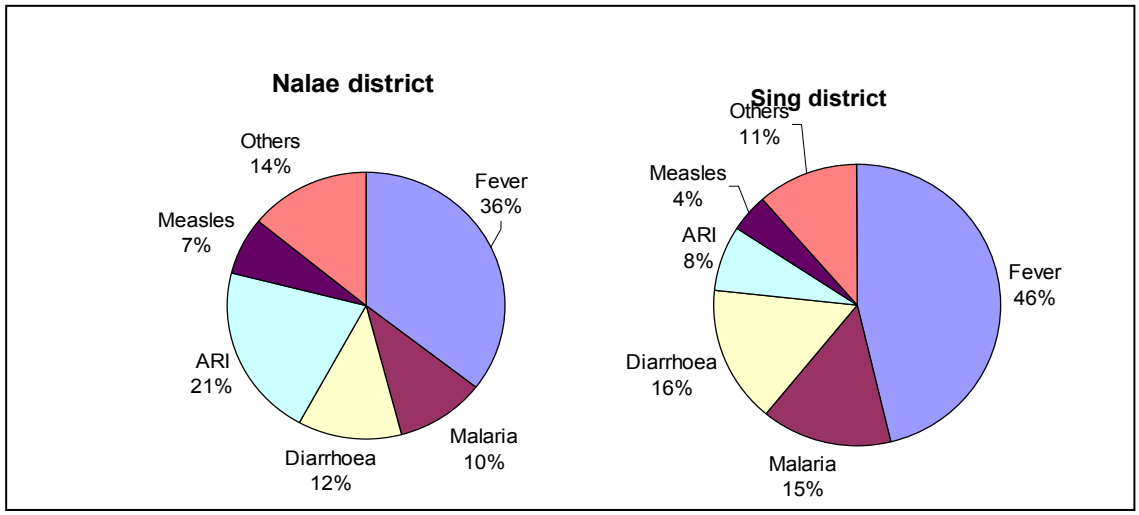


Figure 6: Causes of child death in 1997 (n = 476 women, reported 534 deaths)

3.2 Direct causes

3.2.1 Family's food intake

Rice consumption

On average 544 g rice was consumed per day per capita. The population in Nalae district consumed glutinous rice only, while non-glutinous rice was the preferred variety among the population studied in Sing district.

Rice consumption and association to nutritional status

The quantity of rice consumed per capita was significantly lower for families of children suffering from acute malnutrition (480 g against 550 g rice for wasting and non-wasting, p = 0.044, ANVOA). But rice consumption was neither associated with chronic malnutrition nor with mother's nutritional status.

Number of meals and diversity of side dishes

The majority of households (94.8%) consumed three meals per day. More than half of the households (53%) consumed three meals with different side dishes each time. The percentage was higher for Nalae than for Sing district (62.7% in Nalae district, 43.0% in Sing district). In Sing district meals were more monotonous; 24.2% of the households had the same side dishes for all the three meals compared to 8.3% in Nalae district. In total 3.4% of the households (4.4% in Nalae and 2.4% in Sing district) had plain rice only, or a spicy paste or sauce in addition, mainly consisting of powdered chilly, iodised salt, mono-sodium glutamate and water.

Consumption of snacks or light meals in between the three main meals was uncommon. Only 2.6% of the households stated to have light meals in between, while the percentage was higher for Nalae than for Sing (4.4% in Nalae, 0.8% in Sing district). Besides fruits the products consumed were steamed pumpkin, cassava, taro, or sweet potatoes.

In 80% of the households mothers and fathers consumed the same foods (Nalae 73.5%, Sing district 84.5%). In 20% of the households they had different meals. Within a number of households the meals consumed by the father contained additional nutritious food items, mainly richer in animal products but also in plant

products, while mother's meals were more monotonous (17% in Nalae district and 8.6% in Sing district). Following food restrictions was the major reasons for the mothers having different items. One quarter of those having plain rice and one additional item, mainly salt, where lactating mothers within the first few weeks after delivery.

Number of meals, diversity of side dishes and nutritional status

The number of meals consumed at the day prior to the study did not show any association to nutritional status, though the variety of side dishes served did show an association to the nutritional status (table 20). Children in households where different kinds of side dishes were served for breakfast, lunch and/or dinner were nutritionally better off compared to those having the same kind of side dishes for all meals (ANOVA, unifactorial, p = 0.08; all meals different side dishes, two meals different dishes, or all meals same side dishes). Furthermore, children of families having fruits and other snacks between meals were better off than those who did not (ANOVA, unifactorial, p = 0.033).

Table 20: Number of meals, snacks and nutritional status in 1997

Determinants	n	Mean HAZ ± SD[1]	Mean WHZ ± SD[1]
Variety of side dishes			
High	257	-2.61 ± 1.37	0.46 ± 1.02
Medium	149	-2.76 ± 1.38	-0.39 ± 0.99
Low	78	-2.89 ± 1.05	-0.64 ± 1.04
Level of significance		p = 0.08	p = 0.22
Snacks or fruits			
No snack/one fruit	570	-2.72 ± 1.32	-0.49 ± 0.99
Snack/more than one fruit	15	-1.98 ± 1.09	-0.18 ± 1.56
Level of significance		p = 0.033	p = 0.01

[1] ANOVA, unifactorial

Dietary diversity and food groups

In order to assess the dietary quality a food diversity score consisting of a number of food items derived from different food groups was calculated. The food groups, respective food items and frequency of consumption is presented at annex 6. The diet consisted of an average of 4.3 different food group items daily in addition to the staple food. Figure 7 presents food group items as proportion of total number consumed. The staple food, without any exception, was rice for all meals consumed,

A few households had root crops (cassava, taro and sweet potatoes) as a side dish or as a snack in between main meals (1.8%).

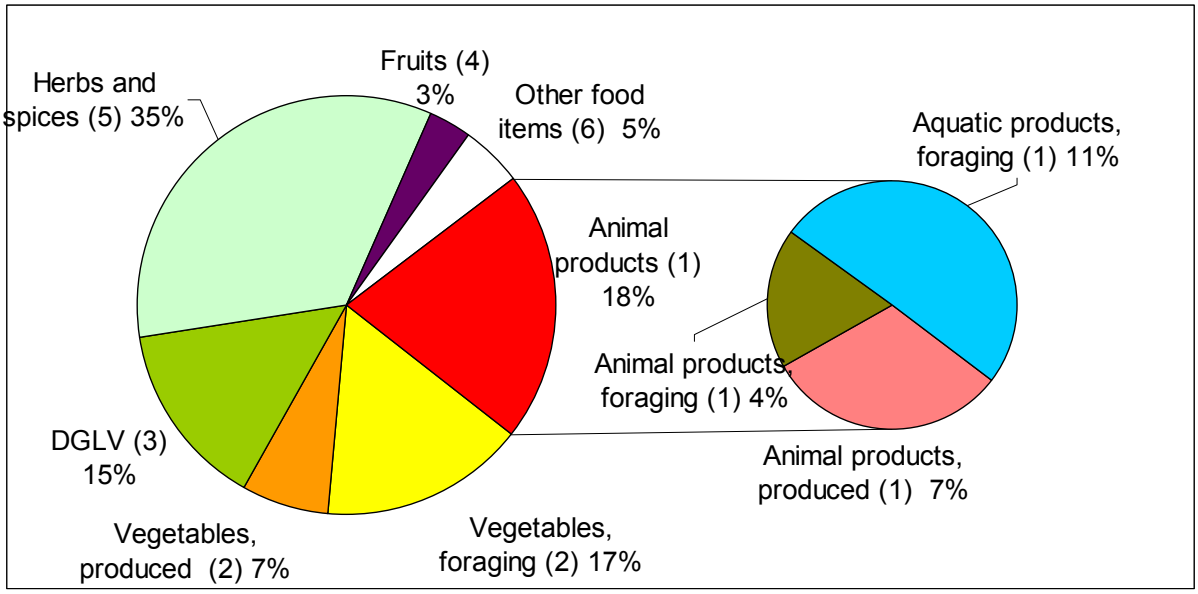


Figure 7: Proportion of food group items out of total number of items consumed in 1997
(Vegetables and animal products are additionally disaggregated by sources, (n) refers to the food group numbers, n = 475, annex 6, summary table. DGLV: dark green leafy vegetables).

Food Group 1 – Animal products

Animal products derived from animals raised (domestic), hunted and aquatic sources (annex 6, table 6.1.1, 6.1.2 and 6.1.3); the average household consumed 0.9 items derived from animal sources. Three quarters of the households did not have any animal products from domestic production; in fact milk consumption was uncommon, and consumption of eggs very seldom. In Sing district, the use of pork fat is a traditional practice (11.5% of the households had pork fat), but this was not a practice for Nalae district. Hunting of wild animals and/or gathering aquatic products including fish, or other forest products, was a common practice resulting in an extensive list of animal products consumed from those sources. In total 13% of the households consumed meat from animals hunted or gathered and more than one third of all households had aquatic products (fish, shrimps, shells, oyster). Food gathered in the forest played a more important role in Nalae than in Sing district.

Food Group 2 – Vegetables

Most vegetables, referring to vegetables not belonging to the group of dark green leafy vegetables (DGLV), require cultivation and are seasonal products, they were known but not consumed very frequently (three quarters did not have any non-DGLV, annex 6, table 6.2.1). Most common was the Chinese cabbage particularly in Sing district (consumed in 26% of households), followed by pumpkin, gourd, squash, eggplants and green beans. Pumpkin and gourds, partly also eggplants, were frequently cultivated in a mixed cropping system together with rice in the upland fields.

Food Group 3 – dark green leafy vegetables (DGLV)

DGLV consumed were predominantly collected in the forest. The list of products commonly collected is extensive and more than half of the households consumed such products (annex 6, table 6.3). Again, the importance of those forest products was higher for Nalae district.

Food Group 4 – Fruits

The consumption of fruits was not very common and particularly low for Sing district (average number of fruit items per household 0.14, almost 90% of the households did not consume any fruits, annex 6, table 6.4). Banana or wild fruits collected in the forest were preferred in Nalae, while watermelon was common in Sing district.

Food Group 5 – Herbs, spices, condiments

The list of herbs, spices and other condiments used for daily food preparation was large. Almost all households added salt and chilly; garlic and spring onions were added by about 40% of the households (annex 6, table 6.5). About 80% of the households used mono-sodium glutamate (MSG, 73.9% in Nalae district and 87.7% in Sing district). Regarding the use of iodised salt, an additional survey conducted in Nalae district showed that the iodine intake was sufficient to meet requirements (100% of the households consumed iodized salt). In 88% of the households the iodine content of the salt was above the recommended level of 30 ppm. The average consumption was 14 g of salt per capita and day, whilst the consumption was slightly lower in poorer households and higher in better off households (12.5 g and 16.5 g respectively, IFSP/GTZ/Kaufmann 1998b, p. 57/18).

Food Group 6 – Others

Other food items were derived either from cultivation (sugar cane, soy beans, sesame), from forest resources (fresh water algae, honey, mushrooms), or a commercial product or processed food (biscuits, liqueur). Algae were particularly relevant in Nalae district (consumed by 8.7%) and mushrooms in Sing district (consumed by 7%). Other food items played a minor role (annex 6, table 6.6).

Dietary diversity, food sources and nutritional status

It was assumed, that food diversity, as an indicator for dietary quality and household food security, would be a predictor to the nutritional status. Higher food diversity was assumed to indicate consumption of a better quality diet, more balanced and more nutritious.

The multifactorial regression analysis model (sectoral analysis model, including the complete set of food consumption indicators) showed a significant association between the variety of side dishes and height-for-age z-score. An additional side dish, different in composition, resulted in an improvement in height-for-age by 0.3 z-score units (regression coefficient = 0.29, CI 0.67 to 0.02, p = 0.04). Other variables did not show any significant association with the nutritional status (annex 6). Also none of the variables showed a significant association with acute malnutrition of children or with the nutritional status of mothers.

Within the model applied, food diversity did not correlate with malnutrition, but the origin of the food products was assumed to play a role. Thus, food items, animal products, vegetables and plant products were grouped according to their origin:

1. Food items derived from own production: plant products (mainly pumpkins, gourd, eggplants, green beans) and products of domesticated animals (mainly chicken or goat).
2. Food items derived from foraging: plant products (mainly banana-flowers, other banana products, bamboo sprouts, rattan sprouts, taro, cassava, other roots) and animal products (meat of hunted wild animals and insects collected).

Unifactorial analysis of variance complemented the multiple regression analysis to allow for better interpretation and description of results (ANOVA unifactorial, presented in table 22, regression, multi-factorial presented at annex 6).

Food items comprising of condiments, aquatic products or DGLV were excluded from the final disaggregated analysis described above. Those products are consumed on a regular basis by all households, and are mainly ingredients to improve the taste of a meal. Those products were commonly collected in the nearby surrounding areas regardless of access to one's own production areas or forest resources, food security situation, poverty status or the household's location. The consumption of such products was not associated with the nutritional status applying the unifactorial analysis (i.e. spices or herbs, fresh water food such as shell fish, crab or small fish, DGLV).

Higher food diversity was associated to a better nutritional status when comprising of animal products or vegetables derived from own production. The height-for-age z-score improved by 0.34 z-score units comparing the group consuming no food item from own production compared to those consuming two or more items from own produce (ANOVA, $p = 0.085$, table 21 and annex 6).

Contrary, a higher food diversity comprising of foods from wild resources, animal products, vegetables or roots, was associated with a lower nutritional status. Height-for-age z-score decreased by 0.55 z-score units for those not consuming any wild products compared to those consuming more than two products (ANOVA, $p = 0.002$, table 21 and annex 6). Access to agricultural resources, food security status or the economic situation of a household did not confound those results (tested for income, occupation, farming system, rice sufficiency, rice consumption).

Table 21: Number of food items and nutritional status by source in 1997

	Source of food items			
	Production/cultivation[1]		Wild sources [2]	
Number of food groups item by source	n	Mean HAZ ± SD	n	Mean HAZ ± SD
No item	347	-2.77 ± 1.34	134	-2.43 ± 1.35
One item	134	-2.54 ± 1.28	299	-2.81 ± 1.30
Two or more items	4	-2.44 ± 1.21	33	-2.97 ± 1.24
Level of significance [3]	485	p = 0.085	466	p = 0.002

[1] Domestic production or cultivation: plant and animal products
[2] Products from wild sources: non-DGLV, roots or animal products
[3] ANOVA, unifactorial

Changes in food intake

The per capita rice consumption was still high in 2001 (540 g/day/capita), also there was no change in the number of meals consumed by a family over the course of a day (94.8% in 1997 and 95.2% in 2001).

3.2.2 Infant and young child feeding

Information on infant and young child feeding (IYCF) practices, mainly comprising of breast-feeding and weaning practices, were obtained by assessing the time of initiation of breastfeeding, use of colostrum, time and type of the first complementary food, time of introducing vegetables and meat to the child as well as the duration of breastfeeding.

Initiation of breastfeeding

International guidelines recommend starting breastfeeding within the first hour after delivery. The immediate initiation of breastfeeding right after birth is most important to stimulate milk production. The provision of colostrum, produced in the first three days after delivery contains essential fats, micronutrients and antibodies necessary to assure an optimal nutrition and immune protection of the newborn (WHO 2004, p. 1-2).

Breastfeeding practices differed for the two districts studied. In Sing district, breastfeeding was started within the first 24 hours for most children (table 22). In Nalae district, about half of the children were breastfed within the first 24 hours; others received milk only on the second or third day after delivery. Initiation of

breastfeeding later than 3 days after delivery was rare (1.3% total, 2.2% in Nalae, 0.3% in Sing district).

Table 22: Initiation of breastfeeding in 1997 (n = 608, in %)

		Nalae	Sing	Total
Time period	n	n = 313	n = 295	n = 608
< 24 hours	467	56.2	98.6	76.8
> 24 hours	141	43.7	1.3	23.2

In Nalae district, more than one third (38%) of the mothers discarded colostrum for up to two and three days after delivery. The provision of pre-lacteal food, food provided before any colostrum or before breastfeeding was started, was a major problem (table 23). Pre-masticated rice was the preferred item and 0.3% provided sugar water (Nalae district only).

Table 23: Type of first feeding by district in 1997 (n=609, in %)

		Nalae	Sing	Total
Type of first feeding	n	n = 313	n = 295	n = 608
Breast milk	404	35.4	99.3	66.4
Pre-lacteal feeding	205	64.2	0.7	33.5

Time of introducing complementary food and exclusive breast-feeding

The pattern of the exclusive breast-feeding and the introduction of complementary food varied tremendously between the two districts. Generally, children in Nalae district received complementary food much too early, while the children in Sing district received complementary food much too late (table 24). In Nalae most children received rice already as pre-lacteal food or during the first days of life. The feeding of rice complementary to breast milk continued thereafter. Only very few children received the first complementary food at the age of 4 to 6 months[4]. Contrary in Sing district, only a small percentage of children received complementary food too early, about one third at the age of 4 to 6 months, and almost half of them received complementary food only between 6 and 12 months of age. Here, almost one fifth of

[4] At the time the study took place the Lao national recommendation was to introduce complementary food at the age of 4 to 6 months (minimum of 3 months exclusive breastfeeding). The recent WHO recommendations for exclusive breast-feeding up to 6 months were not yet accepted in Lao PDR in 2001. But in 2004 the new guidelines were adopted recommending the introduction of complementary foods at the age of 6 months (World Bank 2004, p. 3).

all children were exclusively breastfed up to the age of 12 months and received complementary food only thereafter.

Table 24: Time of first introduction of complementary food by district in 1997 (in %)

Age group in months	n	Nalae n = 309	Sing n = 257	Total n = 566
≤ 3	301	95.5	2.3	53.2
4 - 6	90	2.9	31.5	15.9
7 - 11	126	1.3	47.5	22.3
≥ 12	49	0.3	18.7	8.7

Type of first complementary food

The majority of the children received pre-masticated, chewed or steamed rice as a first complementary food (Nalae district 97.1%, Sing district 78.2%), others received plain rice prepared as porridge or soup (Nalae district 1.0%, Sing district 3.5%) or mixed food from the family's pot (Nalae district 0.6%, Sing district 5.1%). The provision of plant or animal products was seldom. Complementary food was bulky, difficult to chew, or too liquid, hence, low in nutrient density and therefore not adequate to meet physiological and nutrient requirements. Complementary food consisting of a variety of different nutritious food items and provided in form of a smooth porridge, ensuring the required nutrient density and more appropriate for the infant to digest, was uncommon in Nalae district and slightly more frequently provided in Sing district (Nalae district 1.3%, Sing district 13.2%).

Complementary foods, apart from rice, were usually introduced much too late to meet nutritional requirements. Vegetables or fruits were introduced even much later than animal products (50% of the children received plant products for the first time at the age of 9 months only, but animal products at the age of 7 months).

One quarter of the children in Nalae district received animal products even before the age of 4 months and almost half of the children at the age of 4 - 6 months (median 6 months). Nearly one third received vegetables or fruits only at the age of 12 months or even later (median 8 months). In Sing district both food items were introduced much later. Almost 80% of the children received animal products and almost 90% received plant products only when they were older than 6 months (meat: median 8 months; vegetables: median 10 months, table 25).

Table 25: Age of first introduction of plant and animal products by district in 1997 (in %)

	Nalae		Sing		Total	
Age groups (in months)	Animal products[1] n = 292	Plant products[2] n = 284	Animal products[1] n = 255	Plant products[2] n = 248	Animal products[1] n = 547	Plant products[2] n = 532
≤ 3	24.3	5.3	1.6	1.6	13.7	3.6
4 - 6	46.9	37.3	19.2	8.9	24.0	24.1
7 - 11	19.9	28.9	49.0	43.1	33.5	35.5
≥ 12	8.9	28.5	30.2	46.4	18.8	36.8

[1] Animal products: animal sources, hunted or raised, aquatic foods, eggs
[2] Plant products: plant sources (grown or collected), vegetables or fruits

Whether or not the weaning pattern was different for populations living in remote locations compared to those living closer to peri-urban centers was also examined. Remote villages had a considerably higher number of children who received additional food, including plant or animal products, too late, often at an age older than 11 months (table 26).

Table 26: Accessibility of location and introduction of complementary food in 1997 (in %, n = 532)

Determinants	Age groups (in months)	Accessibility		Level of significance[1]
		Nearby	Remote	
First complementary food (mainly rice)	4 - 6	14.0	17.3	n. sign.
	> 11	2.9	13.1	p < 0.001
Introduction – plant products	4 - 6	31.0	18.5	p = 0.002
	> 11	24.1	43.1	p < 0.001
Introduction – animal products	4 - 6	34.8	38.8	n. sign.
	> 11	11.0	22.1	p = 0.001

[1] Chi-square, Pearson to identify differences by location

Duration of breast-feeding

The WHO recommends continuing breastfeeding up to the age of 24 months and beyond (WHO 2003a, p. 8). Long duration of breastfeeding was a common practice within the area studied (table 27), 50% of the children were breastfed for 27 months (mean 24 months in Nalae district and 29 months in Sing district). Only 2.8% of the mothers stopped breastfeeding before the child was 12 months old. In Nalae district, some children continued to receive breast milk even beyond the delivery of the newborn sibling (14.4%). This habit was culturally taboo in Sing district. In both districts, it was the intention to make use of breast milk as long as possible. The main

reasons for stopping breastfeeding was a subsequent pregnancy, delivery, or the discontinuation of milk production, which was perceived as natural.

Table 27: Duration of breastfeeding by age group and district in 1997 (in %)

Age groups (in months)	n	Nalae n = 125	Sing n = 77	Total n = 202
≤ 18	36	13.6	24.7	17.8
19 - 24	65	40.0	19.5	32.2
25 - 30	34	19.2	13.0	16.8
31 - 36	49	19.2	32.5	24.3
> 36	18	8.0	10.4	8.9

Infant and young child feeding practices and nutritional status

Early infant feeding

The time of initiation of breast-feeding did not show an association with the child's nutritional status considering the total sample of children under 5 years. However, there was such an association noticeable, but statistically insignificant, when considering a sub-sample of children less than 6 months of age. Those receiving breast milk during the first 24 hours were nutritionally better off than those receiving breast milk later (n = 50, ANOVA, age-adjusted, HAZ -1.42, SE=0.21 compared to -1.89, SE=0.33, p = 0.25; stunting 28.6% compared to 40%, p = 0.5).

Age-adjusted threefactorial analysis including children below 12 months only and considering variables of early infant feeding, showed that children receiving breast milk during the first 24 hours had a better height-for-age z-score than those receiving breast milk later (HAZ -0.99, SE 0.32 and -1.85, SE 0.49, p = 0.082, annex 7). Pre-lacteal feeding had no impact, nor did the type of first complementary food provided (p = 0.34, p = 0.26 respectively). No difference was observed for weight-for-height z-score or morbidity.

Weaning age and nutritional status

Age-adjusted threefactorial analysis (timing of introduction of common complementary food, introduction of plant products and introduction of animal products) indicated that the children receiving the first additional food or animal products before four months or later than six months were better off than those receiving it at the age of 4 - 6 months, while those receiving plant products at the age

of 4 - 6 months were better off (table 28). Those results were not significant applying the threefactorial model.

Table 28: Introduction of common complementary food, plant and animal products and height-for-age in 1997 (ANOVA, multifactorial, age as covariate, n = 519)

Age groups (in months)	Introduction of complementary food (rice mainly)		Introduction of plant products		Introduction of animal products	
	n	Mean HAZ (SE)	n	Mean HAZ (SE)	n	Mean HAZ (SE)
≤ 3	264	-2.69 (0.12)	18	-2.71 (0.33)	67	-2.49 (0.26)
4 - 6	86	-2.86 (0.19)	125	-2.53 (0.23)	173	-2.86 (0.20)
7 - 11	120	-2.64 (0.29)	181	-2.66 (0.19)	176	-2.77 (0.17)
≥ 12	49	-2.36 (0.64)	195	-2.86 (0.16)	103	-2.63 (0.23)
Level of significance	p = 0.766		p = 0.620		p = 0.887	

Age-adjusted threefactorial analysis showed that weight-for-height z-score was worst for those children receiving first complementary food or animal products at the age of 4 - 6 months. However, results are not significant (table 29).

Table 29: Introduction of complementary food, plant and animal products and weight-for-height in 1997 (ANOVA, multifactorial, age as covariate)

Age groups (in months)	Introduction of complementary food (rice mainly)		Introduction of plant products		Introduction of animal products	
	n	Mean WHZ (SE)	n	Mean WHZ (SE)	n	Mean WHZ (SE)
≤ 3	264	-0.69 (0.10)	18	-1.03 (0.33)	67	-0.71 (0.21)
4 - 6	86	-0.75 (0.15)	125	-0.82 (0.18)	173	-0.89 (0.16)
7 - 11	120	-0.71 (0.23)	181	-0.53 (0.15)	176	-0.60 (0.14)
≥ 12	49	-0.67 (0.51)	195	-0.65 (0.13)	103	-0.66 (0.17)
Level of significance	p = 0.63		p = 0.18		p = 0.61	

Weaning age and diseases

There was a strong association between morbidity and the time of weaning. Children receiving complementary food before or later than 4 to 6 months of age were at a higher risk to suffer from diseases than those receiving it at the recommended age (table 30). The number of diarrhoeal episodes continued to increase with a further delay of weaning beyond the age of 11 months (2.2 episodes, $p < 0.001$). Frequency

of other diseases did not change with any further delay in weaning. Associations between weaning and morbidity were not observed for the 2001 data.

Table 30: Time of weaning and morbidity in 1997

Age groups (in months)	Point prevalence [1]		Distended abdomen		Diarrhoeal episodes	
	n	%	n	%	n	No. of episodes (SE)
< 4	284	38.5	296	38.9	296	1.4 (0.94)
4 - 6	89	21.1	90	29.5	89	1.1 (0.17)
6 - 11	124	36.6	125	39.0	124	1.9 (0.15)
≥ 12	49	30.0	48	23.8	49	2.2 (0.23)
Level of significance[2]	p = 0.019		p = 0.13		p < 0.001	

[1] Composite indicators comprising of frequency for ARI, diarrhoeal diseases and fever at the day of interview.

[2] ANOVA, unifactorial, age as covariate, average age estimated 30 months.

No association was found for other indicators such as initiation of breastfeeding, provision of colostrum, introduction of pre-lacteal foods and morbidity.

Duration of breastfeeding and associations to nutritional status

Including age as covariate, the duration of breastfeeding did neither show any significant association to chronic nor acute malnutrition (ANOVA, age-adjusted).

Significant differences were seen when analysing reasons to stop breastfeeding. Children of mothers who stated having had no more breast milk as a reason to stop showed a better nutritional status than children of mothers who stopped because they were pregnant again (HAZ mean -2.5 compared to -2.9, ANOVA, p = 0.047, age-adjusted). Also among the group of children being severely stunted significantly more mothers stated a new pregnancy as the reason to stop breastfeeding (Chi square, Pearson, p = 0.01). No significant association was noticed for reasons to stop and duration of breastfeeding, those being pregnant again breastfed 2.6 months longer than others (ANOVA, age-adjusted, 27.6 months and 25.0 months, p = 0.11). There was no association between the duration of breastfeeding and mothers' nutritional status.

It is important to note that children who had to share the breast milk from the first day onwards with their older siblings had a higher prevalence rate for chronic malnutrition (62.3% compared to 56.3%, HAZ -2.1 compared to HAZ -2.4, not significant, n = 36).

Multifactorial analysis - sectoral model - IYCF indicators

Performing a multiple regression including variables of IYCF shows that none of the early infant feeding variables showed an association with malnutrition or morbidity (annex 7). Similar to the results obtained from unifactorial analysis, the multifactorial model revealed a positive association between the introduction of plant products at the age of 4 to 6 months and a better height-for-age z-score (regression coefficient = -0.25, p = 0.05). Also reasons to stop breastfeeding remained a significant determinant to chronic malnutrition (no breast milk any more versus new pregnancy: regression coefficient = -0.46, p = 0.05).

The duration of breastfeeding was negatively associated with malnutrition, the longer the duration the lower the child's status (regression coefficient=-0.189, p = 0.09). None of the variables included in the multifactorial model was associated to acute malnutrition. The introduction of vegetables at the age of four to six months was related with a lower prevalence of diseases (composite indicators, point prevalence fever, ARI, diarrhoea, p = 0.04; distended abdomen, p = 0.002; diarrhoeal episodes, p = 0.045). Other variables did not show any significant impact applying the multifactorial model (annex 7).

Changes in infant and young child feeding practices

Initiation of breastfeeding

A change was observed for the year 2001, particularly in Nalae district, where IYCF practices were particularly worrisome. I.e. the share of children receiving colostrum as first food rather than pre-lacteal foods, mainly rice, increased from one third to two thirds (table 31). Similar improvements were observed for the initiation of breastfeeding during the first 24 hours. Nevertheless, even in 2001 still more than half of all children received rice on the first day of life (1997: 76.2% and 2001: 58.1%), while the feeding of rice continued in addition to colostrum or breast milk thereafter. At the age of three months, rice was already introduced to most children (1997 96% and 2001 91%). Introduction of pre-lacteal foods or a too early introduction of complementary food was not a problem in Sing district.

Introduction of complementary food

The time-pattern of introducing complementary food did not change much and no improvements were observed for the introduction of plant or animal products (table 31). In Nalae district most children received additional foods other than rice, too early, the percentage of children receiving plant or animal products before 4 months of age even increased (from 24.3% to 27.2% for plant products and from 5.3% to 16.3% for animal products in 1997 and 2001, respectively). In Sing district, complementary food apart from rice was introduced too late in 1997 as well as in 2001.

The percent of children receiving a more balanced complementary food (better in quality than just plain rice), doubled, but was still low. The situation was better for children in Sing district, here almost one fifth of the children received a better quality of complementary food.

Table 31: Initiation of breastfeeding and introduction of complementary food in 1997 and 2001 (1997: n = 614, 2001: n = 882; in %)

	Nalae		Sing		Total	
	1997	2001	1997	2001	1997	2001
Practices	n = 311	n = 466	n = 295	n = 411	n = 606	n = 877
Receive colostrum as first food	34.4	65.9	99.3	99.1	44.2	86.3
Start breastfeeding during first 24 hours	56.2	89.3	98.6	98.8	76.8	93.7
Introduction of complementary foods at the age of 4 to 6 months[1]	n = 309	n = 455	n = 257	n = 347	n = 566	n = 802
Rice	2.9	6.2	31.5	33.3	15.9	17.9
Plant products	37.3	40	8.9	12	24.1	27.6
Animal products[2]	46.9	39.6	19.2	24.6	30.3	32.8
Better quality of complementary food	1.3	7.4	13.2	19.4	6.7	12.6

[1] Following the Lao National dietary guidelines, which recommends the provision of additional foods at the age of 4 to 6 months (3 months exclusive breastfeeding)

[2] Refers to animal products: meat, fish, eggs, and aquatic products

Duration of breast-feeding

No change was observed for the duration of breastfeeding, nor for the reasons to stop breastfeeding. Usually children were breastfed as long as possible, the average duration was 27 months, only 2.8% in 1997 and 2.6% in 2001 stopped before the child was one year old. The reasons given for stopping breastfeeding were either a subsequent pregnancy or the ending of breast milk.

3.2.3 Health status

Methodological considerations

To assess the prevalence of nutrition-related diseases children were examined for acute respiratory infections (ARI), unspecified fever, skin diseases and signs of distended abdomen. Within the given environment, an advanced stage of severe intestinal parasite infections was assumed to be the predominant cause of a distended abdomen (Seidlein v et al 1997). However, severe and repeated malaria infections are likely to lead to a malfunction and enlargement of the liver or spleen, which may appear as diffuse swellings. This complicates differentiation and diagnosis. The signs and identification of a distended abdomen may therefore also include children having swollen organs due to severe and repeated malaria infections.

Questions with regard to the general health status as well as diarrhoeal diseases were asked of the respondent, but here verification by the health team was not possible, as acute symptoms were not necessarily observable at the day of the interview, hence the results reflect the respondents' perceptions only.

Results

At the start of the programme, the point prevalence[5] of nutrition related infectious diseases was very high for both districts. At the day of the interview, one third of the children suffered from either one, ARI, diarrhoeal diseases or unspecified fever. ARI was highly prevalent, about a quarter of the children suffered from ARI, whereas skin infections and unspecified fever were less prevalent. A distended abdomen was observed in one third of the children (table 32).

[5] Point prevalence refers to the percentage of children suffering from a given disease at the day of the interview.

Table 32: Morbidity by age groups in 1997 (in %)

Age groups (in months)	n	ARI n = 145	Diarrhea n = 202	Fever n = 38	Skin Infection n = 34	Distended abdomen n = 202
< 6	53	11.3	9.4	1.9	0	3.8
6 - 12	75	30.7	10.8	9.5	12.5	12.0
12 - 24	137	22.6	16.2	6.6	2.9	39.7
24 - 36	134	24.6	12.8	8.2	6.0	41.8
36 - 48	101	22.8	4.0	4.0	8.0	37.0
> 48	108	26.9	1.9	5.6	4.6	41.1
Total	608	23.8	9.6	6.3	5.6	33.4

Beyond the acute infections at the day of the interview, respondents were also asked about the health status of the child in general. In 1997 more than one third of the respondents (36%) stated that the child was not healthy. Frequent diarrhoeal diseases (15.4%) and repeated malaria attacks (12%), cough, flue other respiratory infections (5.6%), fever or convulsions associated with diarrhoea or injuries due to accidents (3%) were the problems reported.

Health status by age

Unspecified fever, ARI, and skin infections were highly prevalent for children at the age of 6 to 12 months, while the latter decreased with age, but fever remained at high levels (table 32). Diarrhoeal diseases were also high for the youngest age group 6 to 12 months and remained at high levels up the to the completion of 36 months, while the peak was at the age of 12 to 24 months. Similarly, episodes of diarrhoea showed a similar trend and were highest for the 12 to 24 months old (mean 1.92 episodes for the 12 to 24 months old, compared to an average of 1.5). The percent of children showing signs of a distended abdomen increased continuously up to 24 months, and was higher for the older children (24.6% for children below 24 months compared to 40.2% for children 24 months or older).

Seasonality of diseases

Semi-structured interviews were conducted to collect information regarding the seasonal occurrence of diseases. Results indicated great variations for the different seasons, whereas the climate and the respective working load were reported as the major causes to the changes. Diarrhoeal infections were stated to have their main peak during the early period of the rainy season, from May to July, while malaria was

also most common during the rainy season, but started a little later and lasted for one more month, June to August. Respiratory infections were most common during the winter season, January to February. The increased workload during the cultivation seasons, May to July, diminishes time available for health care and nutrition. During those times, parents and children frequently stay in the fields for many hours or even during the night, increased exposure combined with the lack of means for protection leads to the increased risk. As a result, malnutrition is stated to increase in May, June to August are the months of highest nutritional vulnerability. A calendar presenting villagers perception on the seasonality of nutrition related diseases and the interrelation to malnutrition and its seasonal fluctuation is presented in annex 8 (source: focus group discussion 1997). The survey was conducted during the dry season, between February and May.

Health and nutritional status

The different infectious diseases were associated among each other applying a unifactorial analysis. Signs of distended abdomen closely correlated with episodes of diarrhoea (ANOVA, $p = 0.004$). Children suffering from ARI had higher prevalence rates of fever (Chi-square, Fisher's exact test, $p < 0.001$ for both).

To allow a more specific analysis of the effects of the single determinant on malnutrition a multifactorial analysis was performed. The model incorporated the point prevalence of the three nutrition related diseases as single indicators as well as a composite indicator combining the three (diarrhoeal diseases, acute respiratory infections, unspecified fever), number of diarrhoeal episodes over the past six months and signs of a distended abdomen; age was included in the model as confounding factor.

No significant association between nutritional status and the point prevalence of nutrition related diseases as single or composite indicator was observed applying uni- or multifactorial analysis (table 33).

Table 33: Morbidity and height-for-age in 1997

Health Determinant	Regression coefficient	SE	Level of significance
Diarrhoeal episodes	- 0.197	0.109	p = 0.072
Distended abdomen	- 0.204	0.115	p = 0.077
Point prevalence[1]	- 0.093	0.115	p = 0.421

[1] Composite indicator: ARI, unspecified fever and diarrhoeal diseases
[2] Linear regression, multifactorial, sector-wise, n = 574

Unifactorial analysis of the 1997 and 2001 data showed an increased risk of chronic and acute malnutrition with every episode of diarrhoeal disease (Pearson correlation: for HAZ, correlation coefficient = -0.12, $p < 0.001$, for WHZ, correlation coefficient = -0.12, $p = 0.003$). Linear regression showed that every episode of diarrhoea resulted in a reduction of height-for-age by 0.1 z-score units and weight-for-height by 0.07 z-score units (HAZ regression coefficient = -0.096, $p < 0.001$, HAZ mean -2.43; WHZ regression coefficient=-0.071, $p < 0.001$, WHZ mean -0.45). Expressed as a relative percentage, one episode of diarrhoeal disease causes a 4% reduction in height-for-age and a 16% reduction in weight-for-height z-scores. Linear regression applying chronic malnutrition as dependent variable (dichotome) shows an estimated increase of chronic malnutrition of 3.3% for every episode of diarrhoea (regression coefficient = 0.033, $p = 0.001$)

Prevalence rates of diarrhoeal episodes were higher for those suffering from other infections. The multifactorial analysis model showed a similar trend as the unifactorial analysis: children suffering from more than one diarrhoeal episode over the last six months had a lower nutritional status (regression, multifactorial, age was included; HAZ, $p = 0.072$, table 33; WHZ, $p = 0.003$, table 34).

Table 34: Morbidity and weight-for-height in 1997

Health determinant	Regression coefficient	SE	Level of significance
Diarrhoeal episodes	- 0.080	0.28	p = 0.003
Point prevalence[1]	+ 0.002	0.98	p = 0.980

[1] Composite indicator: ARI, unspecified fever and diarrhoeal diseases
[2] linear regression, multifactorial, sector-wise, n = 574

Children showing signs of a distended abdomen had a lower height-for-age z-score than their peers not showing such signs ($p = 0.08$, table 33). Accordingly, those children also had a significantly higher rate for chronic malnutrition (75.5% compared

to 66.0%, regression, multifactorial, age was included, p = 0.018). The sectoral multifactorial logistic regression analysis showed a 55% higher risk of malnutrition for those who showed such signs (logistic regression, odds ratio = 0.55, CI 0.36 to 0.85, p = 0.007).

Health and anaemia

Multifactorial analysis considering the nutrition related diseases as determinants and age as confounding factor showed a close association between diseases and increased risk for anaemia. The association was significant for unspecified fever, ARI and diarrhoeal episodes (table 35).

Table 35: Morbidity and anaemia in 1997

Determinant	Regression coefficient	SE	Level of significance
Point prevalence			
Unspecified fever	0.30	0.460	p < 0.001
Acute Respiratory Infections	0.08	0.027	p = 0.005
Diarrhoea	-0.04	0.040	p = 0.380
Distended abdomen	0.02	0.024	p = 0.450
Diarrhoeal episodes	0.08	0.023	p = 0.001

[1] linear regression, multifactorial, sector-wise, age was included, n = 576

Changes in morbidity

Measures to prevent as well as to treat infectious diseases were implemented by the IFSP. Clean water supply and environmental hygiene including hygiene promotion were preventive measures. Health service through community health workers aimed to treat most common diseases at an early stage. Parasite control through deworming was part of the curative services.

Over the period of four years of programme implementation children's health status improved. The number of children suffering from ARI, unspecified fever, distended abdomen or any further unspecified prolonged health problem dropped significantly (table 36). Frequency of skin infections was not extremely high at baseline and remained at a similar level.

Table 36: Morbidity by district in 1997 and 2001 (in %)

	Nalae		Sing		Total	
Diseases	1997 n = 315	2001 n = 467	1997 n = 294	2001 n = 422	1997 n = 609	2001 n = 889
ARI	29.7	3.6[2]	17.8	3.1[2]	24.0	3.4[3]
Unspecified fever	8.2	4.1[1]	4.7	3.6	6.5	3.8
Skin infections	4.8	4.5	6.4	4.0[1]	5.6	4.3
Distended abdomen	37.1	1.5[3]	29.2	13.0[3]	33.3	7.0[3]
Other health problems	41.0	3.4	30.2	4.5	36.0	3.9

Chi-square, Fisher's exact test: [1] $p < 0.05$; [2] $p < 0.01$; [3] $p < 0.001$.

The point prevalence of diarrhoeal diseases (table 37) within the whole sample reduced by almost one quarter, while changes were more obvious for Sing district. However, here the number of episodes during the six months prior to the interview did not change considerably. This was different for Nalae district, where the number of diarrhoeal episodes a child had in the past, was reduced significantly. The main change was observed within the group of children suffering from more than one episode (reduced from 43.2% to 25.3%; Chi-square, Fisher's exact test, two-sided, $p < 0.001$). In 2001 about half of the children did not suffer from any diarrhoea during the previous six months, compared to only one third in 1997 (table 37).

Table 37: Diarrhoeal diseases by district in 1997 and 2001 (in %)

	Nalae		Sing		Total	
	1997 n = 315)	2001 n = 466	1997 n = 294	2001 n = 420	1997 n = 609	2001 n = 886
Point prevalence[1]	8.0	7.1	11.1	7.9	9.5	7.4
Episodes (Number)[1]						
0	29.2	50.8[2]	37.8	37.5	33.3	44.5[2]
1	27.6	23.9	19.0	19.7	23.5	21.9
2	22.5	13.1	14.6	14.9	18.7	14.0
3	15.6	9.5	15.6	13.9	15.6	11.6
≥ 4	5.1	2.7	12.9	13.9	8.6	8.1
Mean	1.43	0.90[3]	1.65	1.68	1.54	1.28[3]

[1] Point prevalence in %, number of episodes in %
[2] Fisher's exact test for % of children suffering from any episodes, $p < 0.001$
[3] ANOVA comparison of means for number of episodes, $p = 0.002$

At the start of the programme, one third of the children suffered at least from one of the three major nutrition related diseases, either ARI, unspecified fever or diarrhoea at the day of the interview, this was reduced significantly in both districts (Nalae district 37.4% to 11.5%, $p < 0.001$, Sing district 28.1% to 11.1%, $p < 0.001$). In Nalae

district, health indicators improved significantly in both locations, but even more significantly in remote locations.

Mother's health status

In 1997 almost one quarter of all mothers surveyed stated not to feel healthy. Main diseases were either malaria, unspecified abdominal pain, respiratory infections, diarrhoea or others diseases comprising of headache, toothache, back-pain etc. In Sing district, opium addiction and its detrimental effects on the health status was another health concern listed. In both districts, frequent deliveries were stated as a major burden to women's health.

Similar to the health situation among children, mothers' health also improved considerably over the programme period. In 1997 almost one quarter of the women stated to be of weak health compared to only 3.7% in 2001 (Chi-square, Fisher's exact test, 2 sided, $p < 0.001$). Main diseases were malaria (reduced from 5.3% reduced to 0.6%), unspecified abdominal pain (4.7% to 0.2%), ARI (4.7% to 0.2%), diarrhoea (2.2% to 0.3%) or other health problems (comprising of headache, toothache, back pain, etc), which reduced from 8.9% to 2.3%. Prevalence and changes were similar for both districts.

3.3 Indirect causes

3.3.1 Access and use of health services

Health seeking behaviour

Diarrhoeal diseases were one of the most pervasive nutrition related diseases frequently causing malnutrition. This was the perception of villagers and also confirmed by the actual data. Early and effective treatment was seen as one of the most important and direct measures to prevent a deterioration of the nutritional status. Therefore, treatment of diarrhoeal diseases was also perceived as a suitable indicator to describe the health seeking behaviour of the population.

Among the population studied, health-seeking behaviour was critical before programme implementation but changed remarkably (table 38). In 1997, almost half of the parents did not consult anybody for advice to treat diarrhoea, about one

quarter followed the advice of non-trained persons. In 2001 the majority of parents, almost three quarters, consulted a trained health professional, a village health worker, a sub-district nurse, hospital staff or a trained pharmacists. The most evident change was the increased consultation of village health workers (nil in 1997 and 39.5% in 2001). The number of those not seeking any advice decreased correspondingly. The percent of those consulting traditional or spiritual healers did not change (about 14% for both years).

Table 38: Persons consulted for treatment of diarrhoea diseases in 1997(in %)

	Nalae		Sing		Total	
Person consulted	1997	2001	1997	2001	1997	2001
	n = 315	n = 450	n = 284	n = 373	n = 599	n = 823
Trained health worker[1]	32.7	78.8	21.8	61.8	27.5	71.1
Untrained person[2]	36.0	16.6	15.9	18.3	26.6	17.4
Nobody	30.8	4.7	62.3	19.6	45.7	11.4

[1] Village health workers, sub-district nurses, hospital staff or a pharmacists
[2] Traditional or spiritual healers, grandparents or other relatives

The quality of treatment improved simultaneously. The use of a commercial sugar-salt solution as immediate first aid treatment available from health workers increased from 9.6% to 23.2%, another quarter of diarrhoeal cases received further medical treatment from health workers (increased from 32.7% to 47.0%), mainly antibiotics (Berberine). Correspondingly, the number of children not receiving any treatment decreased from 17.6% to 6.8%, the use of traditional herbs, roots or opium dropped from 38.1% to 22.6%. The increased use of commercial sugar-salt solution was a success, still the promotion of homemade sugar-salt solution was not yet very successful (used in only 1% of all children). Lack of utensils and sugar were the main reasons given. Despite its provision through the village based drug revolving fund, the availability of sugar in villages was low.

Vaccination

The National Expanded Program on Immunisation (EPI) started in 1996 and was largely funded by UNICEF[6]. The kind of IFSP support to vaccination starting in 1996 was different in the two districts.

[6] The programme includes immunisation against major child hood diseases: DPT (diphtheria, whopping cough, tetanus), poliomyelitis (polio), measles and BCG vaccine (tuberculosis). National plans to achieve polio eradication[6] were a 10% increase per year, starting with 65% coverage in 1995, increasing to 75% in 1996 and to 85% in 1997. Still, an eradication of polio requires an increase up to 95% coverage. Starting in 1995 the provision of Vitamin A for pre-school children was included into

IFSP's support to vaccination – Nalae district

The IFSP did not provide any additional financial assistance, but did provide technical support in planning, implementation and reporting. Services entailed training and support of VHW, TBA as well as mobile health teams providing health education, measures to increase awareness and ensure community mobilisation, including the formation of village immunisation committees.

IFSP's support to vaccination – Sing district

The situation was different and more problematic in Sing district. Funds available at the District Health Office (DHO) were said to be insufficient to reach out to all remote locations. As agreed with government officials, the IFSP provided personnel and a financial contribution to reach most remote locations up to the end of 1998. Subsequently, the DHO expected to cover all costs through UNICEF and additional national funds. During 1999, 2000, and 2001, remote mountain villages were only reached for the national immunisation day against polio and measles in 2001 (2 applications per antigen and year). Still EPI was planned to continue in lowland locations throughout the IFSP's programme cycle.

Changes in coverage

The IFSP started its first support to the EPI in 1996. This explains the relatively high coverage at the time the baseline survey took place. Also a considerable number of children were holding immunisation and growth charts distributed with the support of the IFSP (62% in 1997 and 77% in 2001). Immunisation data were largely collected from this chart.

In Nalae district coverage doubled and tripled for polio, BCG vaccine, measles and DPT3 (figure 8). Although these were great achievements, the national target of achieving 85% coverage for DPT3 was not yet met in 2001. Coverage for polio vaccination was also insufficient to ensure an eradication (78% coverage achieved, 95% target). However, national targets were achieved with regard to vitamin A supplementation.

---

the national immunisation programme. The aim was to provide one capsule (200,000IU) annually to 80% of the children between one and five years of age. To achieve those targets, each village had to be visited four times a year for regular vaccination, and two more times during the national

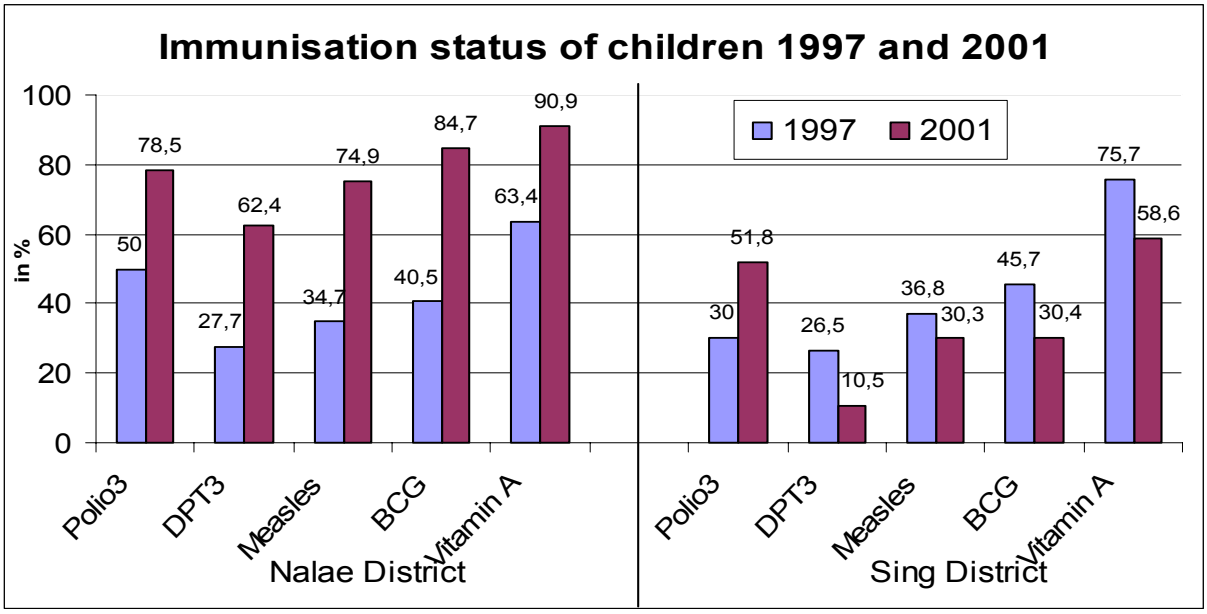


Figure 8: Immunisation coverage and vitamin A supplementation by district in 1997 and 2001 (children > 12 months of age).

The situation was totally different for Sing district. The immunisation coverage dropped between 1997 and 2001 (figure 8). Coverage was far below national targets for EPI even in more easily accessible areas. Moreover, coverage also decreased for measles and polio immunisation despite the continuation of the national immunisation days for measles and polio in March and May 2001. The coverage of vitamin A supplementation for children between 12 and 24 months decreased from 70.8% to 44%. Immunisation coverage for children between the age of 12 and 24 months in 1997 and 2001 is presented in annex 9 (table 1).

Changes of immunisation coverage by location

In Nalae district, changes were particularly obvious for remote locations whereas in Sing district coverage decreased in both locations, but even more drastically in remote locations (Nalae district: increase from 0 to 40.1% in remote locations and from 65.8% to 73.3% in nearby locations; Sing district: decrease from 14.0% in remote locations to 1.2%, and from 39.1 to 16.1% in nearby locations).

immunisation day for polio eradication, which usually took place in January and February. Between March and May 2001 two additional national immunisation days against measles were observed.

Access to health services and nutritional status

Immunisation coverage, completion of three injections by the age of 12 months, was used to indicate the availability, access and use of health services. Children who were fully immunised in 1997 showed a better nutritional status than those not or incompletely immunised (ANOVA, HAZ -2.34 compared to HAZ -2.70, $p = 0.002$, age-adjusted), but in 2001 the nutritional status was equal in the two groups. Frequency of distended abdomen was lower for immunised children (28.9% compared to 44.5%, ANOVA, age-adjusted, $p = 0.002$), but no difference was observed for the frequency of other diseases.

Immunisation coverage was higher for children whose parents were educated and where better hygiene was practiced (Chi-square, Fisher's exact test: use of latrines 22.3% compared to 4.1%, $p < 0.001$, treatment of drinking water, 68.1% and 25.5%, $p < 0.001$).

Growth monitoring and nutrition promotion

Growth monitoring and promotion (GMP) was set up by the IFSP in order to supervise the development of children, for early identification of problems and to provide well-targeted and specific support for proper development. Services were provided in Nalae district through DHO's mobile health teams till 2000, subsequently continued by VHW. In Sing district it was performed by IFSPs health personnel posted at sub-district service centres.

No GMP activities were implemented before 1997. In 2001, in Nalae district only about one third of the villages surveyed were covered by regular growth monitoring activities. In total about one quarter of all children studied participated in growth monitoring sessions. In Sing district, all villages located within the IFSP area were covered by GMP activities and more than one third of all children studied participated. In both districts, about three-quarters of the children measured were also visited at home for further diagnosis, medical treatment (mainly ARI, diarrhoea, malaria), health and nutrition education or other promotional activities (table 39).

Table 39: Participation in growth monitoring and promotion

	Nalae n = 466	Sing n = 417	Total n = 882
Participation rate	25.3%	38.1%	31.4%
No. of weighing sessions per child	1.9	2	1.9
Participation at promotion or home counselling	83.1%	68.0%	74.4%

Benefits of growth monitoring and promotion as perceived by the target population

Whether or not health and nutrition education were effective had to be studied more thoroughly. However, respondents interviewed revealed that the education was well understood and considered to be useful to improve the nutritional situation of their child. Subjects well understood were the following: importance of healthy foods, of a balanced diet, regular consumption of green leafy vegetables, and the need for protein rich foods such as eggs and fish for growth. Only one mother stated that it was not helpful for her, because she would not have the time and financial resources to provide a better and healthy food to her child (source: focus group discussions, response of a widow, Hatdao village, Nalae district).

Family planning

Frequent and closely spaced deliveries can be detrimental for mother's health and leads to depletion of body stores. Apart from the physiological burden, high number of children often leads to a high workload of the family at the time the children are small. In both districts, frequent deliveries were mentioned as the major burden to the women's health. On average, a mother of 40 years has had 7 to 8 deliveries.

Villagers expressed support for family planning as a priority intervention, but a national policy did not yet exist, hence the Government did not yet support a community-based programme in 1997. In 1998 the DHO with support of the IFSP in Nalae district started the introduction and implementation of a birth spacing programme on a pilot basis. In 2000 the programme was evaluated by the government and continued as a pilot of the National Family Planning Programme supported by UNFPA. In 2001 the National Family Planning Programme was under implementation as a pilot programme in about three quarters of the villages.

Methodological limitations

One has to bear in mind that only households with children under 5 years where visited, therefore households having less children nowadays were less likely to be included in the survey. Additionally, individuals studied benefited from IFSP support only during the previous four years, while the data collected to calculate the birth rate cover their entire reproductive life span (average of 10 within the given sample). To measure the impact more precisely and timely an analysis of annual demographic information is preferable, but was not available of the required quality.

Results - use of services

Before the start of the programme, the use of contraceptives was uncommon. This changed considerably in locations where services were provided. In 2001, among all mothers studied, one quarter was using contraceptives (25.2%). Participation in the Family Planning Programme did not differ by age, but was slightly higher for mothers who had already five or more deliveries (30.1% participation). In villages where the Family Planning Programme was directly targeted for implementation 30.7% of the mothers used contraceptives, but only 5.1% in villages not directly covered. Here mothers had to travel to other locations, such as the neighbouring villages, or the district or provincial hospitals to receive support. The participation was 95.7% for the villages closest to the district capital and decreased to 29.2% for villages along the riverside and accessible by a 2 to 3 hours boat ride (village Phavi 95.7%, Ohm 54.2%, Vaen 48.1%, Thonthrone 30.8%, Hatchala 47.8%, Hatdao 29.2%). Participation was significantly lower in remote locations, between 8.5% and 12.9% in villages only accessible through a walk of more than 2 to 3 hours (Phu Hoen 12.9%, Chomsy 9.7%, Saken 8.5%).

In Sing district the IFSP supported awareness raising and promotion of birth spacing, but the outreach health teams did not provide any kind of contraceptives at community level. Here 2.4% of the mothers used contraceptives. Those mothers were from villages close to the district capital or had easy access to markets in China (Phi Yer, Hua Na Gang, Hua Na Mai, Boukhou, and Phabatnoy village).

Results – Impact on birth rate

No changes were observed in the mother's birth rate for Sing district. In Nalae district the number of deliveries decreased slightly (from 4.5 to 4.4 deliveries per mother

interviewed, table 40). In contrast, despite the high awareness and participation in birth spacing measures, the number of children under five a mother had at the time of the interview increased (1.3 in 1997 to 1.5 in 2001).

Table 40: Number of birth and child death per mother by district in 1997 and 2001 (mean values)

	Nalae		Sing		Total	
Mean per mother	1997 n = 253	2001 n = 351	1997 n = 243	2001 n = 328	1997 n = 496	2001 n = 679
Deliveries	4.53	4.39	3.81	3.79	4.17	4.10
Children alive (all ages)	3.19	3.12	2.69	2.69	2.94	2.91
Children alive (< 5 years)	1.25	1.51	1.32	1.35	1.27	1.42
Children died (< 5 years)	1.36	1.29	1.21	1.10	1.29	1.20

Pre-natal and natal care

Health statistics and baseline information analysed at the beginning of the IFSP showed that the maternal mortality was extremely high. Child mortality was, as well, extremely high and showed its peak for new newborns within the first days and month. Core components of the support to the primary health programmes were early identification of complications, assistance and referral of risk pregnancies, proper care of newborns, such as the early initiation and promotion of breastfeeding etc. The IFSP in Nalae district supported the implementation of mother-child-health-care at village level particularly through the development of a training curriculum, and the recruitment, training and up grading of traditional birth attendants (TBAs). The role-out of the programme became effective at village level in early 1998. By the time the 2001 survey took place, three quarters of the villages studied had a trained TBA.

Use of services

In Nalae district, among all the mothers studied, 16.8% went for pre-natal consultation, 9.4% of them went once and 7.1% twice or more. Use of services was high for villages where the programme was under direct implementation, but low in those villages not directly covered (18% compared to 4.4%). Women of villages not covered went for consultation to the district hospital or consulted sub-district nurses. Coverage was still fairly low for prenatal consultations; still, the TBA played an important role in identifying and referring risk pregnancies. Hospital records showed an increasing number of mothers referred by TBAs for hospital delivery (Nalae hospital statistics).

In Sing district prenatal care services were predominantly performed by IFSP health staff supported by governments sub-district health staff. One village participated in Nalae's TBA programme. However, even in 2001, only 1.4% of the mothers went for prenatal consultations.

To assess the use of natal health care services, mothers were asked about the status of their most previous delivery; hence results reflect the situation of the five years previous to the studies. The number of deliveries assisted by skilled health personnel increased slightly for Nalae district (table 41). However, the positive trend became more obvious at the one-year period preceding the 2001 survey. During the period of one year prior to the survey, more than one third of the deliveries were assisted by trained health staff (29.9% of them by TBAs). Changes in Sing district were insignificant.

Table 41: Natal health care by district in 1997 and 2001 (in %)

	Nalae		Sing		Total	
	1997 n = 314	2001 n = 465	1997 n = 294	2001 n = 417	1997 n = 608	2001 n = 882
Not assisted [1]	44.9	40.7	21.4	21.3	33.6	31.6
Untrained person [2]	54.1	47.1	77.9	75.6	65.6	60.4
Trained staff [3]	0.6	12.1	0.3	2.6	0.5	7.6

[1] Birth-giving mother alone or with presence of the husband
[2] Assisted by mothers, grandmother or other experienced but un-trained villagers
[3] Trained health staff, such as trained birth attendant or sub-district health staff

Malaria control measures

A malaria control programme was part of the IFSP in both districts starting in 1998. In Nalae district the programme was continued with World Bank funds from 2000 onwards. Core messages were formulated, culturally appropriate information and communication material developed, education campaigns conducted, volunteers trained and a revolving fund established to make pre-impregnated bed nets available and to allow for net impregnation campaigns twice per year.

In 1997 bed nets were not used frequently, was almost nil for Sing district, and possibilities for impregnation did not exists. In 2001, 94.8% of the surveyed villages in Nalae district and 82.4% of the villages in Sing district participated in the malaria control program. In 2001 two thirds of the families used bed nets (table 42). Average

households owned 1 net for 3 family members (0.37 nets per family members, same results for both districts). However, the percentage of people using a net was higher for Nalae district, and here also one third of the nets were impregnated at least once during previous 12 months.

Table 42: Possession and use of bed nets in 2001

	Nalae n = 309	Sing n = 342	Total n = 651
No bed net	9.1	13.5	11.4
Using bed net	76.7	56.1	67.3
Impregnated bed net	64.8	18.8	43.9

3.3.2 Water, sanitation and hygiene

Water supply

Water supply systems were generally poor in terms of quality but also in terms of quantity. Shortages were common during the dry season, March/April to June. Basically seven different types of water sources were identified: river water was used only in Nalae district (4.8%), creek (18.1%), spring (45.6%), unprotected well or borehole (8.3%), improved-protected well (19.2%), water container close to the village fed by a locally taped spring (3.4%) and a gravity fed water system (0.6%) the later two were only used in Sing district. In summary, the majority of the households used local sources without any techniques to improve the quality (84.5%, river, creek, spring, well or borehole), and a few households used locally improved systems (15.5% container, local system gravity fed water supply using bamboo pipes).

Treatment of drinking water

Within the given context, none of the systems would supply purified or hygienic drinking water, thus treatment at household level was important. Only 16% of the households used to boil water before drinking, but 64% never boil their drinking water. About half of those did not like the taste of boiled water (50%), others stated lack of time (34%) or a lack of required utensils, such as a kettle (14%) as reasons for consuming unboiled water. Other methods for household based purification (i.e. local filter systems) were not applied.

Water source and treatment were closely correlated; the lower the water quality, the more households would consume boiled water. All households fetching river water

used to boil it, 35.1% among the group using other local sources, and 14.7% within the group using locally improved systems.

Water quality and nutritional status

A twofactorial covariance analysis revealed that both factors, water supply system and treatment, determined the nutritional status significantly (annex 9, table 9.2). This was different for acute malnutrition, here only water treatment was a significant determinant (ANOVA, multifactorial analysis, $p = 0.01$ for treatment of drinking water).

Water quality and association to infectious diseases

The number of diarrhoeal episodes was associated with the treatment of drinking water. Children of families boiling water had less diarrhoea than those consuming unboiled water (ANOVA, twofactorial, treatment and water system, 1.4 compared to 1.7 episodes, $p = 0.024$).

The frequency of signs on distended abdomen was associated with the water system as well as the treatment of the drinking water (ANOVA, twofactorial analysis, $p < 0.001$ for water system and $p = 0.04$ for treatment). The risk was highest for those getting drinking water from a local system (42.3%), followed by those that consume river water (28.6%), and was lowest for those consuming unboiled water from a locally improved system (11.8%).

The villagers identified an improved water supply as a priority for assistance. Thus, in 1997 and 1998 the IFSP in cooperation with a NGO specialising in water and sanitation supported the introduction and implementation of the water supply systems in both districts. Systems installed were either gravity fed water system or a protected reservoir or container for collecting spring water. Both systems ensure an improved quality and quantity of water in near distance to the houses. Training for village sanitation volunteers was part of the water and sanitation programme component.

In 2001 more than half of the households had access to an improved water system, either a gravity fed water system or a water reservoir (table 43).

Table 43: Water supply systems in 1997 and 2001 (in %)

Water systems	1997 n = 497	2001 n = 652	Level of significance[1]
Local systems	84.5	41.2	p < 0.001
Improved systems	15.5	58.7	p < 0.001

[1] Fisher's exact test, 2-sided, p < 0.001

An improvement was observed for the treatment of drinking water, the percent of households drinking unboiled water reduced noticeably (table 44). Still, less than half of those households that changed their behaviour did not always use boiled water but had unboiled water when being outside the village, i.e. for work in the forest or in the rice fields (annex 9, table 9.4).

Table 44: Purification[1] of drinking water in 1997 and 2001 (in %)

Purification	1997 n = 489	2001 n = 651	Level of significance[2]
Yes	35.6	55.3	p < 0.001
No	64.4	44.7	

[1] Purification: consumption of boiled water
[2] Fisher's exact test, 2-sided, p < 0.001

Change in water quality and nutritional status

In 2001 an additional 43.2% of the households had access to an improved water system and an additional 18.8% of the households consumed boiled water. Threefactorial covariance analysis, considering the water supply system, the treatment of drinking water as well as the year showed that both factors contributed significantly to the overall change in HAZ (ANOVA, threefactorial, age-adjusted, dependent variable HAZ, p = 0.008 for water system, p = 0.001 for treatment, p = 0.74 for the year, no interactions between the three factors, p = 0.74, table 45). An improvement of 0.31 z-score units was attributable to the improved system and 0.40 z-score units were attributable to the improved behaviour. Improved behaviour showed the same impact in both systems and vice versa.

Table 45: Water quality and height-for-age in 1997 and 2001

Water source	Purified[1]	1997 n = 477	2001 n = 646	Estimate mean p = 0.008
		Mean HAZ (SE)	Mean HAZ (SE)	
Improved	yes	-1.85 (0.37)	-2.21 (0.08)	
	no	-2.43 (0.15)	-2.50 (0.11)	-2.25 (0.11)
Local	yes	-2.40 (0.10)	-2.35 (0.13)	
	no	-2.85 (0.08)	-2.65 (0.10)	-2.56 (0.05)
Estimated mean p = 0.736		-2.39 (0.11)	-2.43 (0.05)	

ANCOVA, threefactorial, covariate age, estimated HAZ mean for purification of drinking water: -2-21 (SE 0.10) and -2.61 (SE 0.06), p = 0.001

Applying the same threefactorial analyses model, none of the factors was associated with the change in acute malnutrition, anaemia or morbidity, with the exception of the association with signs of distended abdomen. For the latter, both, system and treatment, contributed significantly to the reduced prevalence rate (24.2% for the local system and 7.3% for the improved system, $p < 0.001$; 19% and 13%, respectively for the consumption of boiled water, $p = 0.086$). The estimated risk was lowest for those consuming boiled water from an improved system and highest for those consuming unboiled water from a local system (7% and 45.2% respectively).

Household and human waste disposal

Within the given context, environmental hygiene was assumed to be one of the major factors contributing to malnutrition. Lack of waste disposal, human or household waste, contributes to an increased contamination, consequently contributing to an increased disease risk.

Waste disposal systems did not exist. The majority of the households in Nalae district disposed household waste outside the village into the forest surrounding (90%), while the near surrounding of the house was the predominant location for waste disposal in Sing district (97%).

Latrine facilities were uncommon (table 46), the forest was the most important place for defecation. The few latrines constructed were generally in a poor condition, dark and not ventilated sufficiently, often the hut and the ground cover were fragile and near to collapse. Children of households having latrine facilities (4.2% of the households) were nutritionally better off (ANOVA, -2.26 $\pm$ 1.22 and -2.74 $\pm$ 1.33,

p = 0.003, n = 485). Possession of latrines was not associated to acute malnutrition, anaemia or mothers nutritional status.

The association between human waste disposal and morbidity was noticeable, but statistically not significant. Children of households having a pit latrine suffered less frequently from diarrhoeal episodes (1.2 compared to 1.6 episodes, p = 0.18, or 34% percent had at least one attack over the last 6 months compared to 46% within the group of not having latrines, p = 0.15). Their children also had a lower risk for distended abdomen (26.2% compared to 37.8%, p = 0.18).

Construction of latrine facilities was planned as part of the water and sanitation programme in both districts. Hygiene promotion was an important component. By the end of the programme, latrine facilities were still uncommon in Sing district, while in Nalae about one third of the household surveyed used water sealed toilets.

Table 46: Sanitary facilities by district in 1997 and 2001 (1997: n = 475, 2001: n = 652, in %)

	Nalae		Sing		Total	
Sanitary facilities	1997	2001	1997	2001	1997	2001
Pit latrine	8.2	6.8	0	0.3	4.1	3.4
Toilet	0.2	31.3	0	0	0.1	14.9

Hygienic housing conditions

Unhygienic, dark and insufficiently ventilated houses, and the subsequently higher indoor pollution, increases the risk for environmental contamination, hence, the risk for communicable diseases such as skin infections, scabies, respiratory infections, diarrhoea, and also malaria.

Within the sample studied 6.3% of the houses were in a very unhygienic condition and about one quarter (24.2%) were judged by the survey team as being too dark and not sufficiently ventilated, only 13.7% were well ventilated. Many houses were constructed without any window (91% of the houses in Sing district and 40% of the houses in Nalae district).

Hygiene and nutritional status

Children living in houses well ventilated were significantly better off than those living in houses not well ventilated, their rate of chronic malnutrition ranged from 61.2% to 79.7%. A better nutritional status was also observed for those living in cleaner houses (table 47).

Table 47: Hygiene conditions and height-for-age in 1997 (ANOVA, unifactorial)

Hygiene conditions		n	Mean HAZ ± SD
Ventilation	Insufficient	118	-2.89 ± 1.25
	Medium	299	-2.72 ± 1.35
	Good	67	-2.26 ± 1.26
	Level of significance		p = 0.005
Hygienic housing	Insufficient	401	-2.77 ± 1.33
	Good	81	-2.34 ± 1.27
	Level of significance		p = 0.008

Hygiene and diseases

Hygiene indicators, composed of clean housing and ventilation, did not correlate with the prevalence of infectious diseases assessed as point prevalence (tested as single or composite indicator). Still, a noticeable difference was observed for episodes of diarrhoea. Those living in houses well ventilated or in a clean condition were less likely to suffer from episodes of diarrhoea (ANOVA, 1.1 and 1.7 episodes, p = 0.009, n = 487).

Changes

No changes were observed for Sing district. In Nalae district the percentage of houses judged of being well ventilated and having enough daylight increased from 21% to 30.3%. The number of houses being in a hygienic and clean condition increased from 12% to 19%. This was mainly due to the use of improved construction material and the increased use of commercial roofing materials, which allows for cleaner conditions.

3.3.3 Food security and livelihood

Food production

Rice production

Subsistence upland farming is the predominant livelihood system of the population studied in Nalae and Sing district. The IFSP supported the development and the implementation of sustainable upland farming systems. The ultimate aim was to provide suitable and sustainable alternatives to 'slash-and-burn' cultivation techniques and to increase productivity. The focus was on improved upland systems, including terracing, alley crop, intercropping and soil management techniques; it also included the introduction of flatland rice production. Flatland rice fields[7] are either rain fed or irrigated through small-scale irrigation systems, providing one or two harvests per year, respectively. Flatland rice production requires small plots of flat land either in valleys or terraced. The IFSP supported the development of flatland production, but was not heavily involved in lowland production.

The percent of households farming as their main occupation was the same in 1997 and 2001 (97.2%, no change). There was a considerable trend towards the adoption of the more sustainable and productive flatland rice production system. In 2001 fewer families practiced slash-and-burn cultivation and more families applied flatland rice production as their dominant system for producing their major staple, rice (table 48). In Nalae district flatland production was not a common system before, and changes observed in 2001 were evenly distributed over the district. For Sing district, changes predominantly took place in remote mountain villages (Xai and Xieng Khaeng sub-district), while a share of villagers living close to lowland areas were already practicing paddy[8] rice production at the time the baseline survey took place (Thong Mai and Muang Mom sub-district).

[7] 'Flatland rice production' differs from 'lowland' rice production (the so-called lowlands in the highlands, New Agriculturist 2005). 'Lowland' rice production is a technical term typically applied for rice production in wider lowland areas, large valleys and mainly at lower altitudes. Lowland production usually involved larger scale irrigation systems.

[8] 'Paddy' refers either to 'low' or to 'flat' land rice production, and involves irrigation systems, small or large scale).

Table 48: Rice production system by district 1997 and 2001 (in %)

	Nalae		Sing		Total	
Production system	1997 n = 242	2001 n = 310	1997 n = 241	2001 n = 341	1997 n = 484	2001 n = 664
Slash-and-burn	89.8	77.1	60.1	42.8	75.2	59.1
Flatland (exclusively)	10.2	22.9[1]	39.9	57.2[1]	24.9	40.9[1]

[1] Differences between 1997 and 2001: Chi-square, Fisher's exact test, 2-sided, $p < 0.001$

Those cultivating flatland rice had an increased yield in 2001, despite the adverse climate conditions during the cultivation season prior to the survey (2,280 kg increased to 2,485 kg). Successes were greater for Sing district (from 2,421 kg to 2,690 kg).

Households depending on slash-and-burn cultivation had a much lower rice harvest (1,600 kg decreased to 1,370 kg between 1997 and 2001), whereas the reduction in Sing district was even more serious (1,733 kg to 1,365 kg, $p = 0.02$). The number of households considering the 2001 upland harvest as a bad harvest almost doubled compared to the year 1997. Information obtained from focus group discussions showed that weather conditions during the slash-and-burn cultivation season prior to the survey were extremely unfavourable. Heavy rain hindered proper and timely slash, burning and clearing up of the upland fields, continuation of rains during the cultivation season, caused extensive erosion, and hindered weeding. It was said to be the worst harvest since 1993 in most of the areas in Sing district and since 1980 for some villages in Nalae district. Consequently, almost half of the families doing upland rice had a relatively bad harvest compared to an average year (table 49).

Table 49: Harvest situation in December 1996 and December 2000 (1997: n = 360; 2001: n = 383, in %)

	Nalae		Sing		Total	
	1997	2001	1997	2001	1997	2001
Bad harvest	26.5	46.0	20.5	41.8	23.9	44.4

[1] Villagers self-assessment, upland farmers only

Despite the reduced availability of rice for households depending on shifting cultivation, the percentage of households stating to be rice sufficient increased from about one third to half (table 50). Changes were greater for Sing than for Nalae district.

Table 50: Rice sufficiency in 1997 and 2001, villagers self-assessment (in %)

District	Nalae		Sing		Total	
Rice sufficiency (in months)	1997 n = 243	2001 n = 309	1997 n = 241	2001 n = 335	1997 n = 484	2001 n = 664
< 6	22.2	16.2	16.2	13.1	19.2	14.6
6 - 11	37.0	28.9	48.9	35.9	43	32.5
> 11	40.6	55.1	34.8	51.0	37.9	53.2

Rice production and nutritional status

The unifactorial analysis model showed a negative association between rice production and nutritional status at baseline (regression, rice production in 100 kg/capita/year and HAZ, regression coefficient = 0.06, p = 0.032). Prevalence of malnutrition was significantly higher in households being rice sufficient (68.2% and 81% for households harvesting less and more than 360 kg/capita/year, respectively, Fisher's exact test, p = 0.009).

Rice consumption was lower in households doing upland farming compared to those doing flatland farming (527 g in upland households compared to 600 g, p < 0.001, ANOVA). Consumption was also lower for non-farmers compared to farmers (480 g compared to 560 g, not significant). Rice production or production system were not associated with the number of meals or diversity of side dishes.

Still, there was a difference between the two districts in showing changes in the nutritional status in relation to the adoption of the new rice production system (table 51). In Nalae district the situation at baseline was already much better among the few flatland farmers than among upland farmers. In 2001 the nutritional status had improved within both systems, and to a greater extent for the upland system. In Sing district, the baseline data showed that chronic malnutrition was equally high among upland farmers compared to flatland farmers. This was different by the end of the programme. In 2001 the nutritional status had improved significantly for flatland farmers and remained high among the group of upland farmers.

Table 51: Production system and chronic malnutrition in 1997 and 2001 (in %)

	Nalae		Sing		Total	
Production System	1997	2001	1997	2001	1997	2001
Slash-and-burn	n = 212	n = 235	n = 144	n = 144	n = 356	n = 379
	72.2	64.7[1]	70.8	71.5	71.6	67.3
Flatland	n = 25	n = 71	n = 96	n = 193	n = 121	n = 264
	56.0	50.7	76.0	58.3[2]	71.9	56.3[3]

[1,2,3] Comparing differences within the system between 1997 and 2001, Fisher's exact test, 2-sided, [1] $p < 0.01$, [2] $p < 0.004$, [3] $p = 0.005$

In order to calculate the effects of the production system in combination with the rice yields and changes observed over the years, a threefactorial covariance analysis was performed. Results of this sectoral analyses model show that the difference in nutritional status attributable to the production system was significant +0.2 z-score, $p = 0.046$). A significant difference was also attributable to the overall progress measured over the years (+0.3 z-score units, $p = 0.002$). Rice yields were not associated with the differences in nutritional status. The status was estimated lowest within the group of upland farmers being rice sufficient in 1997 and best within the group of lowland farmers being rice sufficient in 2001 (table 52), with 80.1% compared to 50%, respectively, when applying percent of chronic malnutrition (dependant variable dichotome). Thus, the adoption of the new production system supports the nutritional improvements significantly while the rice production did not play a role.

Table 52: Production system, rice yields and height-for-age in 1997 and 2001

		1997	2001	
Production system	Rice yields[1] n = 714 n = 280	Mean HAZ (SE) n = 461	Mean HAZ (SE) n = 533	Estimated marginal mean p = 0.026
Slash-and-burn (n = 620)	Insufficient	-2.70 (0.07)	-2.63 (0.08)	-2.64 (0.19)
	Sufficient	-2.84 (0.17)	-2.40 (0.19)	
Flatland (n = 374)	Insufficient	-2.47 (0.16)	-2.49 (0.11)	-2.45 (0.07)
	Sufficient	-2.49 (0.11)	-2.06 (0.11)	
Estimated marginal mean p = 0.002		-2.69 (0.06)	-2.39 (0.06)	

[1] Threefactorial covariance analysis, sector-wise. Covariate age: mean age estimated at 30.6 months, estimated marginal mean for rice sufficiency: -2.57 (SE 0.06) and -2.52 (SE 0.08), p = 0.56

Gardening

The IFSP supported the implementation of gardens. Cash crops such as sugar cane, coffee and cardamom, food crops such as soybeans, green beans, peanuts, sesame, maize and fruit-trees as well as vegetable production were promoted. The IFSP support focused on technical assistance, extension service, and the initial provision of seeds and seedling also for multiplication, support to the management of a revolving fund and the initial provision of seeds, seedlings, tools and materials.

The percent of families doing gardening increased from 65% in 1997 to 95.6% in 2001. Opening new gardens was mainly done for commercial interest; improvements in vegetable gardening were of low priority to villagers, thus promotion difficult. In Nalae district 20% of the households opened new garden areas particularly for the purpose of fruit and legume cultivation. Pineapples and legumes to a certain extent contributed already to household's income. Similarly for Sing district, 15% of the opened gardens were producing cash crop products, mainly sugar cane, coffee and cardamom. About 8% of the households were able to obtain income from their gardens, more significant contributions were expected by about 2002 and 2003. Gardening was neither associated with the nutritional status nor with food consumption patterns.

Livestock

Livestock plays a central role in upland livelihoods. Villagers base a family's wealth status on the number of livestock it had. Following this classification about three quarters of the households were classified as poor, one seventh as medium and less than 10% as rich (source: focus group discussions). Households owned on average 1.9 big animals like cows or buffaloes, 2.7 pigs and 8.8 chicken or ducks (table 53).

The IFSP supported the District Agriculture Forestry Office (DAFO) in setting up of veterinary services. Village based livestock volunteers were trained and equipped; vaccination campaigns were implemented with required regularity. New, more productive and resistant breeds were tested and introduced in selected locations. The focus was mainly on poultry and fish raising, support for pig raising was on trial only.

Between 1997 and 2001, the number of households raising ducks increased from 12.3% to 20.4%, the increase was even more significant in Nalae district (from 20.1% to 36.1%). The number of animals raised per family was constant. Also more households raised chicken (78.9% to 91.7%). The number of big animals raised, cows or buffaloes, did not change. Animal death due to epidemic diseases was reduced by 50% for big animals and poultry and by 25% for pigs (table 53). The situation was similar for both districts. Other livestock raised were goats (3.2 animals per household) as well as dogs for economic purpose and ponies for the transport of goods.

Table 53: Wealth categories by possession of livestock and death rates in 1997 and 2001

	Number of livestock		
Wealth category[1]	Buffalos/cows	Pigs	Poultry
Poor (in %)	0	< 2	< 11
1997	44.7	57.3	76.3
2001	42.0	45.8	62.7
Medium (in %)	1 to 2	2 to 5	11 to 20
1997	39.2	32.3	15.4
2001	38.0	42.2	21.3
Rich (in %)	>2	>5	> 20
1997	16.0	10.3	8.3
2001	19.9	12.0	16.0
Average number of animals raised per family			
1997	1.9	2.7	8.8
2001	2.0	2.5	13.8
Animal death rate[2] (loss due to epidemics, in %)			
1997	37	84	149
2001	23	62	70

[1] Categories were based on villager's perception (source: focus group discussion)

[2] Animal death rate = (Animals alive / animals that died during 12 months prior to the survey) * 100

Livestock and nutrition

For analysis of effects of animal rearing a composite indicator was formulated including number of pigs, chicken and ducks. Villager's perceptions on wealth categories were applied to form the groups, values range from 0 to 8 animal units, median is 4 animal units, 2 animal units consist of 2 pigs or 10 poultry.

The possession of small animals correlated with the nutritional status (ANOVA, HAZ and animal units p = 0.012 for linearity; independent variable dichotome at median: p = 0.001; for single variables: pigs p = 0.006, chicken p = 0.078, ducks p = 0.018). Raising small animals was also associated with acute malnutrition (ANOVA, WHZ and animal units, p = 0.013 for linearity; dependent variable dichotome at 1 unit below median, p = 0.001; for single variable: pigs p = 0.028, chicken, p = 0.002, not significant for ducks). Linear regression shows an increase of 0.1z-score unit for each animal unit raised (regression coefficient = 0.086, p = 0.014).

The number of animals a family raised correlated with income, for each animal unit raised the annual income of the family increased by 17.5 USD (linear regression, coefficient=17.53, p < 0.001, n = 453). A covariance analysis allowing to control for income showed that the possession of livestock was still a significant determinant to malnutrition. A difference of +0.4 z-score units was attributable to livestock possession (ANOVA, income adjusted model, mean income 125 USD, HAZ -2.81, SE 0.072 to -2.44, SE 0.10, p = 0.003). The prevalence of chronic malnutrition decreases from 80.4% for those owning 3 animal units to 60.7% for those owning 7 or 8 animal units (Chi-square, Pearson, p = 0.052).

Apart from the association between income and possession of small livestock there was no further significant association with causes of malnutrition. Possession of livestock did not correlate with the consumption of animal products. The number of big animals raised was neither associated with nutrition nor with causes of malnutrition.

Fish farming

Introduction and support to the management of fishponds was supported by the IFSP as an alternative to the decline of supply from wild sources. At baseline fish farming was not practiced in Nalae district, while in 2001 almost one third of the households had a fish pond (29%). In Sing district the number of households having access to a fish pond increased from 9% to 14%. Possession of fishponds did not show any association to the children's nutritional status.

Income and occupation

Income situation and changes in income

At baseline, the average cash income[9] of a family was 124 USD. Farmers had about half the income compared to families following other income-generating opportunities (120 USD annual income for farmer's households compared to 234 USD for non-farmer households, ANOVA, $p < 0.001$). Such 'other occupations' were for example government employees, teachers or traders. However, the number of households following other occupational activities was low (2.8%).

The IFSP supported feeder road construction to improve accessibility, establishment of regular markets including the construction of market buildings and the promotion of food and cash crops as well as livestock for commercial purposes. A simultaneous improvement of the provincial road network and transport facilities reduced transport costs and allowed more frequent and easier access and trade.

Comparing the income situation at the beginning of the IFSP to the situation in 2001 a significant change was observed (table 54). More than half of the households stated an increased income (Nalae district 60.3%, Sing district 50.5% increase). The mean income increased by 47%. The changes were significant for both districts; still, increases were even greater for Sing district than for Nalae district (58.0% and 30.2%).

Table 54: Annual cash income per household by district in 1997 and 2001 (in USD)

	Nalae		Sing		Total	
Income[1]	1997 n = 253	2001 n = 308	1997 n = 203	2001 n = 338	1997 n = 456	2001 n = 656
Mean±SD	119±189[3]	155±292	131±150	207±232[2]	124±173	182±273[2]
Median	55	72	77	121	66	98
25th centile	20	36	33	60	28	37
75th centile	152	181	165	261	165	241

[1] 1997: 1 USD = 910 Kip, 2001: 1.0 USD= 7,600 Kip, 110.34 USD inflation rate, base year 1997, [2] $p < 0.001$, [3] $p = 0.09$

[9] Cash income assessed in local currency and converted into USD.
Exchange rate applied: January to April 1997: 1.0 USD = 910 Kip, January to April 2001: 1.0 USD = 7,600Kip, http://www.oanda.com/convert/classic).
At evaluation data were adjusted by inflation rate using 1997 as baseline. 1997: 100 US$ in 1997 worth 110.34 USD in 2001 (http://data.bls.gov).

The most significant change took place within the lowest and highest income group. The percentage of households falling into the category of lowest income dropped by 13% (table 55). Correspondingly, the number of households falling into the category of highest income increased by 9.5%. Changes in number of households falling into the mid-income categories were minor.

Table 55: Income groups by district in 1997 and 2001 (in %)

	Nalae		Sing		Total	
Income groups[1] (in USD)	1997 n = 253	2001 n = 308	1997 n = 203	2001 n = 338	1997 n = 456	2001 n = 646
Low (< 55)	49.4	39.0	35.5	23.4	43.2	30.8
Mid-low (55 - 110)	17.0	23.7	25.1	17.8	20.6	20.6
Mid-high (110 - 220)	18.2	15.6	20.2	27.8	19.1	22.0
High (> 220)	15.4	21.8	19.2	31.1	17.1	26.6

[1] 1997:1 USD = 910 Kip, 2001: 1.0 USD = 7,600 Kip, 110.34 USD inflation rate, base year 1997

Source of income

In Nalae district the main income derived from selling non-timber forest products (NTFP[10], 76.4% in 1997 and 85.2% in 2001) and the second important source was the trade of animals (45.5%, remained similar compared to 1997). The third and fourth important sources were selling rice and other crop products[11] (22.3% and 16.5%, respectively, similar for 1997 and 2001).

For Sing district the most important source of income at baseline were non-timber forest products[12] (48%), followed by trading opium, animals or rice, followed by hiring out labour. Between 1997 and 2001 the importance of hiring out labour increased greatly compared to other options (from 13.5% to 31.8%). The importance of selling rice increased slightly (23.4% to 29.8%), while the importance of income from opium decreased slightly (33.6% to 29.8%). In addition, about 8% of the families generated cash income predominantly from selling other food or cash crops[13] seeds, sugar cane, or any, this was not yet a source of income in 1997.

[10] Mainly cardamom, tree bark (Tiang polzonzia sp.), tiger grass (Thysanolaena maxima, poacea), rattan, palm fruits

[11] Maize, soybeans, sesame, peanuts, vegetables

[12] Bamboo sprouts had highest priority in addition to the NTFP listed for Nalae District

Villager's perception of the most important reasons for the change in income was assessed as well. In Nalae district, major reasons for the increased income was the improved access to markets and the trade of non-timber forest products as well as increased production and trade of rice (43.7%, 21.3%, 12.6%, respectively). This was different for Sing district, here the increased rice production was the predominant reason for the increased income and stated by almost halve of all households (45.1%). Other reasons were increased trade of animals and opium combined with the improved access to markets (12.2%, 9.8%, 8.5% respectively). The increased contribution of other agricultural products, cash or non-rice food crops, was stated as a main reason by 5% of the households (4.4% in Nalae district and 6.7% in Sing district).

A number of households also reported a drop in income (16.6% in Nalae district, n = 51, and 24.5% in Sing district n = 77). Major reasons reported for both districts were a failure in rice production or a loss of man-power (35.2% and 13.7% in Nalae district, 37.7% and 14.3% in Sing district). Additional reasons were the decreased availability of forest products in Nalae district (27.5%) and the drop in animal or opium production available for trade in Sing district (15.6%, 11.7%, respectively).

Household expenditures

A share of the income was kept as savings (25% in Nalae district and 13% in Sing district). In Nalae district income was mainly on condiments (mono-sodium glutamate, salt and sugar), medical treatment, housing, clothes and rice. Priorities were different for the increased income obtained. Housing became number one priority followed by expenses on education and medical care (housing 22.7%, education and medical care 15.7%).

A difference was noticed for Sing district, here, rice was the major expense, followed by housing material, medical treatment, and clothes. In 2001, similar to the situation in Nalae district, expenses for education became an additional priority (rice, housing, education, medical care, 17.0%, 11.5%, 10.3, 9.7%, respectively). In 2001, 8.3% spend their cash income for opium consumption (including the purchase of the raw opium as well as utensils required for its consumption).

[13] Sugar cane, coffee

Income and nutrition

There was a statistically significant association between the household's economy and nutrition. Children of households having better income were nutritionally better off compared to those of lower income groups. Chronic malnutrition was very high within the lowest income group, and decreased with an increase in income in both years. At baseline, chronic malnutrition ranged from 72.1% within the lowest income group to 62.9% within highest income group and in 2001 from 69.2% to 56.8% (ANOVA, twofactorial, age-adjusted, p = 0.05).

Over the years the nutritional status had improved significantly and improvements were even greater within the two lowest income groups (ANOVA, p = 0.05 and p = 0.006). In 2001, the status within the group of lowest income was comparable to the status of the mid-high income group in 1997. Changes over the years were lowest within the group of highest income (table 56). A twofactorial covariance analysis, including income and year, showed that the change in nutritional status was statistically evenly distributed over all income groups and was independent of income change.

Table 56: Income and height-for-age in 1997 and 2001

Income groups[1] (in USD)	1997 Mean HAZ (SE) n = 444	2001 Mean HAZ (SE) n = 639
Low (< 55)	-2.74 (0.09)	-2.59 (0.08)
Mid-low (55 - 110)	-2.66 (0.11)	-2.34 (0.11)
Mid-high (110 - 220)	-2.59 (0.13)	-2.40 (0.11)
High (> 220)	-2.34 (0.14)	-2.25 (0.10)

[1] ANOVA, twofactorial covariance analysis, covariate age, no interaction between income and year, p = 0.79, year: p = 0.022; income: p = 0.006

At baseline, contrary to other potential causes, income also correlated significantly with acute malnutrition, the prevalence ranged from 7.8% within the group of lowest income to 2.6% within the group of highest income (table 57).

Table 57: Income and weight-for-height and acute malnutrition in 1997 (n = 444)

Income groups[1] (in USD)	Mean WHZ ± SD	Acute malnutrition (in %)
Low (< 55)	-0.59 ± 1.12	7.8
Mid-low (55 - 110)	-0.53 ± 0.88	2.2
Mid-high (110 - 220)	-0.42 ± 1.14	3.5
High (> 220)	-0.21 ± 1.35	2.6
Level of significance [1]	p = 0.006	p = 0.10

[1] ANOVA for income groups and WHZ; Pearson Chi-square or income groups and acute malnutrition (dichotome)

Also the household's occupation played a role. Children from farming households had a higher risk for chronic malnutrition, but a lower risk for acute malnutrition compared to their peers from households following other occupations. Acute malnutrition was extremely high for non-farming households (table 58).

Table 58: Occupation and nutritional status in 1997

	Chronic malnutrition		Acute malnutrition	
Occupation	Mean HAZ ± SD	%	Mean WHZ ± SD	%
Farming (n = 474)	-2.72 ± 1.28	72	-0.45 ± 1.01	4.0
Other occupations (n = 14)	-1.91 ± 2.20	50	-1.03 ± 1.25	28.6
Level of significance	p = 0.023	p = 0.12	p = 0.036	p = 0.003

[1] ANOVA to compare means and chi-square Fisher's exact test for percent of malnutrition (dichotome)

Contrary to the situation at baseline, no association was noticed between income and acute malnutrition in 2001. In 1997 as well as in 2001, there was also no association evident between income and mothers' nutritional status or anaemia.

Income and food intake

The family's occupational status was not associated to the food intake, but the income situation showed an association. Families having a higher income consumed more food group items, however this association was statistically not very strong (ANOVA, unifactorial, food diversity score 4.2 for households with an income less than 55 USD up to 4.7 for those having an income of more than 220 USD, p = 0.035 for linearity, n = 456). The trend was similar for both sources, either derived from own production or through foraging. Hence, the diet of high-income families was of higher quality, those households consumed more from both sources, collected or from own

production. However, the food variety was not associated to the nutritional status, but income was.

It was also noticed that families of better income more likely consumed fruits or snacks but differences were statistically not significant (2.5% in lowest income group compared to 5.1% in highest income group, p = 0.56). The consumption of mono-sodium glutamate as a condiment was strongly dependent on the income, the better the income, the more households consumed it (lowest income group 74.6% and highest income group 91%, Chi-square, p = 0.017). Associations between income and food intake are presented in annex 6.

Income and morbidity

At baseline, children of low-income households had the highest risk to suffer from infectious diseases. However, children of high income households ranked highest with regard to diarrhoeal episodes (p = 0.006), second highest with regard to distended abdomen (p = 0.032) and third highest regarding point prevalence of infectious diseases (table 59). Such associations did not exist in 2001.

Table 59: Income and morbidity in 1997 (in %, n = 475)

Income groups (in USD)	Point prevalence[1]	Distended abdomen	Diarrhoeal episodes
Low (< 55)	40.6	44.6	1.8 (0.11)
Mid-low (55 - 110)	32.6	29.8	1.2 (0.16)
Mid-high (110 - 220)	27.2	29.9	1.4 (0.17)
High (> 220)	31.6	36.4	1.9 (0.18)
Total	34.9	37.3	1.5 (SD 1.6)
Level of significance[2]	p = 0.14[2]	p = 0.032[2]	p = 0.006[3]

[1] Composite indicator comprising of the point prevalence of at least one of the three diseases: ARI, diarrhoeal infections, unspecified fever

[2] Chi-square, Pearson test [3] ANOVA, unifactorial, age-adjusted

Income, use of health services and hygiene practices

Access and use of health services, as indicated by DPT3 immunisation, did not show a significant difference for the different income groups. It was assumed that better off households adopted more favourable hygiene practices. This held true for the treatment of drinking water (ANOVA, p = 0.001), but not for the possession or use of latrines. Again, a household's occupational status did not show any association to one of the above listed indicators for access and use of health services or hygiene behaviour.

Housing

The use of households' cash income and expenditure within the study population showed that a wealthier household would invest in improving housing conditions. Support to housing was not an intervention; still, good quality housing is a basic need and provides better protection. Furthermore, quality of housing is assessed as a potential proxy indicator for poverty. An aim of the actual chapter is to show the relationship between wealth, housing and a family's nutrition situation. Housing related poverty indicators relevant was the construction material of the floor, the roof as well as number of pillars (stilts) the house was build on.

Most of the houses were of traditional half-permanent construction style, using local material only. The predominant material used for floor construction was bamboo (60% in Nalae district, 75% in Sing district) or wood (38% in Nalae district and 14% in Sing district). Especially for Sing district grass or palm leaves were the predominant roofing material (89%). In Nalae district, almost half of the houses had roofing material of better quality than grass or palm leaves; 26% bamboo, 14% corrugated iron, and 4% used commercial fibre sheets.

Even in 2001 the majority of the houses were still in a very simple condition (table 60). However, there was a change in the use of construction material. A few more households were using wood, considered as the best possible material for floor construction, instead of bamboo. A large difference was seen for the roofing material: the percentage of houses using industrial roofing material increased in both districts and houses using lowest quality material, grass or palm leaves, decreased correspondingly.

Table 60: Change in quality of housing by district in 1997 and 2001 (1997: n = 495; 2001: n = 652, in %)

		Nalae		Sing		Total	
Housing	Material	1997	2001	1997	2001	1997	2001
Floor	Better quality	38.6	49.8	13.9	16.8	27.2	33.9
Roofing	Grass/leaves	48.4	29.4	89.6	77.4	68.2	54.3
	Industrial roofing	18.3	38.4	2.3	13.5	10.1	25.4

Results proved the close association between income and quality of housing in 1997 and 2001. The quality of housing was significantly associated with income of a family.

The higher the yearly income the better the quality of the material used (ANOVA, p = 0.049 for floor, p = 0.01 for roofing material, p = 0.02 for number of pillars). Quality of housing did not differ for the occupational status.

Housing and nutritional status

Data analysis indicated a statistically significant correlation between chronic malnutrition and quality of housing; the height-for-age z-score was better where a better quality construction material was used (ANOVA, twofactorial, floor and roofing, p < 0.001, annex 10, table 10.2). Still, those indicators were not associated to acute malnutrition.

Within the given context, families not having the means to purchase proper construction material would build their house on the ground, the use of pillars improves the structure of the house. In Nalae District, malnutrition reduced with an increased number of pillars used. A 10-pillar increase resulted in a reduction of height-for-age z-score of 0.37 z-score units and weight-for-height z-score of 0.29 units (regression, HAZ: coefficient = 0.367, p = 0.024, n = 237; WHZ: coefficient = 0.286, p = 0.032, n = 240). Number of household members did not confound results. The prevalence of chronic malnutrition was 85.7% for children living in houses build on the ground or using less than 10 pillars and was 28.6% for children from houses build on more than 30 pillars (Chi-square, Pearson, p = 0.064).

Income, housing and nutritional status

At baseline, the nutritional status of children living in houses using industrial material was better compared to their peers living in houses using local material. Between baseline and follow-up, the number of houses using industrial material doubled. Children's nutritional status in those houses using industrial roofing did not change (ANOVA, threefactorial, year, income and construction material, table 61). Contrary, children living in houses using local material improved significantly. Income and nutritional status correlated in both years.

Table 61: Housing conditions, income and height-for-age in 1997 and 2001

Housing	Year	n	Housing %[1]	Mean income USD[2]	Mean HAZ[2]
Local material	1997	495	87.9	114	-2.78
	2001	650	72.5	161	-2.39
Level of significance				p < 0.001	p < 0.001
Industrial material	1997	495	12.1	177	-2.12
	2001	650	27.5	275	-2.09
Level of significance			p < 0.001	p = 0.097	p = 0.410

[1] Chi-square, Fisher's exact test to test differences between the years

[2] ANOVA, comparison of means to test differences between the years

Threefactorial analysis, including housing, income and year, showed that the differences in quality of housing were strongly associated with the differences in nutritional status measured over the years, but differences were independent from income (housing: p = 0.002; income: p = 0.183, year: p = 0.167, no interaction between years and dependant variables, p > 0.2).

Possession of household commodities

The possession of household commodities such as bicycles, motorbikes, TV or video set, or access to electricity supply was not common in 1997. The only frequently owned household commodity was a radio (60% of the household in Nalae district and 36% in Sing district), and numbers did not change in 2001. A correlation with the nutritional status was not identified.

In 2001 goods that were uncommon in 1997, became available (table 62). Some households even had electricity supply; mainly through a household or community owned small-scale hydropower turbine system or a solar system supported by the IFSP.

Table 62: Possession of household commodities in 2001 (in %)

Commodities	n	Nalae n = 310	Sing n = 342	Total n = 652
Bicycle	79	8.7	15.2	12.1
Vehicle	27	4.8	3.5	4.1
Electricity	74	17.0	6.1	11.3
TV/video set	19	5.1	0.9	2.9

Even in 2001, in both districts 27% of the families still pounded rice exclusively by hand, 50% in Sing and 30.5% in Nalae district used mills or mill by hand, alternately,

mainly according to their time availability, and 8.9% do have their own rice mill (11.3% in Nalae and 6.7% in Sing district).

3.4 Basic causes

3.4.1 Education

The logical framework of malnutrition considers literacy as a basic determinant to malnutrition. Commonly literacy is defined as the ability to read and write. Using years of school enrolment as a proxy for literacy, a person who has had less than four years formal education is considered as illiterate. This classification was also applied for national statistics (NSC 2005).

Education situation

Adopting this classification for the population studied, three quarters of the fathers were illiterate (77.1 %, table 63), the situation was worse in Sing district (97.1%) than in Nalae district (54%). The literacy level of mothers was even lower; none of the mothers in Sing district was found to be literate, here one mother attended primary school and she attended for one year. In Nalae district 13% went to school, 2% attended school for more than 5 years.

Table 63: Education of mothers and fathers in 1997 (n = 475, in %)

Education		Fathers			Mothers		
Literacy level	Years of enrolment	Nalae n = 213	Sing n = 244	Total n = 457	Nalae n = 213	Sing n = 242	Total n = 455
Illiterate	0	36.2	95.9	68.1	80.3	99.6	90.5
	1 - 2	17.8	1.2	9.0	6.6	0.4	3.3
Literate	3 - 5	38.0	2.0	18.8	11.3	0.0	5.3
	>5	8.0	0.8	4.2	1.9	0.0	0.9

Ethno-linguistic groups in both districts, Austro-Asiatic in Nalae district and Hmong-Mien in Sing district, speak their traditional languages as mother tongue. Knowledge of Lao, the national language, was low, especially for Sing district (annex 11, table 1.1). Three quarters of the fathers and almost all mothers in Sing district did not understand Lao, only a few men were able to read and write (1.2%). This was different for Nalae district, here fathers and mothers that did not understand Lao were few in numbers.

Education and nutritional status

Educational level of parents correlated with chronic malnutrition but not with acute malnutrition. The height-for-age z-score improved significantly with an increase in parents years of school attendance (table 64). The differences became even more obvious when comparing children of literate parents to those being illiterate. Three quarters of the children of illiterate parents suffered from chronic malnutrition and about half of the children within the group of literate mothers or fathers (Chi-square, Fisher's exact test, 2 sided, 72.4% and 50.0% for illiterate and literate mothers, respectively, p = 0.017; 75% and 57.8% for illiterate and literate fathers, respectively, p = 0.001). A similar relationship was observed for the ability to communicate in Lao language and prevalence rates.

Table 64: Education of mothers and fathers and nutritional status in 1997 (ANOVA, uni-factorial, for linearity)

Years of enrolment	Years of enrolment Fathers		Years of enrolment Mothers	
	n	Mean HAZ ± SD	n	Mean HAZ ± SD
0	305	-2.80 ± 1.24	402	-2.74 ± 1.33
1 - 2	39	-2.95 ± 1.38	14	-2.94 ± 1.54
3 - 5	83	-2.38 ± 1.51	24	-2.05 ± 1.23
> 5	19	-2.18 ± 1.72	4	-1.94 ± 1.40
Level of significance	446	p = 0.005	444	p = 0.016

Mother' and father's education was closely correlated. Both variables showed a similar impact on child malnutrition, while the group of mothers was too small in numbers to perform meaningful statistical analysis on its impact on nutrition (6.2% of the total sample). Thus, a composite indicator combining father's and mother's literacy level was calculated and defined as parents literacy status (literate parents: n = 111, fathers: n = 102, mothers: n = 27, both: n = 19, 24.5% of the total sample).

Education and direct causes

In order to identify the cause effect relationship between parent's literacy and malnutrition, effects of literacy on direct and indirect causes were analysed. Unifactorial analysis of variance showed that literacy levels of parents were closely associated to diarrhoeal episodes over the past (ANOVA, 1.7 compared to 1.3 episodes, p = 0.012), but not to other infections. Literacy also correlated with better

health coverage, hygiene and sanitation practices (higher immunisation rate, $p = 0.04$, possession of latrines, $p < 0.001$, treatment of drinking water, $p = 0.001$, hygienic conditions of the houses, $p = 0.001$). Furthermore, literacy was closely correlated with other underlying factors determining malnutrition. A positive correlation was observed with income of a household; better educated parents had a higher cash income, were more likely to follow non-agriculture occupation opportunities and their houses were in better conditions (ANOVA, cash income, $p = 0.002$, Chi-square, Fisher's exact test: occupation, $p < 0.001$, housing conditions, $p < 0.001$). Literate parents raised more small livestock (ANOVA, animal units, $p < 0.001$). However, literacy was negatively correlated with the annual per capita rice harvest (higher educated parents had a lower rice harvest, 312 kg and 244 kg rice per capita, $p = 0.003$).

In contrast to the better performance of literate parents towards improved hygiene and health practices, practices of breastfeeding and weaning patters were worse (Chi-square, Fisher's exact test, initiation of breastfeeding and timely introduction of complementary food, $p < 0.001$ for both). Further analysis of the group of literate mothers and IYCF practices showed the opposite. Literate mothers performed better than illiterate mothers (67% and 54% introduced colostrums on the first day, $p = 0.22$; 19% and 0.6% introduced complementary at the recommended age, $p < 0.001$, $n = 203$). Table 65 presents the nutritional status and determinants by literacy status.

Table 65: Nutritional status and determinants by parent's literacy status in 1997 (n = 455 households)

			Literacy status of parents		
		n	Illiterate n = 344 75.6%	Literate n = 111 24.4%	Level of significance[1]
Outcome					
Nutrition status, chronic	HAZ-score	455	-2.82 ± 1.26	-2.35 ± 1.53	p = 0.001*
Nutritional status, acute	WHZ-score	446	-0.45 ± 0.99	-0.45 ± 1.07	p = 0.980
Nutrition status, mothers	BMI kg/m^2	439	20.8 ± 2.1	21.2 ± 2.5	p = 0.110*
Anemia (clinical signs)	Yes, %	447	7.9	10.5	p = 0.420
Direct causes					
Food intake					
Number of meals	Mean	457	2.9	3.0	p = 0.010*
Consumption snacks/fruits	Yes, %	457	8.6	1.4	p = 0.001
Diversity of side dishes	Higher, %	457	49.3	61.9	p = 0.026
Food diversity	Items	457	4.1 ± 1.6	4.8 ± 1.6	p < 0.001*
Consumption of foods from production	Yes, %	457	29.5%	25.7	p = 0.465
Consumption of foods from foraging	Yes, %	457	76.1	44.8%	p < 0.001
IYCF					
Initiation of breastfeeding	< 24hours, %	449	86.0	54.2	p < 0.001 (neg.)
Weaning at 4 - 6 months	Yes, %	426	20.8	6.5	p < 0.001 (neg.)
Health status					
Infectious diseases	Yes, %	442	35.9	38.1	p = 0.730
Distended abdomen	Yes, %	452	36.8	43.6	p = 0.216
Diarrhoeal diseases	Episodes	450	1.8	1.3	p = 0.014*
Indirect causes					
Healthy environment					
Water treatment (boiled)	Yes, %	450	23.8	54.1%	p < 0.001
Water system (improved)	Yes, %	455	22.1	0	p < 0.001
Toilet facilities	Yes, %	455	1.2%	16.2%	p < 0.001
Hygienic housing	Yes, %	451	9.7	32.4	p < 0.001
Health care					
Immunisation coverage (DPT3)	>12 months, yes, %	440	18.6	28.3	p = 0.04
Food security					
Production system	flatland, %	425	23.7	12.5	p = 0.022
Rice harvest	Mean kg/capita	437	312 ± 219	244 ± 312	p = 0.003* (neg)
Animal production	Animal units	453	3.6 ± 1.55	4.8 ± 1.7	p = 0.001
Livelihood					
Cash income	Mean USD ± SD	415	105 ± 132	162 ± 237	p = 0.002*
Occupation	non-farm, %	455	0.6	9	p = 0.000
Quality housing	Good, %	431	4.6	24.3	p = 0.000
Basic causes					
Social status of women	At least one decision, %	433	12.8	28.6	p = 0.001
Accessibility	Nearby, %	475	19.8	39.6	p < 0.001

[1] Chi-square, Fisher's exact for 2x2 or Pearson for >2x2; (*) ANOVA, unifactorial to compare means, effect positive if not indicated differently

Education and basic causes

Basic causes analysed were the social status of women and the accessibility of the location. In locations easily accessible, urban or semi-urban areas literacy levels were higher than in remote locations ($p < 0.001$).

The social status of women (measured by the decision power a women has) was higher for better-educated families (at least one decision taken by the women, 23.3% for literate parents compared to 9.7% for illiterate parents, $p = 0.001$). Both, income and social status of women were significantly better where parents were literate. In order to control for those variables, a twofactorial covariance analysis was performed. The model includes education and social status as independent variables, and income as well as age as confounding factors. Results show that literacy was strongly associated with malnutrition (table 66). The height-for-age z-score was +0.76 z-score units better where parents were literate ($p < 0.001$).

Table 66: Education, social status of women and height-for-age in 1997

		Social status of women		
		Lower (n = 290) Mean HAZ (SE)	Higher (n = 46) Mean HAZ (SE)	Estimated marginal mean ($p < 0.001$)
Literacy status of parents	Illiterate (n = 236)	-2.89 (0.14)	-2.61 (0.26)	-2.75 (0.14)
	Literate (n = 100)	-2.50 (0.14)	-1.50 (0.25)	-1.99 (0.14)
Estimated marginal mean ($p = 0.001$)		-2.69 (0.08)	-2.05 (0.18)	

ANOVA, twofactorial, confounding variable age (31 months) and income (124 USD)

The same model applying prevalence of chronic malnutrition (dichotome) as dependent variable estimates 72% chronic malnutrition for the group of parents being illiterate compared to 47% for the children of parents being literate ($p < 0.001$).

Changes in educational status

In Nalae district all villages studied (100%) and in Sing district 47% of them received support for non-formal literacy classes during the four-year implementation phase. Those courses were government initiatives and were supported by the IFSP. The IFSP in cooperation with the District Education Office (DEO) did also support the formal primary education sector, schools were constructed and teachers trained and posted in remote locations. It is too early to expect an impact on the level of formal

education of parents. Nevertheless, besides other benefits, for example improved life skills (including hygiene, nutrition, health care), non-formal classes were assumed to contribute towards increased ability to communicate in the Lao language.

In 1997 non-formal classes were not yet available. In 2001 more than one third of the fathers in Nalae district had attended evening classes. Mothers were encouraged to attend, but their attendance was lower (table 67). Benefits towards improved language skills were minor, the percent of fathers able to read and write remained the same compared to 1997. Only a minor increase was observed for mothers in Nalae district, and it remained nil for the mothers in Sing district. Hence, the ability of the population to communicate in the national language did not change; neither did their level of formal education nor their literacy status.

Table 67: Attendance to non-formal classes and ability to read and write by district in 1997 and 2001 (1997: n = 475; 2001: n = 652, in %)

	Nalae		Sing		Total	
	1997	2001	1997	2001	1997	2001
Attended non formal classes						
Fathers	0	36.8	0	6.9	0	21.9
Mothers	0	26.3	0	0.3	0	13.3
Able to read and write						
Fathers	62.1	60.0	1.2	2	32.2	31.6
Mothers	11.9	17.3	0.0	0.0	2.4	6.1

3.4.2 Social status of women

Women's rights to decide independently about the use of household resource was applied as an indicator to describe their social status within the family. This included decisions over the use of financial resources as well as over the use of household assets, particularly over rice, poultry and handicrafts, which were the most important assets contributing to the household economy. Opium played a role in Sing district only. For descriptive analysis, the decision power over the respective subjects was classified into the categories of: both parents together, father independently, mother independently.

Parents take half to three quarters of the decisions over cash expenses or household commodities together, one person would not sell the products without consulting the other. Frequency of joint decisions was highest for big livestock (83%). Second most frequent decision maker is the father. Women's decision making power decreased with an increase in the monetary value of the asset, whether it was cash or the exchange of household products, while the decision making power of the man increased. Most frequent decisions taken by women independently were the decisions on cash expenses less than 1 USD, the use of poultry, rice and handicrafts (annex 11, table 11.2 and 11.3). In contrast women's involvement in decision over livestock other than poultry was lowest (ratio of women to men: 0.18 for livestock other than poultry compared with 1.29 for poultry, figure 9).

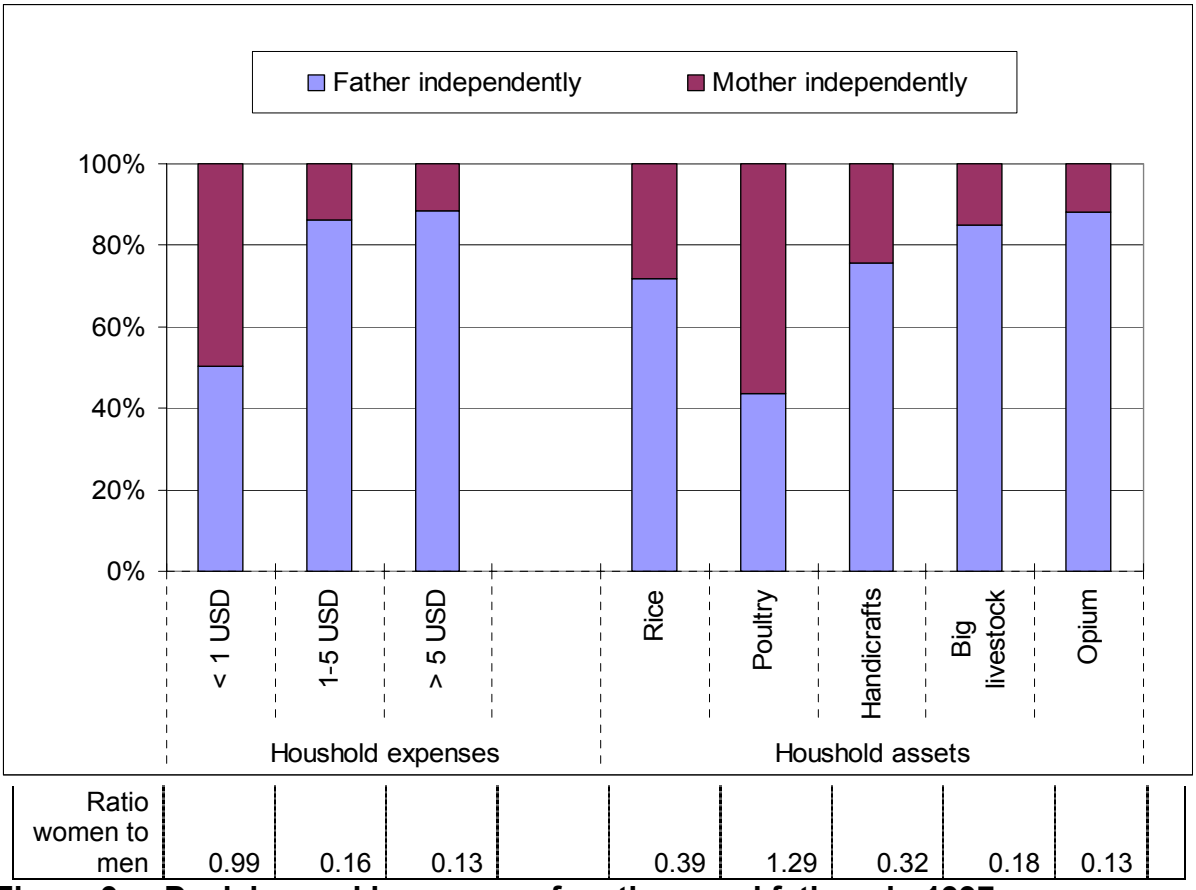


Figure 9: Decision making power of mothers and fathers in 1997 (n = 497, expressed ratio of women to men)

Social status of women and nutritional status

Effects of women's socials status on nutritional status, as well as direct and indirect causes were analysed in order to explain causalities. In 19.4% of the families women decided over the use of at least one of the three assets. The nutritional status improved with an increase in women's power to take the respective decisions. This

held true for decisions over the three most important household assets (rice, poultry and handicrafts) as well as decisions on household's cash expenses (table 68).

Table 68: Women's decision power and height-for-age and chronic malnutrition in 1997

Decision taken by woman	n	Mean HAZ ± SD[1]	Chronic malnutrition %[2]
Expenditures (< 1USD, 1 – 5 USD, > 5 USD)			
None	395	-2.77 ± 1.31	73.2
At least one	66	-1.98 ± 1.21	51.5
Level of significance		p < 0.001	p < 0.001
Decisions on the use of household assets (poultry, handicrafts, or rice)			
None	330	-2.82 ± 1.28	74.7
One	62	-2.25 ± 1.11	56.7
Two or more	17	-1.75 ± 1.63	41.2
Level of significance		p < 0.001	p < 0.001

[1] ANOVA

[2] Chi square, Pearson for >2x2 (expenditure), and Fisher's exact test (use of assets)

Unifactorial analysis also showed that chronic malnutrition decreased with an increase in decisions taken by women from 74.7% to 41.2% (table 68). Annex 11 (table 11.4) presents the difference in nutritional status disaggregated for each household asset.

For every decision making process, the nutritional situation was best were women decided independently, followed by households were both had equal rights and was lowest in households where the father was the only decision maker (figure 10). Prevalence of chronic malnutrition ranged from 16.7% to 58.7% where mothers took decisions over the use of the different household assets and from 71% to 76% where fathers were the independent decision makers.

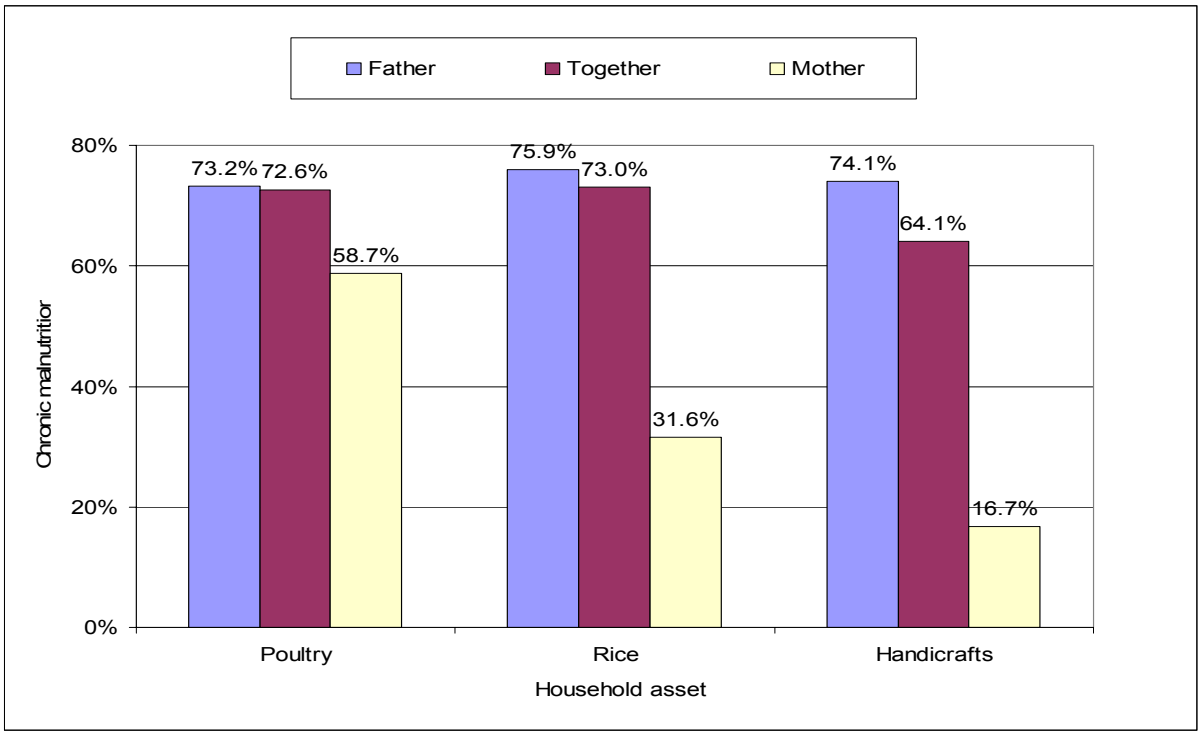


Figure 10: Decision making and chronic malnutrition in 1997
Chi-square, Pearson, decision making over the assets listed and chronic malnutrition, n = 460, poultry, $p = 0.057$, rice, $p < 0.001$, handicrafts, $p = 0.03$

Decision making power of women was not associated with acute malnutrition, clinical signs of anaemia or her own nutritional status. Family's food consumption differed slightly (more snacks, higher diversity of side dishes) and IYCF practices were even worse were women where the main decision makers. Still, their children had a significantly lower risk of infections. Hygiene practices were significantly better (water treatment, toilet facilities, hygienic housing) as was the access to and utilisation of health services (immunisation coverage). The household food security situation did no differ much (rice sufficiency or animal raising), but those households had a higher income and houses were in a better condition. Female's decision-making power was higher were educational status of parents was better, those households were also more frequently living in nearby locations (table 69).

Table 69: Nutritional status and determinants by women's decision power (n = 473 households)

			Social status women		
Determinants		n	Low n = 371 79.4%	High n = 102 20.6%	Level of significance [1]
Outcome					
Nutritional status, children	HAZ-score	461	-2.81 ± 1.28	-2.14 ± 1.25	p < 0.001*
Nutritional status, acute	WHZ-score	455	-0.46 ± 0.95	-0.54 ± 1.16	p = 0.516
Nutritional status, mothers	BMI kg/m^2	455	20.9 ± 2.10	20.9 ± 2.63	p = 0.940
Anemia (clinical signs)	BMI kg/m^2	455	20.9 ± 2.10	20.9 ± 2.63	p = 0.940
Direct causes					
Food intake					
Number of meals	Mean	457	3.0 ± 0.30	2.99 ± 0.12	p = 0.210
Consumption snacks/fruits	Yes, %	457	3.20	7.9	p = 0.099
Diversity of side dishes	Higher, %	457	49.8	65.8	p = 0.014
Food diversity	Items	457	4.3 ± 1.7	4.4 ± 1.9	p < 0.547*
Consumption of foods form own production	Yes, %	457	25.4	26.3	p = 0.465
Consumption of foods from forest resources	Yes, %	457	66.5	53.9	p = 0.883
IYCF					
Initiation of breastfeeding	<24 hours, %	466	82.5	59.4	p < 0.001 (neg.)
Weaning at 4 – 6 months	Yes, %	445	19.0	6.2	p = 002 (neg.)
Health status					
Infectious diseases	Yes, %	456	37.3	24.7	p = 0.022
Distended abdomen	Yes, %	470	37.0	34.3	p = 0.644
Diarrhoeal diseases	Episodes	469	1.6 ± 1.7	1.4 ± 1.4	p = 0.181
Indirect causes					
Healthy environment					
Water system	Improved, %	473	18.3	6.9	p < 0.004 (neg.)
Water treatment	Yes, %	465	31.2	50.0	p < 0.001
Toilet facilities	Yes, %	473	5.9	19.6	p < 0.001
Hygienic housing	Yes, %	468	13.3	30.0	p < 0.001
Health care					
Immunisation coverage (DPT3)	>12 months, yes, %	445	21.9	36.4	p = 0.006
Food security					
Production system	Flatland, %	445	21.2	16.7	p = 0.390
Rice sufficiency	Mean kg/capita	456	311 ± 224	242 ± 167	p = 0.011
Animal production	No. animal units	470	3.8 ± 1.6	3.7 ± 1.9	p = 0.470*
Livelihood					
Cash income	Mean USD±SD	435	115 ± 152	158 ± 233	p = 0.030*
Occupation	non-farm, %	473	3.2	1.0	p = 0.316
Quality housing	Good, %	449	6.5	29.2	p = 0.000
Basic causes					
Educational status	Literate	433	20.8	41.7	p < 0.001
Accessibility	Nearby, %	473	24.8	48.0	p < 0.001

[1] Chi-square, Fisher's exact for 2x2 or Pearson for >2x2; (*) ANOVA, unifactorial to compare means, effect positive if not indicated differently

The number of female-headed households was higher where women were the main decision makers (14.7% compared to 1.9%), at the same time children of female-headed households were of higher risk to malnutrition than children of male-headed households (95.5% compared to 70.2%, $p < 0.001$). Income was higher in households where women's status was better.

In order to control for confounders, a twofactorial covariance analyses, including income and age as covariates was performed. The model included women's status as well as sex of head of household as independent and malnutrition as dependent variable. In both groups the nutritional status was better where women decided over the use of resources. In male-headed households nutritional status was improved by 0.81 z-score units and in female-headed households by 0.35 z-score units (table 70).

Table 70: Women's decision power, head of household and height-for-age in 1997

		Head of household		
		Male n = 359 Mean HAZ (SE)	Female n = 15 Mean HAZ (SE)	Estimate marginal mean (p = 0.078)
Decision power	Low (n = 300)	-2.79 (0.07)	-3.53 (0.49)	-3.16 (0.25)
	High (n = 74)	-1.98 (0.15)	-3.19 (0.40)	-2.59 (0.21)
Estimated marginal mean (p = 0.003)		-2.39 (0.08)	-3.36 (0.32)	

ANCOVA, age and income as covariate (estimated mean age 32 months, estimated mean income 128 USD, no interaction between head of household and decision making power of women, p = 0.428)

3.4.3 Accessibility of the location

The analysis of causes of malnutrition presented at previous sub-chapters also included, where relevant, associations between potential causes and the location's accessibility. In order to identify causes resulting in differences of malnutrition by the location's accessibility a more systematic comparison of determinants, similarities and differences are presented here. Locations were classified into two categories according to the travel distance to reach an urban or semi-urban area, where also market places were available, schooling facilities or health centres and a public transport network existed:

1 Easily accessible – location nearby – effortless to reach centres, located within a maximum of one hour walking distance to reach a road or river network (278 children, 45.3% of the total sample). At the same time, those locations were more likely located at lower altitudes.
2 Difficult to access - location remote – further than one hour walking distance away from a centre, road or river network (336 children, 54.7% of the households). Those locations were more likely located at higher altitudes.

An unifactorial analysis of variance showed that children from villages in remote locations had a higher risk of malnutrition. The association was significant for acute and chronic malnutrition (ANOVA, $p = 0.035$, $p = 0.001$, respectively, table 71), but not significant for mother's nutritional status. An opposite relation was observed for clinical signs of anaemia. Prevalence of anaemia was higher in nearby locations (Chi-square, Fisher's exact test, $p = 0.001$).

Accessibility and direct causes

The prevalence of infectious diseases did not differ significantly by accessibility of location, except for the occurrence of malaria, which was the second most frequently listed health problem a child was suffering from following diarrhoeal diseases. Malaria was more frequently found in locations nearby than in remote locations (15.3% compared to 9.0%, respectively, Chi-square, Pearson, $p = 0.015$). Also anaemia and malaria showed a close interrelation. Children suffering from anaemia had a higher risk for malaria compared to their non-anaemic peers (23.1% compared to 10.1%, Chi-square test, Pearson, $p < 0.001$), and, the same as for malaria, more prevalent in nearby locations. No difference was noticed on habits of IYCF (early initiation of breastfeeding or the timing of introduction of complementary food). A slightly better behaviour towards the timely introduction of plant or animal products was observed for nearby villages (timely introduction of vegetables and meat, $p < 0.001$). A family's diet did not differ by location (table 71).

Table 71: Nutritional status and determinants by accessibility of location in 1997 (n = 495 households, n = 614 children)

			Accessibility		
		n	Nearby n = 278 45.3%	Remote n = 336 54.7%	Level of significance [1]
Outcome					
Nutritional status, chronic	HAZ-score	600	-2.50 ± 1.26	-2.74 ± 1.44	p = 0.035*
Nutritional status, acute	WHZ -score	603	-0.33 + 1.05	-0.61 + 1.08	p = 0.001*
Nutritional status, mothers	BMI kg/m^2	476	21.1 ± 2.2	20.8 ± 2.2	p = 0.222*
Anaemia (clinical signs)	Yes, %	597	13.3	5.1	p = 0.001
Direct causes					
Food intake					
Number of meals	Mean	497	2.94 ± 0.24	2.95 ± 0.28	p = 0.891*
Consumption snacks/fruits	Yes, %		3.9	2.3	p = 0.308
Diversity of side dishes	Higher, %	497	53.9	52.3	p = 0.836
Food diversity	Items	497	4.31 ± 1.67	4.29 ± 1.66	p = 0.892
Food diversity, production	Items	497	0.26 ± 0.46	0.31 ± 0.46	p = 0.247
Food diversity, foraging	Items	497	0.66 ± 0.26	0.70 ± 0.31	p = 0.312
IYCF					
Initiation of breastfeeding	<24hours, %	606	77.1	76.4	p = 0.847
Weaning at 4 - 6 months	Yes, %	566	14.2	17.3	p = 0.357
Health status					
Infectious diseases	Yes, %	594	34.7	31.9	p = 0.484
Distended abdomen	Yes, %	610	34.1	32.6	p = 0.730
Diarrhoeal diseases	Episodes	609	1.5 ± 1.7	1.5 ± 1.6	p = 0.965*
Indirect causes					
Healthy environment					
Water treatment	Yes, %	489	60.2	14.4	p < 0.001
Toilet facilities	Yes, %	497	18.1	0	p < 0.001
Hygienic housing	Yes, %	492	28.7	6.9	p < 0.001
Health care					
Immunisation coverage (DPT3)	>12months, yes, %	596	48.1	6.4	p < 0.001
Food security					
Rice harvest	Mean kg/capita	479	327 ± 259	256 ± 131	p < 0.001*
Animal production	Animal	494	4.4 ± 1.9	3.3 ± 1.4	p < 0.001*
Livelihood					
Cash income	Mean USD±SD	456	155 ± 198	98 ± 142	p < 0.001
Occupation	Non-farm, %	497	2.6	3.0	p = 0.794
Quality housing	Good, %	472	16.2	6.4	p = 0.001
Basic causes					
Educational status	Literate	455	31.4	19.3	p = 0.004
Social status of women	At least one decision, %	473	27.1	11.7	p < 0.001

[1] Chi-square, Fisher's exact for 2x2 or Pearson for >2x2; (*) ANOVA, unifactorial to compare means, effect positive if not indicated differently

Accessibility, indirect and basic causes

Household's from easily accessible locations had better access to health services (higher immunisation coverage, $p < 0.001$), and showed improved sanitation and hygiene practices ($p < 0.001$ for all variables: toilet facilities, boil drinking water, clean and better ventilated houses).

Households from nearby locations were much better off regarding their food security situation (better access to flatland rice production as well as higher rice yields, and more animals: chicken, ducks, pigs, composite indicator, $p < 0.001$). Non-farming occupation opportunities were equally common, still households in easily accessible locations were in a better economic situation as indicated by a higher cash income and better quality of housing ($p < 0.001$ for both indicators). Parents from nearby locations were better educated ($p = 0.004$). It was noticeable that women's status relative to men was better in nearby locations; here women were more likely involved in decision making ($p < 0.001$).

3.4.4 Basic causes and nutritional status (multifactorial analysis)

In order to single out the effects of the individual basic determinants a threefactorial analysis was performed. The model included literacy status of parents, social status of women and the accessibility of the location. Income and age were considered as covariates.

Accessibility as well as the income was not significantly associated with the nutritional status (difference of 0.12 z-score units attributable to distance, $p = 0.60$, covariate income, $p = 0.98$). Similar to the twofactorial analysis, the association remained significant for the social status and parent's literacy and children's nutritional status (table 72). Nutritional status was estimated to be best in remote locations where literacy level of parents and social status of women was high, but estimated lowest for remote locations and where parents were illiterate and women's status low (HAZ estimated mean -1.07, CI -2.02 to -0.12 compared to -2.98, CI -3.20 to -0.12, respectively). It indicated that social status as well as literacy status mitigates negative effects associated to the accessibility of the location.

Table 72: Basic causes and nutritional status in 1997 (threefactorial covariance analysis, n = 336)

Basic causes	Estimated mean HAZ (95% CI)		Level of significance
Accessibility	Nearby (n = 160)	Remote (n = 199)	
	-2.23 (-2.55 to -1.90)	-2.35 (-2.66 to -2.04)	p = 0.595
Literacy status parents	Literate (n = 100)	Illiterate (n = 259)	
	-1.92 (-2.24 to -1.60)	-2.65 (-2.97 to -2.34)	p = 0.001
Social status women	Status low (n = 310)	Status high (n = 79)	
	-2.71 (-2.88 to -2.54)	-1.87 (-2.28 to -1.45)	p < 0.001

ANCOVA, covariate age (estimated mean 30months) and income (estimated mean 124 USD, p = 0.980). No significant interactions between variables (p > 0.1 for all variables included in the model)

The same model was applied to test associations between basic causes and acute malnutrition, weight-for-height z-score. Reverse results were obtained. The location's accessibility and income was significantly associated with acute malnutrition (p = 0.002 and p = 0.018, respectively). Literacy or social status of women did not show a noticeable effect (p = 0.683, p = 0.5, table 73).

Table 73: Basic causes and acute malnutrition in 1997 (threefactorial covariance analysis, n = 335)

Basic causes	Estimated Mean HAZ (95% CI)		Level of Significance
Accessibility	Nearby (n = 144)	Remote (n = 195)	
	-0.10 (-0.37 to -0.18)	-0.673 (-0.92 to -0.43)	p = 0.002
Literacy parents	Literate (n = 101)	Illiterate (n = 238)	
	-0.40 (-0.65 to -0.15)	-0.368 (-0.63 to -0.11)	p = 0.863
Social status women	Status low (n = 294)	Status high (n = 79)	
	-0.45 (-0.58 to -0.31)	-0.322 (-0.66 to -0.02)	p = 0.500

ANCOVA, covariate age (estimated mean 30.4 months) and income (estimated mean 124 USD, p = 0.018). No significant interaction between variables (p > 0.1 for all variables included in the model).

A summary of the tested determinants of all sectors and levels and their distribution by chronic malnutrition is presented in table 74.

Table 74: Chronic malnutrition and determinants in 1997 (n = 495 households, n = 600 children)

			Chronic malnutrition		
Determinants	Criteria	n	Stunted <-2 z-score 69.3% (n = 416)	Not stunted ≥-2 z-score 30.7% (n = 184)	Level of significance[1]
Outcome					
Nutritional status, acute	Mean WHZ-score (% wasting)		-0.40 ± 1.18 (6.0%)	-0.52 ± 1.08 (6.0%)	p = 0.191 (p = 1.0)
Nutritional status, mothers[2]	BMI kg/m^2 (%)	465	20.9 ± 2.2 (14.0%)	21.1 ± 2.22 (11.8%)	p = 0.462 (p = 0.653)
Anaemia (clinical signs)	Yes, %	584	10.1	5.0	p = 0.053
Direct causes					
Food intake					
Number of meals	Mean	485	2.95 ± 0.24	2.94 ± 0.31	p = 0.832
Consumption snacks/fruits	Yes, %	485	2.3	5.0	p = 0.146
Diversity of side dishes	Higher, %	484	51.9	56.1	p = 0.422
Food diversity	Items	485	4.3 ± 1.7	4.3 ± 1.6	p = 0.952
Foods diversity, from produced	Yes, %	485	0.27 ± 0.47	0.34 ± 0.49	p = 0.181
Food diversity, foraging	Yes, %	485	0.72 ± 0.45	0.59 ± 0.49	p = 0.009*
IYCF					
Initiation of breastfeeding	Within 24hours	593	73.8%	79.0	p = 0.168
Weaning age	4 to 6 months, %		17.3	15.8	p = 0.701
Health status					
Infectious diseases	% yes	581	35.2	27.5	p = 0.070
Distended abdomen	% yes	597	38.3	22.8	p < 0.000
Diarrhoeal diseases	Number of episodes	596	1.6 ± 1.7	1.4 ± 1.5	p = 0.164
Indirect causes					
Healthy environment					
Water treatment	Yes, %	477	33.2	40.1	p = 0.169
Toilet facilities	Yes, %	485	7.2	11.5	p = 0.148
Hygienic housing	Yes, %	482	14.9	21.6	p = 0.081
Health care					
Immunisation coverage	DPT3 >12 months	583	24.8%	25.7%	p = 0.836
Food security					
Production system	% flatland	455	21.8	21.7	p = 1.000
Rice harvest	Mean kg/capita	468	303 ± 201	254 ± 207	p = 0.017 (neg.)
Animal production	Animal units (more than 5 units)	482	3.7 ± 1.6 (30.6)	3.9 ± 1.9 (39.6%)	p < 0.325 p = 0.069
Livelihood					
Cash income	Mean USD±SD	444	115 ± 159	150 ± 173	p = 0.059*
Occupation	non-farm, %		2.0	5.0	p = 0.128
Quality housing	Good, %	461	5.8	15.9	p = 0.029

Basic causes					
Educational status	Literate	455	20.0	34.9	p < 0.001
Social status of women	At least one decision, %	461	14.6	30.8	p < 0.001
Single headed household	Female headed	495	5.8%	0.5	p = 0.002

[1] Chi-square, Fisher's exact for 2x2 or Pearson for > 2x2; (*) ANOVA, unifactorial

[2] Children's HAZ decreased with a decrease in mothers nutrition status (HAZ ranges from -2.65 ± 1.32 for mothers normally nourished, BMI ≥ 18.5 kg/m^2, to -3.21±1.57 were mothers were severely malnourished, BMI < 16 kg/m^2, ANOVA, linearity, p = 0.036)

4 Discussion and conclusions

4.1 Outcome level

Chronic malnutrition

The study evaluated a period of four years of intensive community based and multi-sectoral interventions. Chronic malnutrition was extremely high at the start of the programme and exceeded national averages. Over the programme period a rate of annual reduction of 3.9% was achieved (table 75). Lao national nutrition surveys conducted in 1994 and 2000 showed an annual decrease of 2.5%. Similar changes were measured for the northern provinces where the IFSP was implemented (table 75). The latest nationwide survey conducted in 2006 did not show any further reduction (45% chronic malnutrition in 2006 compared to 40% in 2000, WFP 2006b, p. 99-100).

Table 75: Comparison of chronic malnutrition and annual rate of change (in %)

	Reference period	First survey	Second survey	Annual rate of change[1]
Globally, all developing countries[2]	1999 - 2000	34.0	27.0	-2.1
Asia[2]	1995 - 2000	37.3	32.2	-2.7
National surveys [3, 4]				
National average	1994 - 2000	47.3	40.3[2]	-2.5
Urban	1994 - 2000	33.0	29.0	-2.0
Rural	1994 - 2000	52.2	44.4	-2.5
Northern provinces	1994 - 2000	48.0	41.4	-2.4
IFSP	1997 - 2001	69.3	58.6	-3.9

[1] Annual rate of change = (% at follow-up - % at baseline) / % at baseline)100 / reference period

[3] de Onis et al 2004a

[2] GoL-LNAS 1995, p. 54; MoH 2001, p. 74

[4] The nationwide survey conducted in 2006 showed 45.2% chronic malnutrition (WFP 2006b, p. 99)

Regarding severe chronic malnutrition, the Lao Nutritional Assessment Survey reported a national prevalence of 22% and 23.1% for Luang Namtha province (GoL-LNAS 1995, p. 54). Severe malnutrition was not analysed or presented for the 2000 data set. However, the rate of severe chronic malnutrition at the beginning of the IFSP was much higher than the national averages, but prevalence rates came down

significantly and became closer to national averages towards the end of the programme cycle (down from 39.6 to 28.5% compared to the national average of 22.1% and the 23.1% average for Luang Namtha province, GoL-LNAS 1995, p. 54).

The IFSP target villages were located in rural areas, the majority of them very remote. National studies reveal significant differences between urban and rural areas with much higher rates of chronic malnutrition in the latter. National changes between 1994 and 2000 were more substantial in rural areas compared to urban areas (table 75). Substantial differences between urban and rural areas were also observed in one of the earliest nutrition studies conducted in the plains of Lao PDR, home of the Lao-Tai[14], the major ethno-linguistic group, in Vientiane and rural areas in five provinces. Children in urban Vientiane had shown much lower prevalence rates than those in the provinces (31% for Vientiane compared to between 38% and 56% in rural areas, Kripps 1984).

By the end of the 1990s the rate of chronic malnutrition throughout Asia dropped by 2.7% annually, marginally more than the rate of change in the Lao national average and also higher than the global reduction rates measured for all developing countries (de Onis et al 2004a). Between 1980 and 1995 WHO measured a global reduction from 49% to 40%, hence an annual rate of change of about 1.2% (de Onis, Frongillo and Blössner 2000). Still an annual rate of reduction of 3.0% was projected for the period 2000 to 2005 (de Onis et al 2004a). This projection exceeded national, regional as well as global changes achieved in earlier years.

An impact study using a comparable methodology conducted in the programme area of the IFSP/GTZ in East Lombok, Indonesia, showed a reduction by 15.9% over a 6 years period (2.6% annual reduction rate), a reduction from 57.9% to 48.8% (Schultink et al 1995). A similar evaluation carried out for the IFSP/GTZ in Central Flores did not identify noticeable improvements in chronic malnutrition (Reinhard 1996, p. 96-98). A study conducted for the IFSP/GTZ Malawi demonstrated a statistically significant reduction of 15.9% within the project duration of 5 years (3.2% annual rate of reduction) from 59.2% to 49.8%. Comparisons to a control group

[14] Belonging to the Lao-Tai (formerly Lao Loum), Austro-Asiatic (formerly Lao Theung, also the predominant target population in Nalae district), Hmong-Mien (formerly Lao Soung, predominant target population in Sing district).

located in neighbouring districts did not reveal significant differences (Weingärtner 2002, p. 4-5).

In conclusion, there was considerable reduction in chronic malnutrition, particularly its severest forms, within the programme area. These results were statistically significant and exceeded national, regional and global improvements. Results within the programme area were better than those achieved by Integrated Food Security Programmes in other regions. The results also exceeded WHO's global projections for those years (de Onis et al 2004a). Even then, the prevalence rate within the IFSP-supported area remained extremely high, much higher than in any other area of comparison. Applying WHO classifications of populations at risk, the situation is still considered as 'very serious'. On the other hand, four years of programme implementation might be too short to expect a more significant change. Programme consolidation and behavioural changes require time to show an impact on the nutritional status of a child (annex 12)

Acute malnutrition

The situation with regard to acute malnutrition was better than the national or regional situation (IFSP area in 1997: 6.0%, in 2001: 3.8%; Lao PDR 10.5%, South East Asia 15.9%, GoL-LNAS 1995, p. 89). The situation in Nalae district improved significantly and the prevalence dropped close to 3% (from 9.7% to 3.5%). In Sing district weight-for-height z-score did not change, but the prevalence rate increased slightly. The differences were insignificant and remained below the 5% benchmark. A prevalence rate of 5% or below classifies the situation as one of low risk. According to the normal distribution curve, a prevalence of 3% is considered normal in any given population (de Onis et al 2004b).

The Lao National Assessment on Nutrition, carried out nationwide in July/August 1994 reported the average prevalence rate of acute malnutrition to be 10.5%. This climbed to 15.4% in 2000 (GoL-LNAS 1995, p. 54; MoH 2001, p. 73). This rate indicates a serious public health problem throughout the country (WHO 1997, p. 52).

National data showed a remarkable disparity when urban and rural areas were compared. The prevalence of acute malnutrition in rural areas was more than double that in urban areas (11% and 5.0%, MoH 2001, p. 73). However, the national survey

six years later indicated a more severe problem in urban areas (18.6% urban as against 14.3% rural, MoH 2001, p. 73). The situation got worse in both, but changes in the urban areas had been more dramatic.

It is a guess by the author that the Asian crisis of 1998 had a severe impact on the economy of the Lao PDR and the nutritional well-being of the population was adversely affected in the years that followed. Urban households are more dependent on a market economy than rural ones and this could explain the more dramatic changes in urban settings. The time and effort spent on working more to make the same amount of money, and in many cases on seeking employment, perhaps lowered a household's caring capacity. Rural households are usually more resilient to changes in the market economy, their access to subsistence farming and to natural resources helping them cope with the temporary shortages.

A comparison of the national survey results on acute malnutrition to the changes within the project area, find the IFSP to have been successful in Nalae district. In Sing district, the situation should be carefully monitored.

Underweight

At baseline, the prevalence of underweight was much higher within the IFSP area than nationwide (54.0% and 40%), but almost equalled that of the IFSP at the end of the implementation phase (table 76).

Table 76: Comparison of underweight and annual rate of change (in %)

	Reference period	First survey	Second survey	Annual rate of change
Asia (de Onis et al 2004a)	1990 - 2000	35.0	28.0	-2.1
National surveys[2, 3]	1994 - 2000	40.0	40.0[2]	0.0
IFSP	1997 - 2001	54.0	44.4	-4.4

[1] Annual rate of change = (% at follow-up - % at baseline) / % at baseline)100 / reference period

[2] GoL-LNAS 1995, p. 54 and MoH 2001, p. 74

[3] The nationwide survey conducted in 2006 showed 38.1% underweight (WFP 2006b, p. 99)

The Lao PDR's national action plan for nutrition aimed to lower the rate of underweight from 40% to 20% between 1993 and 2000 (GoL 1995, p. 22; MoH 1997, p. 5), requiring an annual reduction rate of 7%. However, the national prevalence did

not change from 1994 compared to 2000 and 2006, remaining high for all three years (GOL-LNAS 1995, p. 54; MoH 2001, p. 73; WFP 2006b, p. 99-100; GoL-NNP 2008). In 2000, targets were adjusted to the UN Millennium Development Goals (MDGs), extending the time period and aiming for a 50% reduction between 1990 and 2015 (2.7% annual rate of change, Chhabra and Rokx 2004, p. 34) or a reduction of 40% by the year 2005 (GoL and UNDP 2004, p. 12). The national nutrition policy released in 2008 formulated the goals to reduce underweight from 38% to 15% by the year 2020 (GoL-NNP 2008). Throughout Asia, the percentage of underweight children has fallen, but still remaining below the MDG targets (table 76). Within the East Asia and Pacific region, China, Malaysia, and Indonesia have made the best progress to reach the goals (annual rate of change: -6.6%, -4.5%, and -3.8%, respectively). Lao PDR, Cambodia and the Philippines have also seen a decline but their progress has been much more modest (-1.4%, -1.1%, and -0.8% respectively, Chhabra and Rokx 2004, p. 11 and 34).

Consequently, the improvements in the programme area were a relative success, particularly when compared to the changes in the region, in reaching the MDGs or the adjusted national targets. Nonetheless, even within the programme region, targets set previously by the government were not achieved despite intensive support. Prevalence rates are still high and indicate a very severe public health problem according to WHO standards.

Nutritional status of mothers

While the nutritional status of mothers in the programme area improved over the programme period, the countrywide situation worsened in these years. The national prevalence rates showed an increase in all grades of chronic dietary energy deficiency -- severe, moderate, or mild --, but came down in all grades within the area studied (table 77).

Table 77: Comparison of chronic dietary energy deficiency in mothers and annual rate of change by grade (in %)

	National Surveys			IFSP		
Grade of malnutrition (BMI in kg/m^2)	1994[1]	2000[1]	Annual rate of change[1]	1997	2001	Annual rate of change[1]
Mild (BMI 17 - 18.4)	9.6	11.7	+3.6	10.3	4.6	-3.5
Moderate (BMI 16 - 16.9)	2.6	3.3	+4.5	2.8	0.8	-4.5
Severe (BMI < 16)	2.6	3.2	+3.8	0.8	0	-6.3

[1] Annual rate of change = (% at follow-up - % at baseline) / % at baseline)100 / reference period

[2] 1994: GoL-LNAS 1995, p. 66; MoH 2001, p. 74

Results from a government pilot project on maternal nutrition implemented in Savanakhet province reported prevalence rates very similar to those in the IFSP target area. A baseline and follow-up assessment covered the intervention area after two years of programme implementation as well as a control group. The prevalence had decreased in both areas, but more in the intervention area. Still, the annual reduction was below changes achieved within the IFSP target area (table 78).

Table 78: Comparison of chronic dietary energy deficiency in mothers and annual rate of change (BMI below 18.5kg/m^2, in %)

Reference	Reference period	First survey	Second survey	Annual rate of change[1]
National surveys [2]	1994 - 2000	14.8	18.2	+3.8
Maternal Nutrition Programme, Savanakhet (Khamhong et al 1997)	1995 - 1997			
Intervention area		14.4	12.8	-5.6
Control group		18.5	17.2	-3.5
IFSP	1997 - 2001	13.9	5.4	-15.3

[1] Annual rate of change = (% at follow-up - % at baseline) / % at baseline)100 / reference period

[2] 1994: GoL-LNAS 1995, p. 66; MoH 2001, p. 74

The national study also shows that the prevalence of underweight is higher in urban areas than in rural areas and that the women are at higher risk than men (14.8% and 12.1%, respectively, GoL-LNAS 1995, p. 54). Similar to the situation within the programme area, the national prevalence of underweight among women increased with age from 9.7% for those below 30 years of age to 13.1% and for those between 30 and 60 years, and up to 37.1% among those older than 60 years.

The assumption for the increase of malnutrition with age is that closely spaced childbearing and extended periods of lactation do not allow women to recover from the physical exertion. Short inter-pregnancy intervals, in combination with sub-optimal nutrient intake and heavy workload, lead to higher malnutrition. Also, a higher number of small children require more attention and care. It is an additional burden for women who have to meet the increasing demands of a growing family, such as ensuring availability of sufficient food, ensuring adequate water supply etc. These are labour intensive tasks that probably affect the women's health and nutritional status.

A mother's nutritional well-being is important for both the quality of her life and the healthy development of her children. Direct consequences of maternal malnutrition are low weight gain during pregnancy, low birth weight, high maternal and infant morbidity and mortality (Lartey 2008). Maternal malnutrition has an additive impact and results in a cycle of malnutrition between generations (Gillespie 2006). Therefore, programmes addressing women's well-being are a priority for breaking the intergenerational cycle of malnutrition.

Changes in chronic dietary energy deficiency among mothers within the IFSP target area were considerable, with levels achieved in 2001 taken to be 'low'. The success is even more noticeable when compared against the overall trends. It is assumed that time saving measures implemented, such as easier access to water sources nearer to the house and the improved agricultural production system contributed to the improved nutritional status of mothers.

Mortality

Infant and child mortality rates (IMR and CMR) at the start of the IFSP in 1997 were much higher than the national averages of 1995, but were reduced considerably during the programme period. In Nalae district IMR and CMR in 2001 were almost the same as the national averages published for 2000 (table 79). Officially collated statistics on mortality rates were not available in Sing district, but the death rate arrived at indicated a positive trend there as well (CDR: 219/1,000 live births, IDR 119/1,000 live births).

Table 79: Comparison of mortality rates in Nalae district and national averages (number of deaths/1,000 live births)

	Nalae		National[1]	
	1997	2001	1995	2000
IMR	235	95	104	82
CMR	259	109	170	106

[1] MoH 2001, p. 41

Besides unspecified fever, ARI, diarrhoeal diseases and malaria were the major causes of death. National data available at that time also found these to be the leading causes of child deaths: malaria, diarrhoeal diseases and respiratory infections (MoH 1992, p. 50). Primary health care interventions that have been gradually introduced within the areas studies, with a focus on prevention and treatment of most common diseases at the community level, including the treatment of malaria, diarrhoea, and ARI, use of the oral rehydration solution, along with support to improve clean water supply were assumed to be among the most effective interventions that contributed directly to the reduction in CDR.

In Nalae district about 90% of all child deaths occurred below the age of one year, while the share was much lower in Sing district (54%). Neonatal deaths accounted for 41% of all child death in Nalae district. Nationwide, too, while the CMR dropped, the neonatal death rate remained high at 40% (World Bank 2004, p. 1). In Nalae district, the proportion of infant mortality to child mortality decreased from 90% to 78%, indicating a more substantial reduction in mortality among the younger children compared to those being older than one year. Infant feeding practices were found to be particularly detrimental. Pre-lacteal introduction of rice, late initiation of breast-feeding and the disposal of colostrum probably contributed substantially to the high neonatal and infant death rates. Initiating a behavioural change was considered a priority when aiming for a reduction in neonatal deaths.

4.2 Direct causes

4.2.1 Family's food intake

The majority of households (95%) consumed three meals a day. If they had two, it was because of time constraints and not because of a lack of food (source: focus group discussions). A number of households consumed plain rice plus chilly-salt

sauce three times a day, about half of the households had the same type of side dishes for all meals over the course of a day, and snacks was seldom eaten. The number of different food items listed and potentially available was large, but the number of items actually consumed by a family was relatively low (4.3 food group items per day). Forest resources supplied a major portion of the daily food; wild animals and aquatic products were of higher importance than animal products from domestic sources. Plant products collected or gathered in the wild were more frequently consumed than vegetables cultivated. Purchase and consumption of commercial products, apart from iodised salt or mono-sodium glutamate, was uncommon.

Rice was the major staple food, and per capita consumption was sufficient to meet energy requirements (544 g/capita/day, table 80).

Rice represents the basic nutritional element of the whole population in Lao PDR (FAO 2003, p. 3 and 12; WFP 2006b, p. 76-77). The national health survey reported rice to be the staple food for 99.3% of the population (MoH 2001, p. 88). In 1972 Hankin et al estimated the mean rice consumption in Lao PDR to be at about 500 g/capita/day, while rice was estimated to provide 85% of the daily energy intake and 67% of the protein intake (Hankin et al 1972). The contribution of rice to the total energy intake then decreased and was estimated at 75% for rural areas in 2002/2003. In 1993 the Lao Expenditure and Consumption Surveys (LECS) reported an average rice consumption of 735 g/adult equivalent[15]/day and a 15% higher consumption in rural areas (FAO 1999, p. 8). Similar results were obtained six years later (580g rice per capita and day in 1999, GoL and ADB 2001, p. 86)

Within the population studied, the energy intake derived from rice[16] was 1, 930 kcal per capita (table 80). Assuming that rice accounts for about 80% of the total energy intake[17], the estimated daily energy requirements of the population were met on

[15] At the given demographic structure, 2,700 kcal per adult equivalent equals about 2,100 kcal per capita. Average daily energy requirement per adult equivalent is 2,700 kcal, 735 g rice per adult equivalent equals 573 g per capita. 735 g rice equals 2688 kcal per adult equivalent and day (Swindale and Ohri-Vachapati 2004, p. 52-56),

[16] Nutrient composition of 100 g rice (food composition table, Mahidol University 1972):
a) Glutinous rice, milled: 355 kcal, 7.0 g protein, 0.3 g fat, 81.1 g carbohydrate
b) Non-glutinous rice, milled: 349 kcal, 6.8 g protein, 0.6 g fat, 77.7 g carbohydrate

[17] The population studied followed traditional consumption patterns, consumption of commercial or processed foods was not common. The consumption of non-rice products was therefore estimated

average, but were below requirements in Nalae district. In Sing district, the calculated average energy intake was comparable to the estimated national average of 2,400 kcal (FAO 1995, p. 88).

Three quarters of all households ate animal products derived from domesticated or wild animals, as well as from natural aquatic sources (25%, 14% and 44%, respectively). However, such products were consumed in low quantities. Other products rich in protein, like legumes, seeds or nuts were uncommon. Rice was the major source of protein[18]. The total protein intake was sufficient to prevent deficiencies within a healthy population[19] (table 80). However, only about 8% to 10% of the total energy intake was estimated to derive from protein, which is below the recommendation. Consequently, the protein intake was insufficient to meet additional requirements necessary, for example, during times of heavy work, physiological stress, infections, pregnancy, lactation, or to allow for healthy growth of children. About 10% of the households in Sing district added pork fat to their meals, but other high-fat foods were rarely consumed or consumed only in low quantities. In Nalae district, there was no major source of fat identified; hence, fat intake has to increase in order to meet WHO/FAO recommendations (WHO 2003b, p. 18).

Table 80: Estimated daily intake of energy and protein derived from rice

	Nalae	Sing	Total
Daily rice consumption	460 g	620 g	544 g
Energy from rice	1,633 kcal	2,163 kcal	1,930 kcal
Protein from rice	32.2 g	42.3 g	38.0 g
Estimate total energy intake[20]	1,959 kcal	2,595 kcal	2,412 kcal
% of energy requirement	93%	123%	115%
% of estimated national average[21]	82%	108%	100%

to be lower than the national average. Hence, rice was estimated to supply about 80% of the total energy intake.

[18] 38 g protein/capita/day derived from rice, 48 g calculated protein intake. Rice supplies 80% of total intake. This results in about 8% to 10% of total energy intake derived from protein.

[19] Recommended intake for population (g/kg/day): 0.75 g good quality protein (reference protein, comprising animal products, milk and eggs, WHO 1985, p. 135). A digestibility of 85% is applied for diets based on cereals and vegetables, low in animal products (WHO 1998, p. 117-135). Average adult body weight 49 kg in study area. Calculated requirement per adult and day: 37 g, accounting for digestibility: 44 g/kg/day. About 10% to 15% of energy should derive from protein (WHO 2003b, p. 56).

[20] Minimum requirement is calculated based on recent recommendations, 2,100 kcal/capita/day, GoL-LECS 2004, NCS no date).

[21] Based on the LECS 1993 the national average consumption was estimated at 2,400 kcal per capita (FAO 1995, p. 88) and decreased thereafter to 2,100 kcal in 2002/2003 (Boupha 2008)

Vegetables were either cultivated or collected, with 25% eating the former and 61% eating the latter. Consumption of herbs and spices was common and consumed in almost all households. Fruits, wild or cultivated, were consumed in about 10% of the households. In sum, plant products were common, thus the dietary intake of micronutrients could be sufficient to meet average minimum requirements. However, bioavailability of micronutrients from plant products is low. This is a problem particularly associated with a cereal-based diet due to the high fibre and phytate content (Welch and House 1995; Ruel 2005, p. 201). Low bioavailability, combined with the low intake of animal products, fats and oils are possible reasons for the development of vitamin A and iron deficiencies within the given context. Proper food combination and preparation techniques are also crucial. Careful meal planning and the incorporation of animal products, even in small quantities only, can be effective to prevent the development of such deficiencies (Leitzmann 2005).

Mono-sodium glutamate was a common ingredient in the diet of more than 80% of the households. Its use allowed for a reduction in the use of salt, thus saving money. Reduced consumption of iodised salt, however, meant reduced intake of iodine, which increased the risk of developing iodine deficiencies. The data show that children from households consuming mono-sodium glutamate had a better nutritional status than others (HAZ, $p = 0.05$). Not having the financial resources for its purchase was the predominant reason for not consuming it. Again this indicates the interrelation between economic welfare and nutrition. It also indicates that financial resources, when available for the purchase of food, were not necessarily invested in improving the quality of the diet.

The FAO stated that the absolute energy intake in Lao PDR met daily requirements for most of the year, but the diet was unbalanced and its quality poor, especially low in fat and protein and in important micronutrients such as iron, iodine and vitamin A (FAO 2003, p. 11-14; Meusch et al 2003, p. iii and 4-11). However, the situation was not the same all over the country since the quality of the diet was better in urban than in rural areas. The Lao National Health Survey reported that nearly 50% of rural people had insufficient energy and micro-nutrient intakes. The diet of people living in urban areas consisted of a higher variety of food items rich in energy, fat and protein. They consumed more fish, meat, and eggs as well as leafy green vegetables than

did people residing in rural areas (MoH 2001, p. 88-89). Protein intake in rural areas depended largely on forest resources. Here wildlife and aquatic resources played an important role (UNDP 2001, p. 92; Meusch et al 2003, p. 11-14).

Family's food intake and nutritional status

A family's diet showed an association to the nutritional status of their children. Diversity of side dishes complementing the main course correlated with chronic malnutrition: height-for-age improved with the increased diversity of side dishes served (analysis of variance, $p = 0.08$). Malnutrition was slightly lower where snacks were consumed (analysis of variance, $p = 0.03$).

The relationship between food diversity, assessed as number of food items, and children's nutritional status was remarkable: the total number of items consumed did not correlate with the nutritional status, but the source of the food was important. The more animal or plant products were consumed the lower the child's nutritional status when the items derived from forest resources and the better when items derived from production or cultivation. The height-for-age z-score decreased with an increased number of items consumed from natural sources and improved with every item consumed from own production (analysis of variance, HAZ -2.43 to -2.97, $p = 0.002$, -2.77 to -2.44, $p = 0.085$, respectively). These results were the same regardless whether a household had access to agricultural resources and rice or of the economic situation. In the lowlands of Lao PDR, aquatic animals were important for low-income families (Friend, Meusch, Funge-Smith 2003, p. 5-6). This was different in the area studied, here all families, regardless of their income status, were foraging for foods including aquatic products.

Products from natural resources contributed substantially to the diversity of the diet, but were mainly consumed in low quantities compared to items of the same food group derived from domestic production or from big mammals. The lower the quantity of a particular item collected, the higher the number of items required to feed the family.

Numerous items collected in small quantities could indicate a reduced availability or depletion of forest resources. The Human Development Report stated that during the 1990s, there was a dense forest and an abundant wildlife close to the villages,

whereas in 2000 only small wildlife, edible plants and mushrooms remained. Resource depletion had resulted in reduced yields and consumption of wild products (UNDP 2001, p. 81-82). At the same time, rearing and consumption of domesticated animals did not compensate for the loss of access to and availability of forest resources (Friend, Meusch, Funge-Smith 2003, p. 1 and 9). For the Luang Namtha province, a higher consumption of products from big forest animals was reported for recent decades. Nowadays, small animals form the main share of the animal products derived from the forest while bigger animals are hunted less frequently (UNDP 2001, p. 81; Johnson, Singh and Duongdala 2004).

There are two assumptions that explain the increase in malnutrition rates associated with the higher number of food items consumed from natural sources. First, the collection of food from natural sources is time intensive. The more items collected, the more time is spend away from home. Although the family's food requirements might be met, less time is available for other nutrition-related chores. Second, the depletion of forest resources results in a reduced quantity available per item, and so, more items are required. Thus, despite the higher number of items, the total quantity remains insufficient.

Evaluations of the food diversity methodology revealed that the number of food items reflects a household's food security situation well. Food diversity shows a positive relation to desirable outcomes, such as chronic and acute malnutrition, birth-weight, health and mortality (Hodgson et al 1994; Hoddinott and Yohannes 2002, p. 3; IFPRI 2002, p. 5). Those studies also show that food diversity is usually closely associated with a household's per capita food consumption, the food energy availability, and the quality of a diet, thus, covering nutritional adequacy well. The same results were obtained regardless of the modification of the methodology (Hoddinott and Yohannes 2002, p. 5-11; IFPRI 2002, p. 3).

The food diversity indicator, within the given context of traditional or partly transitional food security systems, should, however, be interpreted with caution. The methodology may require further modification and validation to allow for a more meaningful analysis and identification of the dietary quality.

In conclusion, apart from rice, the majority of the food items consumed are derived from natural resources. About 80% of the food energy intake is derived from rice. The diet appeared sufficient in energy but low in high quality protein and fat and sub-optimal to meet micronutrient requirements. Not the quantity of rice consumed, but the variation in side dishes and the consumption of snacks determined a child's nutritional status. The increased number of food items consumed correlated with a lower nutritional status when foods were derived from forest resources. A higher number of items from natural resources could indicate insufficient access to and availability of foods. The application of the food diversity indicator within the given environmental context requires further modification to allow meaningful conclusions.

Food restrictions

Food restrictions and taboos are common in Lao PDR, and frequently practiced by women during pregnancy and after childbirth (78.4%); practices differ by ethnicity and are more common in the northern parts of the country (MoH 2001, p. 89-90). Among the population studied, such restrictions were particularly prevalent among the Austro-Asiatic group in Nalae district. Food restrictions for the mother after birth increased the risk for malnutrition of the child, and the risk increased along with the duration of the restriction (ANOVA, $p = 0.02$). Information obtained through focus group discussions showed that breaking such taboos was considered to harm the healthy development of the child. Strict food regimes were commonly followed for three to ten days after delivery. These would usually be rice with salt, rice porridge or rice soup with few traditional plants prepared as herbal tea or just hot water.

Additional restrictions were commonly followed during pregnancy and after delivery for up to one, three or even up to twelve months after delivery. The restrictions were mainly for animal products, only sometimes for vegetables and fruits, and even less often for starchy foods. Meat from albino or 'white' animals, such as a white buffalo, or from white chickens, goats or pigs and forest animals was especially forbidden. These products are common components of any family's daily diet, so the restrictions effectively hindered the woman from getting a balanced and healthy diet. A particular problem with the restrictions is that they kept the woman away from items, particularly meat products, rich in protein and micronutrients, during times when her nutritional requirements were highest. This was different for the Hmong-Mien group, the population studied in Sing district, where women were usually encouraged to eat

more and better. Their post partum tradition was to give the new mother three domestic chickens to eat.

4.2.2 Infant and young child feeding practices

Cultural disparities between the ethno-linguistic groups in Nalae district and Sing district were the reasons for the different feeding practices they followed. The disposal of colostrum, the late initiation of breastfeeding and the provision of pre-lacteal food were the major problems identified among the Austro-Asiatic and Lao-Tai groups studied in Nalae district. These practices were not common among the Hmong-Mien ethno-linguistic group in Sing district. Here, however, too late introduction of complementary food was a concern.

Focus group discussions showed that it was a traditional belief among the Austro-Asiatic group in Nalae district that the first milk was rotten and was sour after delivery having been in the mother's breast for a long time in a generally hot climate and during a period of hard labour. It is, also, believed that colostrum causes cramps and diarrhoea in the newborn. There is no awareness that colostrum is in fact essential and, as a laxative, supports the intestine to pass the first dark stool (meconium).

It is believed that the newborn is hungry and cries for rice, so the preferred item for pre-lacteal feeding is masticated rice. Rice as the first food, even before breast milk, is supposed to ensure that the baby grows up strong, to prevent illnesses, and to develop properly. The rice has to be chewed by the mother or a well-respected relative or a senior community member. Ideally, the chewed rice is put on a node (nodule) of bamboo and is then to be swallowed by the newborn, in the hope that the child will become as strong and resistant as the bamboo node. It was also said that the child has to swallow solid food first, before being breastfed, in order to extricate the mucous in the respiratory tract and to start breathing properly. Mothers also believed that eating the rice would help bring the child's neck into a correct, upwards position (source: focus group discussion).

A study launched by the World Bank described similar beliefs and patterns among the same groups living in other provinces in Lao PDR. It found that only one quarter of the mothers belonging to the Lao-Tai or Austro-Asiatic group started breast

breastfeeding within the first 24 hours and about half of the children received pre-lacteal foods. On the other hand, almost all newborns in the Hmong-Mien group, the ethnic group studied in Sing district, received breast milk within the first 24 hours (World Bank 2004, p. 11).

Similar to the present study results also in other provinces of Lao PDR the introduction of the first complementary food as well as the duration of breastfeeding was found to be more appropriate among the Hmong-Mien and most unfavourable among the Austro-Asiatic group (WFP 2006b, p. 97). Almost all mothers from the Hmong-Mien group, in Sing district or elsewhere, did not introduce any complementary food before the age of four months (World Bank 2004, p. 11), but the introduction much later than 6 months was a major problem in Sing district.

The low quality of complementary food provided was a problem across the study population, and also observed across all ethnic groups elsewhere in Lao PDR (World Bank 2004, p. 30-31). Complementary food was rice-centred, either plain rice or pre-chewed, steamed, or as porridge or soup. Vegetables or animal products were rarely added. Complementary food, thus, was bulky, difficult to chew, or too liquid, and so, low in nutrient density and therefore not adequate in quantity or quality to ensure the healthy development of the child.

The present study did not find a strong association between good early infant feeding practices and children's nutritional well-being, except among children under one year of age; those children were nutritionally better off when receiving breast milk on the first day of life. Also the timing of the first complementary food did not correlate with malnutrition, but children receiving plant products at the age of four to six months were nutritionally better off than those receiving it earlier or later (regression, multi-factorial, sectoral model, IYCF, $p = 0.05$), but the introduction of other complementary foods did not correlate. However, the morbidity was lowest where children received the first complementary food during four to six months of age, but higher for those receiving it before or later (regression, multi-factorial, sectoral model, IYCF and morbidity as dependant variables, $p < 0.05$).

It was assumed that the unfavourable early infant feeding practices in Nalae district contributed to the extremely high mortality rate of infants, particularly for infants

below one month of age (41% of child deaths in Nalae district). However, this causality cannot be demonstrated by the present study data and requires further research.

The cross-sectional design possibly limits the identification of the impact of IYCF on the healthy development of children. First, the study includes only children who survived up to the time of the survey. The number of neonatal and infant deaths was extremely high, especially in Nalae district, where early infant feeding practices were particularly detrimental. Second, other factors determining a child's nutritional status are assumed to confound the impact of infant feeding practices applied during the early days of life, such as i.e. frequency and quality of feeding, hygiene practices, the incidence, duration and management of diseases, water and sanitation, maternal characteristics, etc. The cross-sectional study design does not allow identifying and correcting for such factors. Reverse causalities can also limit the identification of correlation between breastfeeding and morbidity (Mihrshahi et al 2007).

USAID has stated "*Well over two-thirds of malnutrition-related infant and child deaths are associated with poor feeding practices during the first two years of life*" (USAID 2008). FANTA stated that there is a universal consensus on the importance of IYCF as a key determinant of child nutrition and the importance to assess and monitor IYCF practices is increasingly recognised (FANTA 2006, p. 1-3; FANTA 2008).

Research shows a significant impact of early infant feeding on neonatal death. A study conducted in Ghana found that the risk of death as a result of infections increased with the delay in initiation of breastfeeding from one hour to seven days after birth; late initiation (any time after day 1) was associated with a 2.6-fold risk of death, while pre-lacteal feeding was not associated to infections or death (Edmond et al 2007). A study conducted in Nepal showed higher mortality rates where breastfeeding started later than 24 hours after birth, and concludes that early initiation of breastfeeding would reduce neonatal death by 7.7% if the first feed is within the first 24 hours, by 19.1% if the first feed is within the first hour of life (Mullany et al 2008).

The results of a Medline and Cochrane database review suggest that feeding colostrum and exclusive breast-feeding is effective in preventing both, early and late

neonatal deaths by reducing the risk of the leading causes of death: hypothermia and hypoglycaemia infections in early neonatal days, and sepsis, acute respiratory tract infection and diarrhoea in late neonatal days (Huffman, Zehner and Victora 2001).

The Lancet's Series on Maternal and Child Undernutrition does not discuss the direct impact of early child feeding practices on malnutrition or mortality. The few studies assessing the impact of breastfeeding on malnutrition did not prove any significant impact on weight or height gain (Bhutta et al 2008).

At the end of the IFSP a change in practices was noticed. This was particularly significant for Nalae district where provision of colostrum as first food increased as well as the start of breast-feeding within the first 24 hours increased (34.4% to 75.8%, $p < 0.001$ and 56.2% to 89.3%, $p < 0.001$, respectively). In both districts, complementary food provided to the child improved in quality, but was still far below a situation that could be considered as satisfactory. Improvements in timely provision of complementary foods were not observed (table 81).

Table 81: Changes in infant and young child feeding practices (in %)

Practices	1997 n = 312	2001 n = 466	Level of significance[1]
Receive colostrum	44.2	86.3	$p < 0.001$
Initiation of breastfeeding within 24 hours	76.8	93.7	$p < 0.001$
Complementary food at 4 to 6 months of age	15.9	17.9	$p = 0.310$
Better quality of complementary food	6.7	12.6	$p = 0.001$

[1] Chi-square, Fisher's exact test

This indicates that behaviour changes are possible even within a relatively short period of time. Parents were willing to change, if they feel there were good reasons for doing so. Offering positive examples to young parents is therefore vital. Effective health services, including nutrition education and counselling are key interventions to enhance the knowledge on caring practices. At the same time, village based health workers, birth attendance, teachers, representatives of women's groups, community leaders and their families play an important role in promoting the incorporation of improved practices into local culture and tradition.

In conclusion, studies published internationally show that early breastfeeding practices have an impact on infant mortality. The present study data show that prevalent early infant feeding practices, particularly among the Austro-Asiatic group, were unfavourable and probably an impediment to the healthy development of a child. Implementation of appropriate measures to improve knowledge and induce a behavioural change towards more favourable practices was therefore one of the priorities. With early infant feeding practices partly improved, and mothers gradually following the advice of health personnel, unfavourable habits will further be eliminated.

4.2.3 Health status

The conceptual framework applied for this study defines a person's health status in combination with food intake as the direct causes of malnutrition. However, there is a close interaction between diseases and malnutrition, malnutrition also makes a person more susceptible, and increases the incidence, severity and duration of diseases (Tomkins and Watson 1989, p 1-3; Mueller and Krawinkel 2005). Studies showed that the risk of death assessed for diarrhoea, pneumonia, malaria and measles increases with declining z-scores of chronic and acute malnutrition as well as underweight and is significantly higher for those having a z-score below -3 (Black et al 2008).

Before the start of the IFSP morbidity was extremely high, with about one third of the children found suffering either from unspecified fever, ARI or diarrhoeal diseases at the day of the interview, but rates decreased significantly at the end of the programme (table 82). Nonetheless, even with the improvements observed, the health situation was still not optimal, after four years' external support, common infectious diseases still jeopardized people's well-being.

Table 82: Changes in morbidity

Morbidity	1997 n = 609	2001 n = 886	Level of significance[1]
Point prevalence of infections (in %)	33.2	11.3	$p < 0.001$
Distended abdomen (in %)	33.3	6.9	$p < 0.001$
Diarrhoeal episodes (number)	1.6	1.3	$p = 0.002$

[1] Chi-square, Fisher's exact test for point prevalence and distended abdomen, analysis of variance for number of diarrhoeal episodes

Disease rates were already high for children below six months and they were highest for children between two and three years old (22.6% and 40.6%, respectively). The survey was conducted during the dry season. Respiratory tract infections were even higher during winter, and diarrhoeal diseases and malaria during the rainy season. Thus, even higher prevalence rates than the actually assessed rates would be expected for ARI prior to and for diarrhoeal infections and malaria after the period of the survey. Villagers identified seasonal differences in malnutrition and explained this as primarily the result of a combination of seasonal variations in the incidence of diseases and family's workload. Seasonal variations in prevalence rates of diseases are frequently reported as causes for seasonal fluctuation in child malnutrition (Brown, Black and Becker 1982; Katona and Katona-Apte 2008).

Within the population studied there was no significant correlation between the nutritional status and the point prevalence[22] of infectious diseases, such as diarrhoeal diseases, ARI, skin infections or unspecified fever. Possibly, the nature of a cross-sectional study, collecting information on the outcome, here the nutritional status, and causes, here morbidity, at the same time, makes it difficult to identify given causalities or interactions (Madise, Mathews, Mpoma 1997; Mihrshahi et al 2007).

However, within the population studied, diseases that occurred or developed over a longer period of time, were associated to children's nutritional status. This held true for the number of diarrhoeal episodes during the past six months as well as for signs of a distended abdomen (figure 11, p. 148).

Recent studies showed that the risk of stunting increases with each episode of diarrhoea by 4%, thus the number of attacks and of the days they continue add cumulatively to the burden (Checkley et al 2008; Black et al 2008). Analysing the 1997 and 2001 data for such an association, results showed that with every episode of diarrhoea the estimated percentage of chronic malnutrition increased by 3.1%, height-for-age z-scores decreased by 4% and weight-for-height z-scores by 16% (linear regression, uni-factorial: +0.1 and +0.07 z-score units, respectively). Between baseline and follow-up the number of diarrhoeal episodes decreased by 0.3 attacks ($p = 0.002$), and even more substantially in Nalae district (by 0.5 attacks).

Intestinal parasite infestations are very common in Lao PDR, with even higher prevalence rates in the northern mountainous regions (62% and 70%, respectively). The predominant species are *Ascaris lumbricoides,* the hookworm, and *Trichuris trichiura* (34.9%, 19.1%, *and* 25.8%, respectively, Rim et al 2003).

Parasite infections are detrimental to a healthy development of a child; the loss of nutrients impairs physical and cognitive development particularly in late childhood (Berkman et al 2002; Drake et al 2002). Signs of distended abdomen, as an indicator for an advanced and severe stage of parasite infections, were assessed during the survey. Prevalence rates of chronic malnutrition were 13% lower for those children not showing such signs (multi-factorial analysis of variance, sector-wise for morbidity indicators). Rates of distended abdomen were very high at the start of the programme, but dropped drastically (table 82, p. 143).

There are various interrelations between nutrition-related diseases and their potential impact on malnutrition. Unspecified fever and diarrhoeal diseases are additional symptoms of intestinal parasite infestation; anaemia is a common consequence. Within the population studied, fever correlated with diarrhoeal diseases as well as ARI, and all three, fever, diarrhoea and ARI, were significantly associated with anaemia. Also, all three are themselves potential symptoms of malaria infections. Malaria, too, causes severe anaemia.

Malaria was the most frequent health problem for adult women, the second most for children and among the major causes of child deaths reported. Malaria control measures were part of the IFSP interventions, and a reduction in malaria infections was noticed. Malaria and anaemia were correlated, and both were more common in nearby locations. Locations classified as nearby were predominantly located at lower altitudes, in or close to lowland areas and close to natural water sources. The mosquito population is higher at lower altitudes, which results in a higher transmission rate. The higher prevalence for malaria in nearby locations probably contributes to the higher risk of anaemia there. A study on transmission of malaria was conducted in the south of Lao PDR, but precise data on incidence of malaria, transmission and magnitude of consequences in the more mountainous northern

[22] Point prevalence: occurrence of the symptom at the day of the interview

areas rarely exist (Sidavong et al 2004). Surveys showed that prevalence rates ranged from 27% to 68% throughout the country in different seasons (Watson 1999).

In conclusion, the health status of the population improved significantly over the four years' implementation phase. Based on proven linkages between morbidity and malnutrition, it is assumed that the improved health status contributed substantially to a better nutritional status. Simultaneously, given the vicious cycle of malnutrition and infections, the better nutrition reached, possibly as an outcome of other interventions, contributed to some extent to reduced morbidity as well.

4.3 Indirect causes

4.3.1 Access and use of health services

At the start of the programme the majority of the families did not seek any qualified medical advice when a child suffered from diarrhoea, but this changed remarkably over time. By the end of the programme, one quarter of the families consulted a trained health worker and also better quality treatment was provided.

The study shows that children's nutritional status was better in households that had access to health services, indicated by the immunisation coverage. Such children's height-for-age z-score was 13% points lower ($p = 0.002$) and their risk of suffering from parasite infections was 35% points lower ($p = 0.002$). Also chronic malnutrition was 13% points higher were children showed signs fo distended abdomen.

Immunisation coverage increased significantly (table 83, p. 150). It was primarily the responsibility of the Government's Health Office. The main reason for the change was the increase in the availability of such services, as also in the number of trained community health workers. The increase in coverage, particularly in remote locations, demonstrated the successful improvement and extension of such services in Nalae district. Here, between 1997 and 2001 coverage doubled and tripled and reached national averages in 2001 (children 12 to 24 months: DPT3 58% in Nalae district compared to 52% national average, and 92% compared to 69% for BCG vaccination, respectively, MoH 2001, p. 65). Vitamin A supplementation met national targets (national target 80% achievement 90%). Extension of government services to remote

locations in Sing district was less successful. Here, at an initial stage, the IFSP supported the government efforts to spread coverage to the most remote locations. Later UNICEF took over all financial requirements, while the IFSP's financial support was gradually phased out. This resulted in a fall of coverage in remote locations, and, thereby, increased risks for epidemic outbreaks. In combination with the low vitamin A supplementation coverage, an increase in mortality was a major risk factor.

Reproductive health services, including pre- and post-natal care, birth spacing, as well as growth monitoring, nutrition promotion, and an anti-malaria programme were among the most important preventive health services consolidated and continuously supported by the IFSP. Generally, services were functioning, regular and frequently used by the target population, particularly in Nalae district. Here the government was fully responsible for the planning and implementation, while receiving additional technical and financial support from the IFSP. Birth spacing was one of the priority areas requested by villagers. This was a common wish throughout the country, while access remained very low (65%, de Loof 2001, p. ix and 102-117). At follow-up one quarter of all mothers in Nalae district used contraceptives; coverage was even between 50% and 95% in villages nearest to the district capital. Despite this, and with a slight reduction in the number of birth per mother studied (by 3.4%), the number of pre-school children per family increased by one fifth (from 1.25 to 1.51 children under five). Villagers noticed the increase, and explained the change as a result of the reduced child mortality in recent years. This in turn was attributed primarily to the improved access to health services (source: focus group discussions).

An anti-malaria programme was successfully introduced, with two thirds and one fifth of the population in Nalae and Sing district, respectively, using impregnated mosquito nets. Villagers recognised and appreciated the impact of the programme. Fewer mosquitoes and less malaria cases were reported. Equally important was the reduction of other insects like fleas and bedbugs previously contaminating the sleeping places. The use of a net offered protection from rodents as well. Fewer disturbances during the night, also meant more restful nights, was seen as an added and important benefit (source: focus group discussions).

In conclusion, with support of the IFSP, health services were extended to remote areas, and were well accepted by villagers. Common diseases and child mortality

rates decreased substantially. Changes were largely attributed to the improved accessibility to effective health services. Generally, the villagers did not hesitate to use new curative health services, but institutions responsible to provide such services had limited capacities to reach wide areas and consequently coverage rates remained sub-optimal. The situation in Sing district was more complex, ethnical and cultural disparities and language barriers between health service providers and the local population seemed to limit the effectiveness of services.

4.3.2 Water, sanitation and hygiene

Unsafe water, unhygienic environment and poor sanitation are one of the world's biggest killers of children. They are also the major cause of morbidity, particularly diarrhoeal diseases and malnutrition as an outcome (UNDP 2006; Prüss-Uüstün and Corvalan 2006, p. 13). At baseline, water quality was a significant determinant of chronic as well as acute malnutrition. It was also associated to the number of diarrhoeal episodes and parasite infections as indicated by a distended abdomen (figure 11).

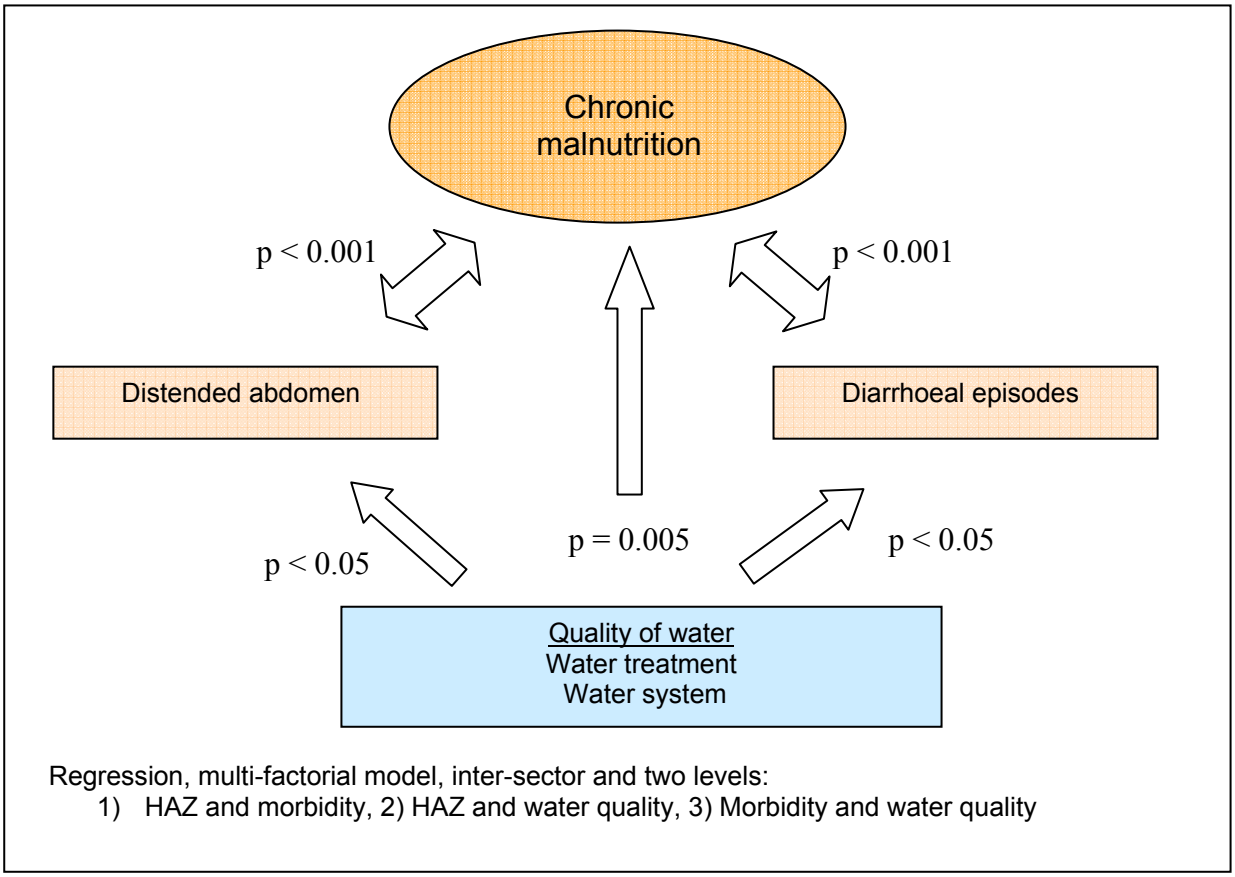


Figure 11: Morbidity, water quality and height-for-age (two-level, twofactorial analysis, n = 475)

Interventions aiming to improve water quality bore fruit. Despite cultural reservations at the initial stage, the new and improved water supply systems were adopted and access to water became easier (table 83, p. 150). Increased awareness of the importance of purified drinking water led to behavioural changes. The number of households drinking boiled water rose from one third to more than half, regardless of the water supply system. This was an important improvement, as baseline data showed that use of unboiled water was uncommon where water was obtained from locally 'protected' sources, even though those sources did not provide purified water, and bore the risks of contamination. Less than 10% of the improved systems that were introduced provided potable water, but its purification was still essential to ensure safety. The improved system and the behavioural change contributed significantly to the reduction of chronic malnutrition and parasite infections. Nutritional status was best within the group of households having access to an improved system and also drinking boiled water. Correspondingly, households using local sources and drinking unboiled water were at the highest risk (analysis of variance, three-factorial, HAZ -1.9 and -2.9, respectively, $p < 0.01$ for both, system and behaviour, $p > 0.1$ for the year).

Villagers rated the introduction of the water supply system as one of the most important interventions leading to the immediate improvement of the health status of children and the situation of women. The new systems both improved the quality and increased the quantity of water available throughout the year and brought it nearer to the house. Easy access to sufficient water improved hygiene practices, and lead to better environmental, personal and food hygiene. In addition, a reduced workload, particularly for women, allowed for more time for other activities were the priority benefits observed. These were mainly market activities, food collection and preparation and spending more time on care for children (source: focus group discussions).

Defecation in the open leads to environmental contamination and increases the risk of infectious diseases for all members of the community. In 1997, latrine facilities, rarely available, were poorly maintained and hardly used. Still, families that owned such facilities were nutritionally better off, suffered fewer diarrhoeal episodes and had a lower risk for parasite infections. The better nutritional situation in households with a latrine might be a direct cause-and-effect relationship, but it could also be an

outcome of the generally improved hygiene practices followed within that family, or an effect of reduced environmental contamination in the village, as there were other families possibly using latrines as well. Promotion of latrine facilities was part of the water and sanitation programme and very successful in Nalae district. Here villagers welcomed the toilets as better and more convenient than defecation open and outside the village, which was the common practice before. This was different in Sing district. Here, as an example, the maintenance of the water supply system was a priority, but the maintenance of sanitation facilities was not. Thus, several attempts promoting the construction and use of such facilities failed. This was possibly a result of differences in village layouts. Traditional villages in Sing district were more scattered, additionally, there were cultural hesitations, and hence it was difficult to have fences or some other form of boundaries. So, domestic animals were free to stray everywhere. In such conditions, construction and maintenance of latrines was not a worthwhile investment. Hygiene promotion was more successful in larger village settlements where animals gradually began to be kept outside the village. However, a behavioural change was not yet measurable for the total sample of villages studied in Sing district.

Table 83: Changes in water, hygiene and health care (in %)

Determinants	1997	2001	Level of significance[1]
Improved water system	15.5	58.7	$p < 0.001$
Water treatment improved	35.6	55.3	$p < 0.001$
Hygienic housing	12.2	19.4	$p < 0.001$
Toilet facilities	7.0	18.3	$p < 0.001$
Immunisation coverage (DPT3)	25.2	32.8	$p = 0.002$

[1] Chi-square, Fisher's exact test

4.3.3 Food security and livelihood

Agricultural system and staple food production

About one third of the national rice production is grown in upland fields (UNDP 2001, p. 41-42) and upland farming is the traditional and predominant livelihood system of the studied population. Upland rice, the staple food, is traditionally produced in a rotational and shifting cultivation system employing slash-and-burn techniques to clear the land and using dry rice varieties for cultivation. Shifting cultivation is extremely labour intensive and provides relatively low yields (0.7 to 1.5 or 2 tons per

ha). A rotational cycle of 10 to 15 years, comprising one-year of production and then an extended fallow period has the merits of being environmentally sound. A shorter cycle or two consecutive cultivation seasons would not allow the soil to recover and would also lead to depletion and erosion. The environmental harm would also results in diminished yields. However, increased population density, migration, land allocation and declaration of forest areas as natural reserves have all reduced the upland available for rice production. This has led to the available land being used more intensively with a shorter rotation cycle of between two and four years duration (source: focus group discussions).

The study shows a reduction in rice yields obtained from slash-and-burn cultivation. This was largely because of the unfavourable weather conditions during the production period prior to the follow-up survey. Almost half the households, double the number in the year of the baseline survey, stated the harvest had been bad. Adverse climate conditions as the major reasons were stated for the decline. This indicates the high susceptibility of the existing upland system against critical climate conditions. Interventions to improve cultivation or soil management techniques did not prove effective enough to lead to more productive or stabilised upland agricultural systems.

With IFSP support, 15% of the total study population was able to change from upland cultivation to flatland rice production (Chi-square, Fisher's exact test, $p < 0.001$). Yields obtained from flatland rice production increased by 10%. Nonetheless, even after four years of intensive support, more than half of the population fully depended on slash-and-burn cultivation and almost half of the population still faced rice shortages. Lack of access to adequate land was a major constraint. Only 4% of the total land area in Lao PDR is arable, with the shortage especially acute in the north. Nationwide, one hectare has to produce enough food for five people, which is almost double the Thai figure of three (New Agriculturist 2005). Along with a lack of qualified human resources required to maintain effective agricultural extension services, this was the biggest problem in food production. One also has to bear in mind that the introduction of a new system requires several cycles to be fully effective, but the trust and confidence of the target population can be gained only if advantages are evident. Comprehensive adoption requires a gradual incorporation of the new systems into

the existing culture and traditional life styles, and this process requires a longer period of time to become fully effective.

The adoption of the improved production system correlated with a decrease in malnutrition, but increased rice production did not show any impact on malnutrition (analysis of variance, three-factorial, $p = 0.046$, $p = 0.563$, respectively). Thus, factors other than rice production must have contributed to the improvement. Upland farming is not mechanized but depends mostly on manual labor and use of simple tools. It is the women's domain to clear small bushes, brushwood and shrubs and also to do a large part of the weeding (Moser, White and Hauser 2007). Upland farmers spend 6 to 9 months of the year in the fields guarding against animals and caring for plants (GoL and ADB 2001, p. 84). Flatland production is less labor intensive. A family spends less time in the fields and does not have to stay away from home for several days or weeks, but can return to the village every day. This reduces exposure to potential health threats. Flatland cultivation also involves a higher level of mechanisation, predominantly a male responsibility. The reduced exposure to potential health threats and the additional time made available, particularly to women, possibly contributed to an improved nutrition.

Wherever it was introduced, flatland rice production methods led to great advantages for nutritional well-being. However, flatland production bears the risk of becoming a rice-centred monoculture regime. Traditional upland fields usually grow various non-rice annual crops that include staples such as sorghum or maize, various types of vegetables, spices, and herbs (NAFRI, NAFES and NUOL 2005, p. 109). A sudden change in the production system could result in a loss of benefits of the traditional food security and coping mechanisms. This, in the absence of effective options combined with a reduction of natural resources, will further endanger dietary variety. It is thus important to promote a diversification in food production to allow for continued access to a variety of foods for a balanced diet.

In conclusion, the study shows that increased rice production neither reduces malnutrition nor improves people's diet. The reduction in malnutrition among the flatland farmers is attributed to other factors. The lighter workload, particularly for women, as compared to slash-and-burn cultivation, could be the most important reason for the nutritional improvements among the flatland farmers.

Gardening

Permanent vegetable gardening did not play an important role within the traditional upland livelihood system. Studies report that in Lao PDR 80% of the vegetables consumed were from forest resources (WFP 2006b, p. 79). At the start of the IFSP two thirds of the households had a garden, mainly of herbs in Nalae district and of poppy for opium in Sing district, while towards the end of the programme almost all households had gardens (table 84, p. 160). There was a strong commercial element attached to this adoption of new gardens growing cash crops such as sugar cane, coffee, cardamom, and fruits. Vegetable gardening was of low priority to villagers, and was hence not a priority area of intervention. In 2001, garden products, food or cash crops, contributed 8% to the income of the households. An increase was expected gradually.

At a time when traditional and diversified upland production patterns are undergoing transition and traditional forest resources are declining, permanent vegetable gardening becomes important to ensure continued access to food products allowing for a diversified diet. A nationwide study showed that families with vegetable gardens enjoyed a better diversity in their diet having two additional vegetable servings per week (WFP 2006b, p. 110). Effective interventions in the sectors of food security and livelihood are imperative to compensate for the reduced supply of products traditionally derived from shifting cultivation and forest resources.

Livestock

Livestock production was the second most important means of livelihood in Nalae district after trade in non-timber forest products (NTFP), whereas in Sing district trade in NTFP and opium ranked higher. On average 35% of the households obtained their main cash income from animal raising. Across the country as well as in Luang Namtha province, livestock was the second most popular livelihood activity following food crop production (ADB 2006, p. 11; WFP 2006b, p. 14). The sale of livestock accounts for more than 50% of the cash income in upland areas (and for about 20% of the GDP (UNDP 2001, p. 42; Gansberghe v 2005, p. 71).

National studies had reported that big animals were less important in the northern parts of Lao PDR than elsewhere, while pigs carried a higher importance in upland communities. Results of the present study confirmed the situation reported for the

north or for upland areas (3 large animals, 1 pig, 15 poultry birds as national average, Gansberghe v 2005, p. 71, as against 1.9 large animals within the IFSP area, 2.7 pigs and 8.8 respective 13.8 poultry birds in 1997 and 2001).

Between 1997 and 2001 there was a significant increase in the number of both, households involved in poultry production (from three quarters to 92%), and animals raised (table 84, p. 160). Epidemics were a major threat throughout the country (UNDP 2001, p. 42; Gansberghe v 2005, p. 75) as well as within the IFSP target area. Although improved veterinary services supported by the IFSP were effective in reducing animal deaths by 25% to 50%, death rates remained high (23% for the big animals raised, 62% for the pigs and 70% for poultry).

The analysis controlled for income, showed that the possession of small livestock, pigs and poultry, was a significant determinant of the nutritional status of children. The higher the number of animals the better the nutritional status (linear regression, uni-factorial, increase of 0.1 HAZ units per animal unit, $p = 0.01$). The possession of big animals was not a determinant to children's nutritional status. The actual data did not indicate any significant relation between owning livestock and direct causes of malnutrition, such as a family's food intake, child feeding practices or morbidity. However, it was strongly associated with an increased cash income (linear regression, uni-factorial, increase by 18 USD per animal unit, $p < 0.001$).

Within the population studied, livestock serves as a 'living bank', providing a kind of economic insurance. It helps households cope in times of seasonal shortages, hunger months, crisis situations or pays for emergency expenses. Livestock is used for bartering or trade for basic needs. The possession of livestock is perceived as an asset and the more livestock a family owns, the higher their wealth status. Buffaloes/cows and pigs rank higher than poultry. Poultry was kept for multiple purposes: the meat would serve for food when guests came, and at traditional ceremonies, and could be sold or bartered to meet emergency expenses (source: focus group discussions). A similar pattern was reported in national studies. Across the country, livestock are used as savings, act as a safety net, pay for emergency medical expenses (UNDP 2001, p. 38; WFP 2006b, p. 122) or to sell in order to compensate for rice shortages (GoL and ADB 2001). Income gained from livestock is also used for longer-term investments, particularly in education and agriculture (i.e.

seedlings, tool, rice mills, Gansberghe v 2005, p. 71). They are also an important source of food (ADB 2006, p. 1-2).

In Lao PDR in general, small livestock is mainly cared for by women, who also sell chicken or ducks, meat and eggs at local markets (Schenk-Sandberger and Choulamany-Khamphoui 1995). Within the study population, women were found to play a bigger role in decisions to do with poultry than in those involving other assets. Correspondingly, men's involvement in such decisions was lower than in decisions regarding other household assets. Thus, ownership of livestock improves women's access to and control over resources, which enhances their options for resource allocation, probably towards improved nutrition. The livestock is assumed to contribute directly to the family's diet, or indirectly, through getting other food items in exchange, or nutrition-related goods such as kitchen utensil, seeds and tools for food production, or through covering expenses related to health care.

In conclusion, the livestock-farming situation improved over the programme implementation period, with a 40% rise in poultry farming, and loss of animals, small or big, reduced up to 50%. Livestock was an important source of income and served as a 'living bank'. Income controlled analysis showed that the nutritional status of a family increased with each unit of small livestock owned. Small livestock being women's domain, ownership enhances their opportunities to allocate resources for better nutrition. Given the decline in wildlife available from forest resources, the importance in livestock farming increases. It is an important and effective alternative to contribute to households food security situation and should, therefore, receive high priority among livelihood measures for upland communities.

Fish farming

Wild aquatic resources derived from forests, through fishing or foraging in rivers, streams or swamps or, to a smaller extent also from irrigated rice fields, contributed substantially to a family's diet. In Lao PDR the decline in forest resources and the intensification of rice production put those resources at danger (Meusch et al 2003, p. 21-22). The introduction and management of fish farming was supported by the IFSP. The introduction of ponds was particularly successful in Nalae district, where they were not common at the time of the baseline survey. In Sing district the focus was on improved management of fishponds. A correlation with better nutrition or a

diversified diet was not yet noticeable. There were various problems in managing fishponds. Availability and nurturing of fingerlings, adequate water quality and feeding were the main constraints hindering survival and productive growth. Where production was successful, fish-dishes were prepared to host guests, to be served at meals during festivities, or fish was sold at local markets.

In conclusion, fishponds could become vital sources for daily nutrition. A further improvement in management of such ponds will enhance productivity and consequently contribute more substantially to the daily diet as well as household's livelihoods. In an area where access to wild aquatic resources are declining, fish farming offers an important alternative source to ensure continued access to high quality protein.

Income and occupation

At baseline, the annual cash income was extremely low but increased by 46% on average (124 USD/family/year to 181 USD/family/year, table 84, p. 160). The percentage rise was almost equal for the mean income and the median, but was smaller in the lower centile than in the upper centile (32% for the 25th and 45% for the 75th centile). So, income disparities existing at the beginning of the programme continued to persist. In absolute numbers income of the poorest centile increased by 9 USD, while the upper centile's income increased by 76 USD. While income within the target area increased, the average national economic situation worsened, between 1993 and 1998 the annual per capita GDP decreased by 13% (from 385 USD to 338 USD, ADB 2007, p. 270).

The national food poverty line[23] was 0.50 USD/capita/day, the absolute poverty line was 25% higher as it incorporated additional allowances for basic non-food requirements (NSC no date, p. 1). Within the population studied, almost all households were subsistent farmers. Based on national statistics[24] it is estimated that the monetary value of foods from a household's own produce or foraging accounts for about 80% of the total consumption (0.40 USD/capita/day). The remaining 20%

[23] Level of income sufficient to buy 2100 kcal per person and day based on 1997/1998 prices (NSC, no date, p. 1, Sisouphanhthong, Souksavath and Dark 2001).

[24] In Lao PDR the lowest income households were estimated to obtain 60% of the food from their own production, and 87% of the energy supply from their their own produce or forage, populations in areas without road access obtain 82% of their total food supply from their own production (NSC 2007, p. 17-18, Boupha 2008, p. 2 and 6, NSC no date, p. 2)

required to cross the food poverty line would need to be purchased (0.10 USD/capita/day, including 0.02 USD/capita/day to cover the annual rice shortage[25]). Between 1997 and 2001 the average cash income increased from 0.05 USD/capita/day to 0.10 USD/capita/day. In 2001 the mean per capita income equalled the national food poverty line. Still, about 70% of the population were below the accepted food poverty line and about 80% were below the non-food poverty line. Thus, even after a substantial rise in incomes, the poverty rate within the area studied was still much higher than the national rates. At national level 30% of the population was below the food poverty line and 46% below the non-food poverty line 1996/97, the latter decreased to 32.7% nationwide (ADB 2007, p. 100) and 52% in Luang Namtha province in 2003 (GoL-LECS 2004).

Despite the substantial increase in income, income disparities were persistent. Farmers had half the income of those engaged in non-farm activities, and households in remote locations earned only about two thirds of the income earned in easily accessible locations. Families in Sing district had a higher cash income than in neighbouring Nalae district, where the income rise was evenly distributed between remote and easily accessible villages, while in Sing district the increases were lower in remote locations.

Most important sources of income were NTFP, livestock and crops, particularly rice. Opium was an additional source in Sing district. The increase in income derived from trade in NTFP in Nalae district, and in rice in Sing district, which also had additional labour opportunities. Villagers explained that their improved health status allowed them to pursue productive activities more vigorously (source: focus group discussions). Non-rice agricultural products from commercial gardening became a new source of income. Trade as well as labour opportunities improved because of new agricultural investments in the region, facilitated by the IFSP but mainly coming from Chinese investors.

The most fundamental reason for the change but also for the geographical disparities in income was the extension of the road and transportation network, improving

[25] Rice shortage per capita 70 kg in 1997 and 55 kg in 2001, local price 115 USD per ton of rice, cash required to purchase that quantity is 0.017 USD and 0.022 USD/capita/day.

accessibility, market opportunities and easier linkages to neighbouring provinces and countries, such as China, Myanmar and Thailand.

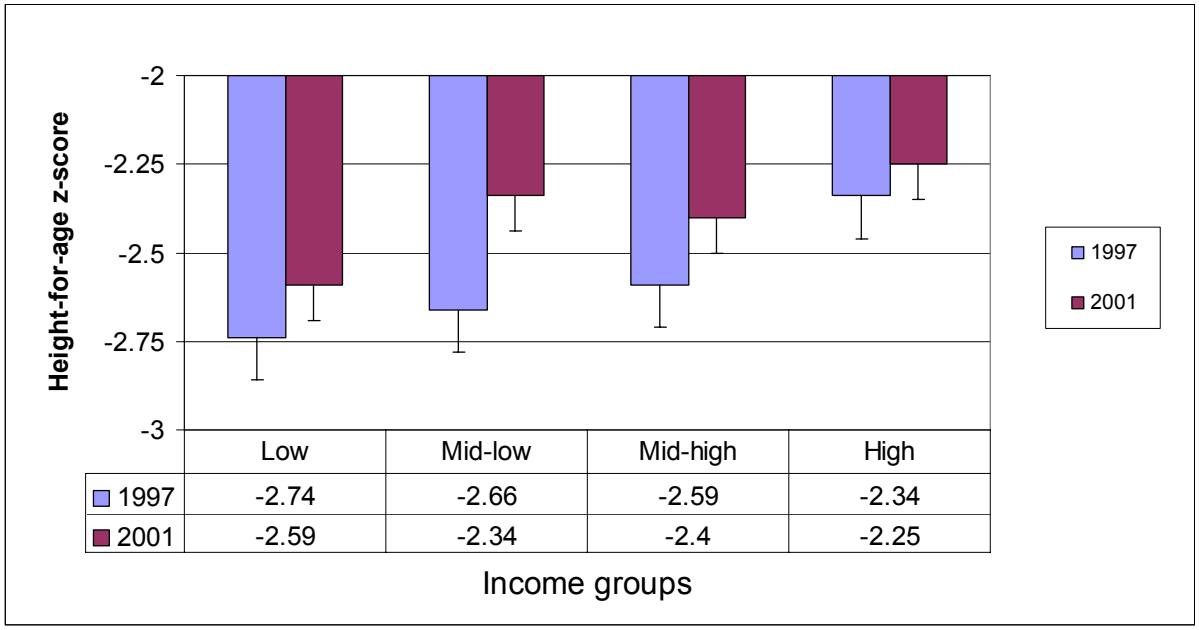
Lack of proper management and over-use or exploitation of forest resources resulted in a decrease of NTFP in easily accessible areas. This together with a failure of the upland rice harvest and a migration of family members resulted in a reduced income in one fifth of the households.

Overall, the income was spent on meeting basic needs: food, particularly rice, then medical treatment followed by housing. Priorities changed where an increased income was achieved. Expenses for food ceased to be a priority. These households were now either sufficient in rice, or food expenses had become minor items in the budget. Investments in improved housing rose in importance, followed by expenses on children's education. This shows that further development can take place only when basic needs like food and housing have been met. Food insecurity and poverty were frequently stated as the major reasons for not sending children to school.

The income correlated with the nutritional situation. Children's nutritional status was better where families had a higher income. Contrary to other potential causes of malnutrition, this was significant for both chronic and acute malnutrition. Higher-income families were in a better position with regard to the food intake as direct cause of malnutrition, but no association was noticeable between income and indirect causes. Better income families were able to ensure a better quality diet; they consumed a larger number of food items from own production or from foraging and had snacks more frequently. It was noticed that their children were better off regarding health (point prevalence and distended abdomen) than the children from the lowest income group, however, they rank second highest among the four income groups.

It was apparent that wealthier families were not in a better situation either with regard to child feeding practices, or following better hygiene practices, except regularly consuming boiled drinking water. This was probably one of the reasons for the high morbidity rates within the group of richer households despite the better food intake and improved access to food.

A household's wealth was closely correlated with the nutritional status in 1997 and 2001 and income increased by 45% over the programme period. Still, improvements in malnutrition were independent of the increase in income. Malnutrition decreased for all income groups almost evenly, while the lowest income group improved at a slightly higher pace than the highest income group (figure 12).



	Low	Mid-low	Mid-high	High
1997	-2.74	-2.66	-2.59	-2.34
2001	-2.59	-2.34	-2.4	-2.25

Figure 12: Income and height-for-age
(HAZ and SE range; 1997: n = 444, SE 0.09 to 0.14; 2001: n = 639, SE 0.08 to 0.11)

Income does not automatically translate into better nutrition as indicated also by the national trends of poverty and malnutrition. The national per capita GDP increased by 36% between 1999 and 2003 (GDP per capita, 338 USD and 460 USD, respectively, ADB 2007, p. 270), while at the same time chronic malnutrition increased from 41% in 2000 to 45% in 2006 (WFP 2006b, p. 99-100).

A comprehensive review of programmes worldwide showed that increased commercialized food production was effective to increase household income, but the increased income did not show an impact on child nutrition. The World Bank concluded that they would need to be complemented with other interventions that target determinants of malnutrition more specifically, such as health and care giving practices (World Bank 2007, p. iiv, 70 and 77-78).

Apart from food security, safe housing is a basic need and a major criterion of sustainable livelihood. Income was firstly spent meeting minimum food requirements. Wealthier families then invested in housing, adding better quality material to existing homes, making them somewhat more permanent. The number of houses using better quality construction material doubled over the implementation period (table 84). This indicates great progress as, besides ensuring better living conditions, such improvements allowed for a more hygienic environment as well.

Table 84: Changes in food production and livelihood

Variables	1997	2001	Level of significance
Flatland production (%)	24.9	40.9	$p = 0.001$[1]
Rice production (kg/capita/year)	289.0	306.0	$p = 0.294$[2]
Gardening (%)	65.0	95.6	$p < 0.001$[1]
Small livestock (poultry)	8.8	13.8	$p < 0.001$[2]
Income (USD/family/year)	124.0	181.0	$p < 0.001$[2]
Housing (industrial material)	10.0	25.4	$p < 0.001$[1]

[1] Chi-square, Fisher's exact test
[2] ANOVA, uni-factorial

The study also shows that housing material was a relevant proxy-indicator in identifying the level of poverty and households at higher risk of poverty-related malnutrition. At baseline, the nutritional situation was significantly better for families living in better quality houses, but their nutritional status did not show much improvement. At baseline, their nutritional status was already better than the nutritional status of high-income families after four years of implementation. It is therefore assumed, that investments in housing indicate a certain level of prosperity at which a family has the financial as well as human capacities to overcome most prevailing nutritional risk factors.

Families living in houses constructed of local material showed great progress in alleviating malnutrition. Between baseline and follow-up, their nutritional status improved significantly and met the mean value of the total sample in 2001 (chronic malnutrition reduced from 73% to 59%).

In conclusion, income was increased by 46% between 1997 and 2001, despite a contrary trend nationwide. Income-poverty was a determinant of malnutrition in both years. Statistical analysis showed that prevalence of malnutrition was reduced for all

income groups with the greatest reduction rates in the lower income groups. This shows that other factors were also responsible for the reduction of malnutrition. Hence, poverty reduction is important, but must be complemented by other interventions to reduce the prevalence of malnutrition more substantially.

4.4 Basic causes

Education

Literacy levels within the population studied were far below national and rural averages, and extremely low for women (male literacy 24% in 1997 and 2001 compared to the 83% national average in 2005; female literacy 6.2% compared to the national average of 48% national average, respectively). Nationwide literacy levels rose by 17% between 1995 and 2005. Levels in remote locations in Lao PDR were 26% lower than the national average. In 1995 female literacy was 36% lower than male's literacy level, but this gap was reduced to 24% in 2005 (NSC 2005). However, gender disparities in literacy were reported to have widened in rural locations (World Bank 2005, p. 14).

Both study groups, the Austro-Asiatic in Nalae district and the Hmong-Mien in Sing district, speak their own vernacular. Those among them without any formal education cannot speak, read or write the Lao language. This makes it hard for them to participate in the ongoing economic and social development process within or outside the district. Illiterate people have fewer possibilities to participate effectively in business and trade, to demand and get fair prices, and to understand messages of social services (i.e. in health, agriculture) well. Particularly in Sing district, low literacy levels aggravated the negative effects of cultural disparities. In Nalae district the situation was more homogeneous.

Improved access to primary education was of high priority to villagers, who also contributed substantially to the construction of schools and appointment of teachers. The IFSP supported formal education as well as literacy classes for adults, including life skills training. Attendance and enrolment rates rose, particularly in remote locations. However, by the end of the programme, it was found that literacy classes had had no impact on either literacy levels or on the ability to read and write.

Despite the low quality of the education offered and their limited academic achievements, even a few years of primary education had a strong impact on child malnutrition. Analysis controlled for income showed that prevalence of chronic malnutrition was 35% lower where parents had had more than three years primary education. Literacy neutralises the negative effects of a low income, as was shown by the better nutritional status in households with low-income but literate parents, than in those with high-income but illiterate parents. Differences were also noticeable with regard to the direct causes of malnutrition. Children's health status was better where parents were literate; the number of diarrhoeal episodes was lower by 28%, the family's diet was of better quality; the diet was more diversified. Literacy also had a significant impact on the indirect causes of malnutrition. Literate parents more often followed better hygiene practices and made use of the health services. Living conditions were better where the parents were literate. They earned more income, raised more small animals, had more non-agriculture income opportunities and their houses were in better condition. Also the women's social status was better where parents were literate.

Various studies in the past have demonstrated the strong influence of education on nutrition, food security and poverty. FAO's food insecurity report 2004 states: "*illiteracy and lack of education reduce earning capacities and contribute directly to hunger and poverty*" (FAO 2004, p. 28). Malnutrition declines as literacy increases, particularly female literacy. Improved education enables women to earn higher incomes, and thus enhances household food security. Education, furthermore, improves the quality and capacity of childcare (Smith and Haddad 2000b). Studies also show that even modest levels of maternal education mitigate the negative effects of a low family income and lead to lower infant, child and maternal mortality and better nutrition. Education improves the use of health services and information (World Bank 1994, p. 15; Herz, Shahidu and Khandker 1991). In India, child mortality was six times lower where the mothers were educated. The reasons identified were better hygiene, nutrition and feeding practices, timely medical treatment by skilled personnel as well as better-quality diet (Chirmulay 1997, p. 77-83; Walker and Ryan 1990; Mukudi 2003). Other studies conducted in India show that both male and female education correlated significantly with child malnutrition and weight as well as height growth (Reddy et al 1992; Brahmam, Sastry and Rao 1988; Mukudi 2003). Studies conducted in 13 African countries between 1975 and 1985 demonstrated that

a 10% increase in literacy rates leads to a 10% reduction in child mortality (SIWI and WHO 2004, p. 9).

Two associations between education of parents and causes of malnutrition within the population studied require further explanation. First, analysis of the total sample showed that literate parents actually performed worse regarding infant feeding practices. However, analysing the effects of female literacy showed contrasting results; literate mothers were more likely to initiate breastfeeding on the first day and provide complementary food at the recommended time. It would thus appear that female literacy has a strong impact on improved infant feeding practices but not male literacy. It also shows that even a few years of primary education is enough to motivate women to abandon unfavourable practices.

Second, literate parents achieved 30% lower agricultural productivity, measured in rice production, than those illiterate. The lower production, primarily noticed among the shifting cultivators in Sing district, can be attributed to limited access to land resources in locations nearby. At the same time, access to education was easier and thus literacy levels grew higher in such locations. Hence, certain locations had a higher need as well as more options to reduce rice dependency through a more diversified livelihood system.

In conclusion, educational levels were extremely low. Still, the few years of primary education did lead to a reduction in malnutrition rates as well as to mitigation of its direct and indirect causes, and reduced the negative impact associated with low incomes. Female literacy was especially effective in adoption of favourable infant feeding practices. Education builds people's capacity to diversify their livelihood system, contributes to improved access to and utilisation of food, and helps reduce people's exclusive dependence on rice.

Status of women

Women in Lao PDR carry the major responsibilities for ensuring their family's food security. Men and women spend an equal amount of time in agriculture activities, with the difference that while the men are more involved in work that generates income, the women work mainly for meeting the household's food needs (World Bank 2005, p. 37). Women often earn some small money from the poultry or

handicraft production, which complements the family's income. Lack of education, together with cultural attitudes, limits women's mobility and engagement in social and economic activities away from home. They are usually involved in village development, but have little participation in decision-making. The position of women is safeguarded by the Lao Women's Union, a mass organisation, officially represented in every village (World Bank 2005, p. 70).

The present study measures women's social status by their decision-making powers. Women were less likely to make independent decisions over the use of household assets compared to men. This power further decreased with an increase in the monetary value of the asset, while that of men increased. In about one fifth of the households women's status was higher than men's status. In these households women decided on the use of most common household assets, such as poultry, rice, handicrafts, or had the power to decide over cash expenses. Analysis showed that in these households, children's nutritional status was 18% better than in households where men were the main decision makers, regardless the family's income. The impact of women's status on nutrition was paramount and was even more evident when adjusting for difficulties faced by a single-woman or a female-headed household. Excluding households headed by women from the analysis, children's nutritional status was found to be even 40% better where women's social status was high (analysis of variance, income adjusted, $p < 0.001$).

Similar to the impact of education, also the social status of women showed an impact on children's health status, family's diet and use of health services and hygiene practices (figure 13). A higher status of women even helped to mitigate the negative effects of low income on malnutrition. But it was remarkable, that these women did not apply proper IYCF practices. No difference was observed in a household's food security status (rice production, animal raising patterns). Income and educational situations were better where women's status was higher. Improved use of health services and better hygiene practices combined with a reduced prevalence of diseases were the primary causalities behind the reduction in the rates of malnutrition where women's social status was higher.

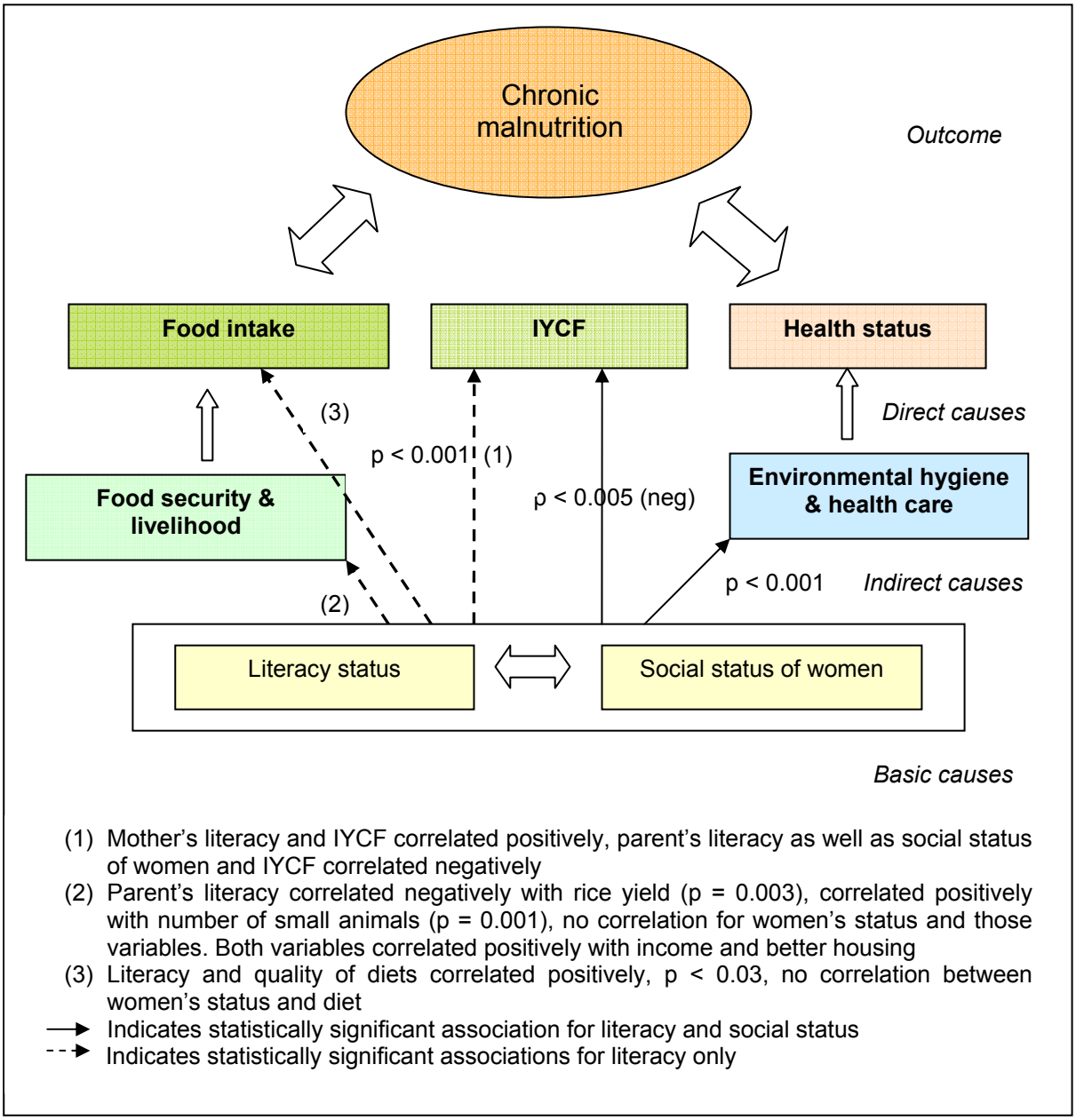


Figure 13: Causalities between women's social status, literacy and height-for-age (unifactorial analysis)

Based on the results of cross-country studies, Smith and Haddad concluded that women's status determines the nutritional status through their own mental and physical capacities and ability to influence the allocation of household resources. A low status restricts women's capacity to act in their own and their children's best interests (Smith and Haddad 2000b). Women of lower status have less control over or access to resources, information and services. Those with poor mental health and self-esteem neglected to take care of themselves and, in turn, of their children (Smith et al 2005). Inequalities in access to resources, in combination with higher nutritional requirements for pregnancies and lactation, make them doubly vulnerable and jeopardises their own as well as their children's well-being (Delisle 2008).

IFPRI had stated as early as 1995 that women unlike men, tend to spend their income disproportionately on food and family welfare. Thus, women's income had more direct and greater impact on household food security, as well as on child health and nutrition, than men's income. But women spend most of their time on non-economic activities like fetching water and fuelwood or grinding grain. They further conclude that time-saving measures enable women to spend more time on household chores and income-generating activities, which ultimately improves children's nutrition (Quisumbing 1995; IFPRI 1995; IFPRI 2000). A study conducted in Guatemala showed that the impact of income on reducing malnutrition was 15 times higher if the income had been earned by the mother rather than by the father (FAO 2005b, p. 16; Herz, Shahidu and Khandker 1991).

The crucial role of women in development has been well known for decades but it still calls for serious recognition. Empowering women, including in matters of health, nutrition, education, and decision-making, is still among the highly recommended priorities when aiming for better health and equity (FAO 2005b, p. 16; Gillespie 2006, Delisle 2008).

In conclusion, in about one fifth of the households women were the main decision makers over the use of household's assets. Women's social status had a significant impact on child malnutrition as well as its indirect causes. Improvements in poultry farming achieved over the programme implementation period presumably increased financial resources available to women. A change from slash-and-burn cultivation to flatland rice production, as well as improvements in the water supply system, reduced women's workload, and thus granted them more time for other tasks. A combination of the two -- more financial resources and additional time -- with improved access to health services, was the presumed pathway to the reduction in child malnutrition measured in 2001. Based on the results, it can be concluded that the MDG are achievable within the given context, if an improvement in women's status and access to resources was achieved.

Distance of location

The accessibility of a village, as measured by the distance one has to travel to reach the nearest semi-urban area or to access the transportation network, was included in

the analysis to identify and better explain characteristics of malnutrition. De Loof identified remoteness, besides ethnicity, as the strongest factor determining child malnutrition in Lao PDR (de Loof 2001, p. 81-107). Within the study areas in Nalae district as well as in Sing district, both chronic and acute malnutrition were significantly higher in remote locations. The situation has improved significantly for both locations, but disparities continue to persist. Direct causes were the same in all locations, except for malaria and anaemia, which were more prevalent in easily accessible locations. Regarding indirect causes, however, households living in easily accessible locations enjoyed advantages, they had better access to health services, water and sanitation, and their hygiene practices were better. These households were also at an advantage regarding food security and livelihood conditions (adoption of the improved rice production system, higher rice yields, possession of livestock, better income and occupational opportunities). Parent's literacy level and women's social status were also better in locations easily accessible.

In conclusion, the data show that locations easily accessible had lower rates of malnutrition and were advantaged particularly with regard to indirect causes of malnutrition. Improvements in women's social status and education, combined with access to financial resources, through, for example, poultry farming, introduction of time saving measures through better methods of agricultural production, easier availability of water, as well as easier access to health services in remote locations, could mitigate the effects of geographical disparities on malnutrition. Hence, those measures should be of high priority when aiming for reduction of malnutrition and poverty in the upland areas of Lao PDR.

4.5 Determinants of malnutrition – multi-factorial analysis

Determinants of malnutrition at baseline

Determinants that proved significance when applied to a sector-wise analysis (figure 13) were selected for an inter-sectoral multi-factorial regression analysis model. The multi-factorial model has two levels: indirect causes and basic causes. Results show that women's social status was the most significant determinant followed by the parents' literacy status (table 85). A difference of 0.76 z-score units and 0.32 z-score units of height-for-age was attributable to these two determinants, respectively. This translates into a reduction of malnutrition rates by more than 60% between children

of women of a better status from literate households, and of those coming from illiterate households where women had a lower social status (chronic malnutrition, 28% and 76%, p = 0.001). Other determinants were not significant when applying this multi-factorial model. The non-significance could also be a result of the reduced caseload included in the multi-factorial analysis.

Table 85: Determinants of malnutrition, regression, multi-factorial model, inter-sectorial analysis (n = 310)

Determinants	Regression coefficient	SE	Level of significance
Farming system	0.006	0.230	p = 0.980
Animal production	0.266	0.168	p = 0.116
Income	0.070	0.155	p = 0.656
Water system	0.290	0.240	p = 0.228
Water treatment	0.151	0.173	p = 0.382
Literacy parents	0.322	0.178	p = 0.071
Women's decision power	0.760	0.209	p = 0.000
Accessibility of location	0.162	0.209	p = 0.440

Results show that women's status, together with education, mitigates the negative effects of other factors jeopardizing children's nutritional status, such as lack of financial resources, the hard work entailed in slash-and-burn cultivation, difficult access to water, lack of health services or other difficulties associated with the accessibility of the location. Results also show that improving women's education would further enhance the positive impact of their status on child malnutrition. For example, despite the strong and continuing influence of traditional practices, literate mothers apply better infant feeding practices, than those with no education but of higher status. Consequently, if the cycle of poverty and malnutrition is to be broken, the greatest attention should be accorded to improving women's social as well as educational status.

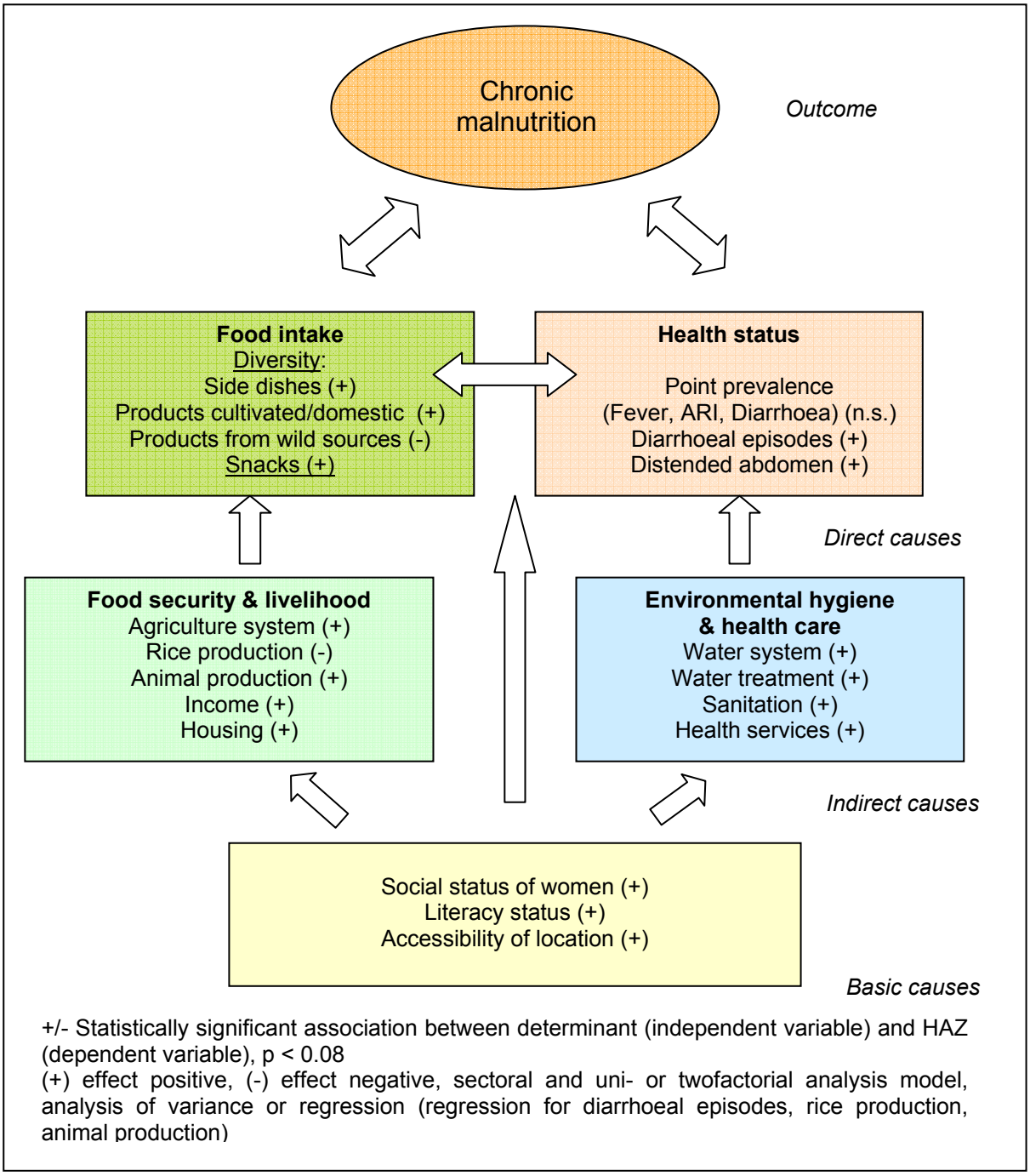


Figure 14: Significant determinants and their association with height-for-age (uni-factorial analysis, n = 475)

Determinants of the reduction in malnutrition

Multi-factorial co-variance analysis was applied to analyse the effects of the single variables eliminating interactions. The multi-factorial analysis model included variables that the sector-wise analysis had shown to be significantly associated to malnutrition (two- or three-factorial, including one or two independent variables and the year to measure overall progress). Results show that purifying the drinking water had the highest impact on malnutrition, followed by improvements in the water and the agriculture production systems. A difference of 0.70 z-score units was attributable

to treatment of drinking water only, 0.64 z-score units to an improved water supply system and 0.45 z-score units to an improved agricultural production system (table 86). Differences over the years, resulting from other possible interventions, were statistically insignificant.

Table 86: Determinants of change in malnutrition, multi-factorial model

Determinant	Baseline Follow-up n	System improved Mean HAZ (SE)	System not Improved Mean HAZ (SE)	Level of significance
Agriculture system	629 378	-2.04 (0.17)	-2.49 (0.07)	p = 0.014
Water system	395 613	-1.95 (0.18)	-2.59 (0.06)	p = 0.001
Water treatment	462 546	-1.92 (0.17)	-2.62 (0.08)	p < 0.001
Year	470 538	-2.13 (0.18)	-2.40 (0.06)	p = 0.135

ANCOVA, multi-factorial model: independent variables: agriculture system, water system, water treatment, year, and age as covariate; dependant variable: HAZ

The estimated prevalence of malnutrition within the group that adopted all three interventions was 25% applying the multi-factorial model, while the nutritional status of those not applying any of the improvements retained their prevalence rate at 73%.

At the end of the programme, about one fifth of the population had adopted all three of the improved techniques (22.2% in 2001 compared to 0.2% in 1997), but, in contrast, one fifth of the population had not yet adopted any of the improved measures (reduced from 40.7% to 19.4%).

The IFSP support had been successful in facilitating an increase in adoption of improved techniques by more than one fifth of the households, resulting in substantial nutritional benefits. Nonetheless, at the end of the IFSP, 58% of the children were still malnourished. In theory, with universal access to purified water and improved production systems, the rate could drop to 25%.

At the end of the programme cycle, the nutritional situation within the group of households benefiting from the three improvements was comparable to the situation within an educated household where women's status was high. However, the three

interventions were effective in reducing chronic malnutrition within a programme cycle of four years while social changes require a longer period of time.

4.6 Overall conclusions

Chronic malnutrition of children was extremely high within the area studied. Morbidity was a direct determinant of malnutrition. The relationship between food intake as well as infant and young child feeding practices and malnutrition was complex. Cash income, possession of poultry, access to water, adoption of hygienic habits as well as access to health services were the most important indirect causes of child malnutrition, showing significant associations performing sector-wise statistical analysis. Those associations also explain the causalities between basic causes and nutritional outcomes. Women's social status and the literacy status of parents were the basic and most significant determinants of malnutrition when applying multi-factorial analysis model controlling for interactions between the selected determinants. Social status of women and literacy mitigated negative effects affiliated with a family's low income.

The study shows that programme interventions led to a significant reduction in malnutrition, prevalence of diseases, and mortality rates. The situation of indirect causes also changed significantly, the most important of them being adoption of an improved agricultural production system, improved water supply, hygienic habits, and easier access to health services. Improvements in the water supply, in terms of both availability and purity and improvements in the agricultural production system were statistically the significant determinants of the reduced child malnutrition measured at the end of the programme.

Besides their direct impact on food production and health, improved agriculture and water supply systems were also important interventions to reduce the workload, particularly of women. Improvements in poultry farming were important to enhance women's access to resources. This probably resulted in improved family and childcare and, in turn, might have contributed to the reduction in malnutrition as well.

Women's social status and education were key determinants of malnutrition at the start of the programme, whereas improved access to water and agricultural

production systems were the key interventions reducing malnutrition effectively within the programme cycle of four years.

Precondition for successful implementation was the availability of resources, particularly natural resources, such as agricultural production area, as well as human and financial resources to build up and strengthen social services, such as health, education and also agricultural services. A further pre-requisite for success was the commitment of institutions and stakeholders aiming for a better life of the local population.

Summary

The World Food Summit in 1996 in Rome and the Millennium Development Summit held in 2000 in New York achieved consensus in halving poverty, hunger and malnutrition by 2015. In the 1990s, Integrated Food Security Programmes (IFSPs) were a measure of the German Government to contribute to a reduction in malnutrition, hunger and poverty.

From 1995 to 2001 the German Federal Ministry of Economic Cooperation and Development through the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) supported the Ministry of Health of the Lao PDR in the implementation of an IFSP in Luang Namtha province, Northern Laos. The programme focused on support for ethnic groups living in mountainous areas, the Austro-Asiatic ethno-linguistic groups in Nalae district, and the Hmong-Mien in Sing district. A context-specific multi-sectoral implementation approach was applied, comprising activities in the fields of agriculture, food and cash crop production, curative and preventive health care, primary and non-formal education, as well as communal infrastructure.

The objective of the study was to analyse the nutrition situation within the programme area, to identify most important causes of malnutrition as well as effective interventions, and thus to contribute to better nutrition programming.

The causal model of malnutrition developed by UNICEF was adjusted to the context and applied as a conceptual framework for the design of the study. Two cross-sectional surveys were conducted, one before and the second one after the four years of community based intensive interventions. The surveys were carried out during the same season, in the same villages and the same methodology was applied. Standardised questionnaires were used for household interviews and anthropometric measurements taken from children and women to assess their nutritional status (1997: 497 households and women, 614 pre-school children; 2001: 652 households and women, 892 pre-school children). Statistical analysis, comprising Chi-square tests, unifactorial ‘Analysis of Variance’ (ANOVA) and linear regression, tested and explained the direct relationship between malnutrition and its potential causes as well as the changes over the years. Sector-wise as well as inter-

sectoral multifactorial models were applied to analyse the effects of single determinants while taking interactions between them into account.

Chronic malnutrition was extremely high at the start of the programme and exceeded the national average (69% and 47%, respectively), but came down significantly particularly for the most seriously affected children (<-2 z-score: 69% to 58%, <-3 z-score: 40% to 29%). The annual rate of reduction exceeded national and global progress with regard to chronic malnutrition and underweight of children as well as chronic dietary energy deficiency of women (3.9%, 4.4% and 15.3%, respectively). Acute malnutrition dropped significantly in Nalae district. The child death rate was extremely high (CDR: 257 per 1,000 live births) and was reduced at a rate of 10% over the four years. By the end of the programme, mortality rates in Nalae district came down to national averages (CMR: 109 compared to 106 per 1,000 live births, respectively).

According to the conceptual framework, food intake and morbidity are direct causes of malnutrition. The diet was sufficient in energy but low in fat and high quality protein, and sub-optimal to meet micronutrient requirements. Not the quantity of rice consumed, but the variety in side dishes and the consumption of snacks were associated with a child's nutritional status. Food diversity and nutritional status were not linked, but a higher number of food items derived from forest resources was associated with a lower nutritional status. In addition to upland rice fields, the forest was the major food source.

Culture and tradition determined infant and young child feeding practices. Pre-lacteal feeding, late initiation of breastfeeding and too early introduction of complementary food were the major problems among the Austro-Asiatic group, while among the Hmong-Mien it was the late introduction. Low quality of complementary food was a problem in both groups. Morbidity was high and determined a child's nutritional status significantly. Height-for-age z-score dropped by 0.2 units among children who had suffered diarrhoeal episodes or who showed signs of a distended abdomen. Over the programme implementation period the prevalence of infectious diseases dropped significantly and a behavioural change towards more favourable early infant feeding and hygiene practices was noticeable, as was the improved access to and use of

health services. The latter two improved even more significantly in Nalae district, which explains the relatively greater success in reduction of acute malnutrition there.

Multi-factorial regression analysis, including determinants that proved significant, applying a sector-wise statistical analysis, showed that women's social status and parents' literacy status were the key determinants of child malnutrition in 1997. The rate of chronic malnutrition was 76% for low-status and illiterate parents compared to 28% where the status of women was higher and the parents, mother and/or father, went to school for a minimum of three years ($p = 0.001$).

This shows that a better status of women, along with better education, mitigated the negative effects of other factors jeopardizing children's nutritional status, such as low income, the hard work entailed in slash-and-burn cultivation, difficult access to water and health services, or other difficulties associated with the location. Improving women's education, combined with increased access to health services and financial resources, could further enhance the positive impact of their status on child nutrition.

A household's income situation determined child malnutrition in both years. Over the programme implementation period, income increased by 45% on average, with even higher rises for Sing district. Nutritional improvements achieved in 2001 were equally distributed over all income groups, hence, independent from the increase in income. The introduction and adoption of a more productive and sustainable rice production system led to increased yields, particularly in Sing district. The improved production system was associated with better nutrition, but the quantity of rice produced did not contribute to the reduction in malnutrition. Increased income and better rice yields indicate achievements in poverty reduction and food security, but did not result in improvements of nutritional security.

Major determinants of the nutritional improvements measured over the years were the behavioural change in the treatment of drinking water, improved water supply and the rice production system. One-fifth of the households adopted all three, while another one-fifth did not adopt, or benefit from, any of the three, with the nutritional status ranging from 25% among the former to 73% among the latter.

The improved agriculture production system as well as the water supply system resulted in a reduced daily workload particularly for women. Presumably both, the time gained as well as the increased availability of water, helped to improve matters related to nutrition, such as child and health care practices and hygiene behaviour, and thus, contributed to a better nutritional status.

At the end of the programme cycle, the nutritional situation within the group of households benefiting from the three improvements was comparable to the situation within an educated household where women's status was high. However, the interventions helped reduce chronic malnutrition in four years while social changes would require a longer period of time.

Zusammenfassung

Der Welternährungsgipfel 1996 in Rom als auch der Gipfel zur Formulierung der Millenium Entwicklungsziele im Jahre 2000 in New York haben sich zum Ziel gesetzt Armut, Hunger und Unterernährung bis zum Jahr 2015 zu halbieren. Integrierte Ernährungssicherungsprogramme waren in den 1990iger Jahren eine Maßnahme der Deutschen Entwicklungszusammenarbeit zur Verringerung von Armut und Unterernährung beizutragen.

Von 1995 bis 2001 unterstützte das Deutsche Ministerium für Wirtschaftliche Zusammenarbeit und Entwicklung, durch die Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), das Ministerium für Gesundheit der Demokratischen Volksrepublik Laos bei der Durchführung eines IFSPs in der Provinz Luang Namtha, Nord-Laos. Das IFSP konzentrierte sich vor allem auf die in den Bergregionen lebenden ethnischen Gruppen, vorwiegend Angehörige der Austro-Asiatischen Gruppe im Distrikt Nalae und der Hmong-Mien im Distrikt Sing. Der multi-sektorale Programmeansatz umfasste Aktivitäten in den Bereichen Landwirtschaft, Produktion von Nahrungsmitteln und Produkten die für den Verkauf bestimmt sind, präventive und kurative Gesundheitsdienste, Grundbildung und außerschulische Bildungsmaßnahmen sowie Maßnahmen zum Aufbau einer kommunalen Infrastruktur.

Ziel der vorliegenden Studie war es die Ernährungssituation in der Programmregion, das Ausmaß der Unterernährung, deren Hauptursachen sowie die Haupteinflussfaktoren für die erzielten Veränderungen zu ermitteln und damit einen Beitrag zur Verbessung von Ernährungsprogrammen zu leisten.

In Anlehnung an das von UNICEF erstellte Kausalmodel der Unterernährung wurde ein kontextspezifisches Model entwickelt, dieses stellte den Rahmen für das Design der vorliegenden Studie dar. Zwei Querschnittserhebungen wurden durchgeführt, eine vor und die zweite vier Jahre nach dem Start der Maßnahmen auf Dorfebene. Die Erhebungen wurden zur gleichen Jahreszeit, in den gleichen Dörfern und mit gleicher Methodik durchgeführt. Bei der Durchführung von Haushaltsinterviews wurden standardisierte Fragebögen verwendet, anthropometrische Messungen bei Müttern und Kindern dienten der Ermittlung des Ernährungsstatus (1997: 497

Haushalte und Mütter, 615 Kinder unter fünf Jahren; 2001: 652 Haushalte und Mütter, 892 Kinder). Chi-square tests, ein- und mehrfaktorielle Varianzanalysen und lineare Regressionen wurden durchgeführt, um die direkten Zusammenhänge zwischen Mangelernährung und deren Ursachen als auch die Veränderungen über die beiden Jahre hinweg zu testen.

Die Prävalenz chronischer Unterernährung war zu Programmbeginn sehr hoch und lag weit über dem nationalen Durchschnitt (69% und 47%). Insbesondere die Prävalenz starker Unterernährung wurde über die Programmlaufzeit hinweg signifikant reduziert (HAZ < -2: von 69% auf 58%; HAZ < -3: von 40% auf 29%). Die jährliche Reduzierung chronischer Unterernährung als auch die von Untergewicht bei Kindern und Müttern (3.9%, 4.4% and 15.3%) war größer als national und global erzielte jährliche Veränderungen. Die Rate akuter Unterernährung sank deutlich im Distrikt Nalae. Die Kindersterblichkeit war extrem hoch (CDR: 257 pro 1.000 Lebendgeburten) und konnte um 10% reduziert werden. Die Kindersterblichkeit im Distrikt Nalae erreichte nationale Durchschnittswerte (109 und 106 pro 1.000 Lebendgeburten).

Im Kausalmodel sind Nahrungsaufnahme und Morbidität die direkten Faktoren der Unterernährung. Die Nahrungsenergieaufnahme war durch den hohen Reisverzehr ausreichend, die Nahrungsaufnahme insgesamt jedoch unausgewogen, vor allem mangelhaft an Fett, hochwertigen Proteinen und Mikronährstoffen. Zwischen der verzehrten Reismenge und dem Ernährungsstatus gab es keinen direkten statistischen Zusammenhang, jedoch hatten Familien die eine größere Anzahl von Beilagen oder Zwischenmahlzeiten aßen besser ernährte Kinder. Auch zwischen der Nahrungsvielfalt und dem Ernährungszustand gab es keinen direkten Zusammenhang, mit zunehmender Anzahl verzehrter Waldprodukte verschlechterte sich der Ernährungszustand jedoch. Neben dem traditionellen Wanderfeldbau war der Wald die Hauptnahrungsmittelquelle.

Praktiken der Säuglings- und Kleinkindernährung waren durch Tradition und Kultur stark geprägt. Prälaktale Ernährung, verzögerter Stillbeginn und zu frühes Zufüttern von Beikost waren die Hauptprobleme bei den Austro-Asiatischen Ethnien, während ein zu spätes Zufüttern ein Problem bei den Hmong-Mien darstellte. Bei beiden ethnischen Gruppen war die Beikost ernährungsphysiologisch unausgewogen. Die Morbidität war hoch und zeigte einen direkten Zusammenhang mit chronischer

Unterernährung. Der Größe-zu-Alter Index war 0.2 Z-score Einheiten geringer bei Kindern die in den letzten sechs Monaten an Diarrhöe erkrankt waren oder Anzeichen einer abdominalen Distention aufwiesen. Die Prävalenz von Infektionskrankheiten wurde über den Projektzeitraum hinweg signifikant reduziert. Verbesserungen waren sichtbar im Bereich Säuglingsernährung, Hygieneverhalten, als auch beim Zugang und der Nutzung von Gesundheitsdiensten. Verbesserungen im Gesundheitsbereich waren insbesondere im Distrikt Nalae stärker sichtbar, dies könnte auch die Reduzierung der akuten Unterernährung in diesem Distrikt erklären.

Eine multifaktorielle Regressionsanalyse, die Faktoren einschließt die sich in den sektoralen Analysemodellen als bedeutend erwiesen, zeigte, dass der soziale Status der Frauen und die Alphabetisierung der Eltern die wichtigsten Determinanten für den Ernährungsstatus waren. Die Rate chronischer Unterernährung betrug 76% in Haushalten in denen Frauen einen geringeren sozialen Status hatten und die Eltern nicht alphabetisiert waren, verglichen mit 28% in Haushalten in denen Frauen einen besseren Status und die Eltern mehr als drei Jahre Schulbildung hatten ($p = 0.001$).

Dies zeigt, dass ein höherer sozialer Status von Frauen in Verbindung mit besserer Bildung die Konsequenzen negativer Einflussfaktoren verringert. Bespiele stellen die negativen Auswirkungen eines geringen Familieneinkommens, eines unzureichenden Zugangs zu Wasser und Gesundheitsdiensten oder der mit der Brandrodung verbundenen hohen Arbeitsbelastung der Frauen und anderer standortspezifischer Faktoren dar. Eine Verbesserung der Bildung von Frauen, in Verbindung mit verbessertem Zugang zu finanziellen Ressourcen und Gesundheitsdiensten, könnte den positiven Einfluss des sozialen Status auf den Ernährungszustand der Kinder weiter verstärken.

Das Haushaltseinkommen zeigte in beiden Jahren einen engen Zusammenhang mit dem Ernährungsstatus der Kinder. Das durchschnittliche familiäre Jahreseinkommen stieg um 45%, wobei im Distrikt Sing eine größere Steigerung erzielt wurde. Die Verbesserung des Ernährungszustandes war jedoch gleichmäßig über alle Einkommensgruppen verteilt und somit unabhängig von der erzielten Einkommenssteigerung. Die Einführung eines produktiveren und nachhaltigeren landwirtschaftlichen Produktionssystems führte zu höheren Reiserträgen vor allem im Distrikt Sing. Die Anwendung des verbesserten Produktionssystems zeigt einen

positiven Einfluss auf den Ernährungsstatus, nicht aber die erzielte Steigerung der Reisproduktion. Erhöhungen des Einkommens und der Reisproduktion weisen auf einen Beitrag zur Armutsbekämpfung und Verbesserung der Nahrungssicherheit hin, spielen aber keine zentrale Rolle für die erzielte Verbesserung der Ernährungssicherheit.

Verbesserungen im Hygieneverhalten, der Trinkwasserversorgung und die Anwendung des verbesserten landwirtschaftlichen Produktionssystems waren Schlüsselfaktoren für die Reduzierung chronischer Unterernährung. Am Ende der Programmlaufzeit wendete ein Fünftel aller Hauhalte alle drei Verbesserungsmaßnahmen an, in dieser Gruppe waren 25% der Kinder unterernährt. Ein Fünftel aller Haushalte hingegen wendete keine der drei Verbesserungen an, hier waren 73% der Kinder unterernährt.

Die Verbesserungen des landwirtschaftlichen Produktionssystems und der Trinkwasserversorgung führten zu einer Verringerung der Arbeitbelastung vor allem der Frauen. Beide Faktoren, der verbesserte Zugang zu Wasser und die Reduzierung der Arbeitsbelastung, tragen zu einer besseren Kinder- und Gesundheitsfürsorge und damit zu einer Verbesserung der Ernährungssituation bei.

Der Ernährungszustand in der Gruppe der Haushalte die alle drei Verbesserungen anwandten war vergleichbar mit Haushalten in denen, bereits zu Beginn der Programmlaufzeit, der soziale Status der Frauen höher war und die Eltern über eine bessere Bildung verfügten. Der Einfluss der Interventionen auf die Verbesserung der Ernährungssituation wurde innerhalb einer Programmlaufzeit sichtbar, soziale Veränderungen und Ausbildung hingegen benötigen einen längeren Zeitraum.

Literature

ADB. Indigenous peoples development and planning document Lao PDR: northern region sustainable livelihood development project. Project no. 35297, 15 p. GoL for ADB, Vientiane, August 2006

ADB. Key indicators 2007. Volume 38, 469 p. ADB Manila 2007

ACC/SCN. Third report on the world nutrition situation, 111 p. ACC/SCN Geneva December 1997

ACC/SCN. Fourth report on the world nutrition situation. Nutrition throughout the life cycle. ACC/SCN in collaboration with IFPRI, 121 p. ACC/SCN Geneva 2000

Alam N, Woityniak B, Rahaman M. Anthropometric indicators and risk of death. Am J Clin Nutr 49; p 884-8, 1989

Allen L, Gillespie S. What works? A review of efficacy and effectiveness of nutrition interventions. ACC/SCN Nutrition Policy Paper 19, ADB Nutrition and Development Series 5, 123 p. ADB Manila 2001

Arimond M, Ruel MT. Assessing care: progress towards the measurement of selected childcare and feeding practices, and implications for programs. IFPRI discussion paper 119, 101 p. IFPRI Washington DC August 2001

Bechstedt HD. Analysis of activities – assessment of impact 1997-1999, MoH/GTZ/DED/IFSP Luang Namtha province, Lao PDR, 152 p. Bangkok 2000

Bellin-Sesay F, Dresrüsse G, Pfeifer H. Food aid and food security - German experience during twenty years of cooperation, p. 601-615. In: Kracht U and Schulz M (eds). Food security and nutrition, the global challenge, 692 p. Lit Verlag, St. Martins Press New York 1999

Berkman DS, Lescano AG, Gilman RH, Lopez SL, and Black, MM. Early malnutrition and parasitic infections reduce cognitive ability later in childhood. Lancet, 359: p. 564-71, 2002

Bhutta ZA, Ahmed T, Black RE, Cousens S, Dewey K, Giugliani E, Haider BA, Kirkwood B, Morris SS, Sachdev HPS, Shekar M. What works? Interventions for maternal and child undernutrition and survival. Lancet series on maternal and child undernutrition III, Lancet, 371: p. 417-40, 2008

Black R, Morris S, Bryce J, Where and why are 10 million children dying every year? Lancet 361: p. 2226-34, 2003
(accessible at: http://www.thelancet.com/journal/vol361/iss9376)

Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M, Mathers C, Rivera J. Maternal and child undernutrition: global and regional exposures and health consequences. Lancet series on maternal and child undernutrition I, Lancet, 371: p. 243-60, 2008

Blössner M, de Onis M, Morris R. Forecast of trends in child malnutrition, WHO, Department of Nutrition for Health and Development, Geneva, and Department of Primary Care and Population Sciences, Royal Free University College and Medical School, London, 2001 (poster presented at the IUNS international nutrition conference, Wien 2001).

BMZ. Sector concept, food security and food aid as instruments of development co-operation, no. 074, 12p. BMZ Bonn 1997

BMZ/GTZ. Integrierte Ernaehrungssicherungsprogramme in der Deutschen Entwicklungszusammenarbeit. Eine Orientierung für die Projektarbeit, 52 p. BMZ Bonn 1998

Bouis H, Hunt J. Linking food and nutrition security: past lessons and future opportunities, p. 168-213. In: Hunt J, Quibria MG. Investing in child nutrition in Asia. ADB Nutrition and Development Series 1, ADB and UNICEF, 273 p. ADB Manila 1999

Boupha S. Sub-national estimates of food insecurity and statistics in the 2002/2003 LECS. Side event paper for the International conference on agriculture statistics. EC-FAO Food Security Information for Action Programme, 12 p. FAO Vientiane 2008

Brahmam GNV, Sastry JG, Rao NP. Intra-family distribution of energy – an Indian experience. Ecol Food Nutr 22: p. 125–30, 1988

Braun v J. Food security - a conceptual basis, p. 41-53. In: Kracht U and Schulz M (eds.). Food security and nutrition, the global challenge, 692 p. Lit Verlag, St. Martins Press New York 1999

Brown KH, Black RE and Becker S. Longitudinal studies of infectious diseases and physical growth of children in rural Bangladesh. Am J Epidemiol 115 (3): p. 315-24, 1982

Bryce J, Boschi-Pinto C, Shibuya K, Black, R. WHO estimates of the causes of death in children. Lancet 365: p. 1147-52, 2005

Bryce J, Coitinho D, Darton-Hill I, Pelletier D and Pinstrup-Andersen P. Maternal and child undernutrition: effective action at national level. Series on maternal and child undernutrition IV, Lancet 371: p. 65-80, 2008

Care International. Food security and policy guidelines. Food Security Unit. 204 p, Care Atlanta 1996

Carney D. Approaches to sustainable livelihoods for the rural poor. ODI discussion paper, ODI, London, January 1999

Checkley W, Buckley G, Gilman RH, Assis AMO, Guerrant R L, Morris SS, Mølbak K, Valentiner-Branth P, Lanata CF, Black RE. Multi-country analysis of the effects of diarrhoea on childhood stunting. The Childhood Malnutrition and Infection Network. Intern J Epidemiol 37 (4): p. 816-30, 2008 (http://ije.oxfordjournals.org, latest access August 2008)

Chhabra R, Rokx C. The nutrition MDG indicator, interpreting progress, HNP discussion paper. Human Development Network, 50 p. World Bank, Washington DC 2004

Chirmulay D. Child nutrition, care and poverty, p. 77-83. In: Nutrition and poverty. ACC/SCN symposium report, Nutrition Policy Paper 16, 103 p. ACC/SCN Kathmandu 1997

CIA. The World Fact Book – Laos. CIA, Washington DC 2002

Cohen M. Food aid and food security trend: worldwide needs, flows and channels. EuronAid and IFPRI, 17 p. EuronAid The Hague March 2000

Collins, S. Duffield, A., Myatt, M. Assessment of nutritional status in emergency affected populations, adults, 20 p. ACC/SCN Geneva July 2000

Coppens M, Phanlavong A, Keomoungkhoune I, Dung NT, Gutekunst R, Venkatesh, Mannar MG, Thilly C. Successful start of the salt iodisation in Laos. Food Nutr Bull 20 (2): p. 201-7, 1999

Delange FM, Iodine deficiency disorders in mothers and infants, p. 89-102. In: Delange F, West PK. Micronutrient deficiencies in first months of life. Nestle Nutrition Workshop Series, Pediatric Programme 52, 376 p. Vevey/S Karger Basel 2003

Delisle HF. Poverty: the double burden of malnutrition in mothers and the intergenerational impact. Reducing the impact of poverty on health and human development, part V, human nutrition and poverty. Ann NY Acad Sci 1136 (13): p. 172-84, 2008

de Loof F. Factors associated with the nutritional status of children in a rural area in Northern Laos. Master thesis. 117 p. Center of Public Health, University of New South Wales, Sydney 2001

de Onis M, Monteiro C, Akre J, Clugston G. The worldwide magnitude of protein energy malnutrition: an overview from the WHO global database on child growth. Bull World Health Organ 71(6): p. 703-11, 1993

de Onis M, Habicht JP. Anthropometric reference data for international use: recommendation from a WHO expert committee. Am J Nutr 64: p. 650-8, 1996

de Onis M, Blössner M, Villar J. Levels and patterns of intrauterine growths retardation in developing countries. Europ J Clin Nutr 52 (S1): p. 83-89, 1997

de Onis M, Frongillo EA, Blössner M. Is malnutrition declining? An analysis of changes in levels of child malnutrition since 1980. Bull World Health Organ 78: p. 1222-33, Geneva 2000

de Onis M, Blössner M, Borghi E, Frongillo EA, Morris R. Estimates of global prevalence of childhood underweight in 1990 and 2015. Department of Nutrition, WHO. J Am Med Assoc 291(21): p. 2600-6, Geneva 2004a

de Onis M, Blössner M, Borghi E. Morris R, Frongillo EA. Methodology for estimating regional and global trends of child malnutrition. Int J Epidemiol 33 (6): p. 1260-1270, 2004b

Devereux S, Baulch B, Hussein, K, Shoham J, Sida H, Wilcock D. Improving the analysis of food insecurity. Food insecurity measurement, livelihoods approaches and policy: applications in FIVIMS. Paper prepared for FIVIMS secretariat, Rome 2004
(accessible at: http://www.fivims.org, latest access August 2008).

Donnison D. The politics of poverty, 239 p. Martin Robertson, Oxford 1982

Dop MC, Ballard T, Solal-Celigny A, Kennedey G. Bridging food security and nutrition, simple tools for measuring household's access to food and dietary diversity. EC-FAO Food Security Information for Action Programme, Nutrition Consumer Protection Division, FAO and FANTA, SCN 34 Annual Meeting, Rome 2007 (www.unsystem.org/SCN/Publications/AnnualMeeting/SCN34, latest access September 2008)

Drake L, Maier C, Jukes M, Patrikios A, Bundy D, Gardner A, Dolan C. School aged children: their nutrition and health, p. 4-30. ACC/SCN school aged children their health and nutrition, ACC/SCN News 25, p. 75. Geneva December 2002

DSE-ZEL. a. Assessments within a cycle of a food and nutrition programme, 15 p. b. Selection of indicators for food and nutrition security programmes, 22 p. Background documents prepared by Kaufmann S for the international course: food and nutrition security in the context of poverty alleviation, crisis mitigation and response. GAA, GTZ and DSE- ZEL Feldafing April 2000

EC. Enhancing EC's contribution to address child and maternal undernutrition and its causes. Background paper for the seminar of the EC, 23 p. Brussels, May 2008

Edmond KM, Kirkwood BR, Amega-Etego S, Owusu-Agyei S, Hurt S. Effect of early infant feeding practices on infection-specific neonatal mortality: an investigation of the causal links with observational data from rural Ghana. Am J Clin Nutr 86 (4): p. 1126-31, October 2007

EIU. Country Profile Laos. The Economist Intelligence Unit, London 1999

Engle PL, Bentley M, Pelto G. The role of care in nutrition programmes: current research and a research agenda. Proc Nutri Soc 59: p. 25-35, 2000

FANTA. Food security indicators and framework for use in the monitoring and evaluation of food aid programmes. Riely F, Mock N, Cogill B, Bailey L, Kenefick E, 45 p. FANTA Washington DC 1999

FANTA. Developing and validating simple indicators of dietary quality and energy intake of infants and young children in developing countries: Summary of findings from analysis of 10 data sets, working group on infant and young child feeding indicators. 99 p. FANTA Washington DC August 2006

FANTA. Homepage focus area: infant and young child nutrition. FANTA Washington DC 2008 (http://www.fantaproject.org/focus/children.shtml, latest access September 2008)

FAO. Diagnosis of the nutrition situation and food consumption in Lao PDR. Final report. ESNA:TCP/Lao/2354, 198 p. FAO Rome 1995

FAO. The sixth world food survey. 168 p. FAO, Rome 1996

FAO Rome declaration on world food security and plan of action. World Food Summit November 1996. FAO Rome 1997 (http://www.fao.org/DOCREP/003/W3613E/W3613E00.HTM, latest access September 2008)

FAO. Assistance to review and analyse existing food consumption practices and prepare a technical co-operation programme proposal on household gardens and nutrition, Lao PDR. Mission report. FAO field document SPP-RAP 52/10/98. 38 p. FAO Vientiane May 1999

FAO. The state of food insecurity in the world 2000. Food insecurity: when people live with hunger and fear starvation. 31 p. FAO Rome 2000 ftp://ftp.fao.org/docrep/fao/x8200e/x8200e00.pdf, latest access September 2008)

FAO. The state of food insecurity in the world 2001. Food insecurity: when people live with hunger and fear starvation. 58 p. FAO Rome 2001

FAO Nutrition country profiles – Laos. 32 p. FAO Rome July 2003

FAO. The state of food insecurity in the world. Monitoring progress towards world food summit and millennium development goals. 40 p. Rome 2004 (ftp://ftp.fao.org/docrep/fao/007/y5650e/y5650e00.pdf, latest access September 2008)

FAO. Nutrition indicators for development. Reference guide, 85 p. FAO Rome 2005

FAO. The state of the food insecurity in the world 2005. Eradicating world hunger – key to achieving the Millennium Development Goals. 29 p. FAO Rome 2005b

FAO. The state of food insecurity in the world 2006. Eradicating world hunger – taking stock ten years after the World Food Summit. 40 p. FAO Rome, 2006

FAOSTAT. Statistic data base of FAO (webpage). Rome 2000 and 2002 (http://faostat.fao.org, latest access 2003)

FAO. Nutritional status assessment and analysis. EC-FAO Food Security Information for Action Programme. Training module. FAO Rome 2007 (http://www.foodsecinfoaction.org/dl, latest access September 2008)

FAO. Guidelines for measuring household and individual dietary diversity. Version 2, June 2007. EC-FAO Food Security Action Programme and FANTA Project, FAO Rome 2007b

Felice FF. Can world poverty be eliminated. Human rights and human welfare. An international review of books and other publications. University of Denver, Volume 3: p. 133-49, 2003

Ferro-Luzzi A, Sette S, Franklin M, James WTP. A simplified approach of assessing adult chronic energy deficiency. Eur J Clin Nutr 46: p. 173-186, 1992

Fleiss JL. Statistical methods for rates and proportions. Second edition. John Wiley, New York 1981

Frankenberger TR. Measuring household livelihood security: an approach for reducing absolute poverty. Food Forum 34: p. 1-5, 1996

Friedman JF, Kwena A, Mirel L, Kariuk SK, Terlouw DJ, Phillips-Howard P, Hawley WA, Nahlen BL, Ping-Shi Y, Ter Kuile FOT. Malaria and nutritional status among pre-school children: results from cross-sectional surveys in West Kenia. Am J Trop Med Hyg 73 (4): p. 698-704, 2005

Friend R, Meusch E, Funge-Smith S. Aquatic resources, food security and nutrition in Lao PDR. A case study from Attapeu province. Study report, 11 p. Vientiane 2003

Gansberghe v D. Smallholder livestock systems and upland development, p. 71-77. In: NAFRI, NAFES, NUOL, NUOL. Improving livelihoods in the uplands of Lao PDR: initiatives and approaches. A source book, Volume 1, 262 p. Vientiane 2005
http://www.mekonginfo.org/mrc_en/doclib.nsf/0/2BDE2B639D4DA54C47257181003D8AE3/$FILE/FULLTEXT212.pdf, latest access July 2008)

Gillespie S. Health and nutrition. IFPRI Brief 08, 2020 Focus, Washington DC 2006

GoL. National plan of action for nutrition, 1995 to 2000. Draft report presented to the national seminar on national plan of action for nutrition. 97 p. Committee for Planning and Cooperation supported by FAO and WHO, Vientiane March 1995

GoL. Rural accessibility study. NSC Vientiane 1996

GoL. National food security strategy, 2001 to 2010. MoAF and State Planning Committee Vientiane 2000

GoL. Country paper of Lao PDR for Workshop on development indicators for the ASEAN countries in Manila October 2001. Committee for Planning and Cooperation and NSC Vientiane 2001

GoL. Country profile. Embassy of the Lao PDR to the USA, Washington DC 2008

GoL-LECS. The household of Lao PDR, social and economic indicators, LECS 2, 1997/1998. Committee for Planning and Cooperation, NSC Vientiane 1999

GoL-LECS. The household of Lao PDR, social and economic indicators, LECS 3, 2002/03. Committee for Planning and Cooperation, NSC Vientiane 2004

GoL-LNAS. Diagnosis of the nutrition situation and food consumption in Laos 1994. Final report. MoH supported by FAO, ESNA:TCP/LAO/2354 (A), 99 p. FAO Rome 1995

GoL-NNP. National nutrition policy, 2008 to 2020. MoH Vientiane 2008

GoL and ADB. Country assistance plan 2001-2003 Lao PDR. GoL Vientiane and ADB Manila 2000 (http://www.adb.org/Documents/CAPs/lao.pdf, latest access August 2008)

GoL and ADB. Participatory poverty assessment. 187 p. State Planning Committee, NSC Vientiane and ADB Manila 2001

GoL and ADB. Lao PDR: proposed sector development program. Asian development fund grants. Lao PDR basic education sector development program. Gender and ethnic groups development plan, project no. 32312, 6 p. Ministry of Education Vientiane and ADB Manila 2006 (http://www.adb.org/Documents/IndigenousPeoples/LAO/32312-LAO-IPDP.pdf, latest access September 2008)

GoL and UNDP. Millennium Development Goals. Progress report by the GoL and the UN, 75 p. UNDP Vientiane 2004

Gross R. Nutrition and the alleviation of absolute poverty in communities: concept and measurement, p. 95-101. In: ACC/SCN symposium report. Nutrition and poverty. Nutrition Policy Paper 16, 103 p. Kathmandu, November 1997

Gross R. Food and nutrition: definitions and concepts. Master document prepared for the international course: food and nutrition security in the context of poverty alleviation, crisis mitigation and response, 22 p. GAA, GTZ and DSE-ZEL Feldafing April 2000

Gross R, Schöneberger H, Pfeifer H, Preuss HJ. Four dimensions of food and nutrition security: definitions and concepts, p. 20-25. Nutrition and agriculture. SCN News 20, 76 p. July 2000

GTZ. Handbuch zur Erhebung der Ernährungssituation von Bevölkerungsgruppen. 246 p. GTZ Eschborn 1989

GTZ. Project appraisal mission report for the Integrated Food Security Programme, Laos, by Gross U and Kohl G, 23 p. GTZ Eschborn 1994

GTZ. Lernerfahrungen aus den Integrierten Ernaehrungssicherungs-programmen der GTZ in Südostasien. IESP-Kampot (Kambodscha), IESP Quang Binh (Vietnam) and IESP, Muang Sing and Nalae (Laos). Zusammenfassender Bericht by Schroeder-Breitschuh S, GTZ-OE 0420, Kaufmann P, freier Gutachter. 33 p. GTZ Eschborn 2002

Guthrie HA, Scheer JC. Validity of a dietary score for assessing nutrient adequacy. J Am Diet Assoc 78: p. 240–5, 1981

Hahn H. Conceptual framework of food and nutrition security. Background document prepared for the international course: food and nutrition security in the context of poverty alleviation, crisis mitigation and response, 15 p. GAA, GTZ and DSE-ZEL Feldafing April 2000

Hankin J. Nutritional status of villagers in Laos, 1968-69. HSMHA health reports. Hawai 87 (2): p. 145-53, 1972

Hanmer L, Healey J, Naschold F. Will growth halve global poverty by 2015? ODI Poverty Briefing 8, London 2000

Hambidge KM. Zinc deficiency in young children. Am J Clin Nutr 65 (1): p. 160-1, 1997

Herz B, Shahidu P, Khandker. Women's work. Education and family welfare in Peru. World Bank discussion paper 161, Washington DC 1991

Hatloy A, Torheim LE, Oshaug A. Food variety – a good indicator of nutritional adequacy of the diet? A case study from urban area in Mali, West Africa. Eur J Clin Nutr 52: p. 891-8, 1998

Hoddinott J, Yohannes Y. Dietary diversity as a household food security indicator. Report, 44 p. FANTA Washington DC May 2002

Hodgson JM, Hsu-Hage BHH, Wahlquist ML. Food variety as a quantitative descriptor of food intake. Ecol Food Nutr 32: p. 137-48, 1994

Huffman SL, Zehner ER, Victora C. Can improvements in breast-feeding practices reduce neonatal mortality in developing countries? Midwifery 17 (2): p. 80-92, June 2001

IFPRI. Report finds severe gender inequities. IFPRI news release. IFPRI Washington DC October 1995 (http://www.worldbank.org/html/cgiar/newsletter/Oct95/3ifprw.htm, latest access August 2008)

IFPRI. Women, the key to food security, looking into the household. Brochure, 4 p, IFPRI Washington DC 2000 (http://www.ifpri.org/pubs/ib/ib3.pdf, latest access September 2008)

IFPRI. Global food projections to 2020. Emerging trend and alternative futures, 206 p. IFPRI Washington DC 2001

IFPRI. Dietary diversity as a food security indicator. Discussion paper 136, 81 p. Food Consumption and Nutrition Division, IFPRI Washington DC 2002

IFSP/GTZ/Gebert R. Socio-economic baseline survey. Survey report. Lao German Cooperation Project, Integrated Food Security Programme Muang Sing, 111 p. MoH and GTZ, Vientiane April-May 1995

IFSP/GTZ/Kaufmann S. Rapid nutrition assessment. Assessment report, IFSP Muang Sing and Nalae, 12 p. Nalae April 1996

IFSP/GTZ/Kaufmann S. Erfahrungen mit Ernährungserhebungen und Situation der Mikronährstoffversorgung im IFSP Muang Sing und Nalae, Laos, p. 57/1-57/18. Diskussionspapier zur Vorlage bei der AP-Tagung Ernährungssicherung Asien in Kambodscha. Dokumentation, 95 p. MTK Hofheim May 1998a

IFSP/GTZ/Kaufmann S. Report on iodine situation in Nalae district, Luang Namtha province, Lao PDR. 10 p. IFSP Nalae 1998b

IISD. Participatory research for sustainable livelihoods: A guide for field projects on adaptive strategies. Winnipeg 1995 (http://www.iisd.org/casl/CASLGuide, latest access January 2008)

IMF. Global poverty report. Report to G8 Okinawa Summit, 18 p. African Development Bank, ADB, European Bank for Reconstruction and Development, Inter-American Development Bank, World Bank, IMF July 2000
http://www.worldbank.org/html/extdr/extme/G8_poverty2000.pdf, latest access September 2008)

Inwent. Achieving food and nutrition security, actions to meet the global challenge. p. 8-10. In: Klennert K. (ed). A training course reader. 206 p. GTZ, DWHH, Inwent Feldafing 2005

Islam R. Poverty and effect on nutrition: some questions based on the Asian experience, p. 69-76. In: ACC/SCN symposium report. Nutrition and poverty, Nutrition Policy Paper 16, 103 p. ACC/SCN Kathmandu November 1997

Johnson A, Singh S, Duongdala M. Wildlife hunting and use in Luang Namtha province: implications for rural livelihoods and biodiversity conservation in uplands of the Lao PDR. Paper prepared for the workshop on poverty reduction and shifting cultivation stabilisation in the uplands of Lao PDR, MoAF and NAFRI, Luang Prabang 2004

Jonsson U. Malnutrition in South Asia, p. 53-67. In: ACC/SCN symposium report. Nutrition and poverty, Nutrition Policy Paper 16, 103 p. ACC/SCN Kathmandu, November 1997

Kachondham Y, Dhanamitta S. A new horizon: addressing food and nutrition problems in the Lao People's Democratic Republic. Food Nutr Bull 14 (2): p. 79-87, 1992

Kakwani N, Sisouphanhthong P, Souksavath P, Dark B. Poverty in Lao PDR, Asia and Pacific Forum on Poverty: Reforming policies and institutions for poverty reduction held in Manila, 31 p. Manila February 2001 (http://www.adb.org/poverty/forum/frame_kakwani1b.htm, latest access September 2008)

Kaler SG. Diseases of poverty with high mortality in infants and children: malaria, measles, lower respiratory infections, and diarrheal illnesses. Ann NY Acad Sci 1136: p. 28–31, 2008

Katona P, Katona-Apte J. The interaction between nutrition and infection. CID (Clinical Infectious Diseases) 46 (15 May): p. 1582-88, 2008

Khamhong K. 1997, Nutrition status of reproductive women and children under 5 years. Paper, 3 p. presented at the national conference on results dissemination of five pilot projects in Lao PDR, MoH supported by SEAMEO-Tropmed-GTZ, Luang Prabang, November 27-28, 1997

Krebs-Smith SM, Smiciklas-Wright H, Guthrie HA, Krebs-Smith J. The effects of variety in food choices on dietary quality. J Am Diet Assoc 87: p. 897–903, 1987

Kripps R. Nutrition services in the Lao People´s Demogratic Republic. Assignment report. NUT/LAO/NUT/001 for WHO, Geneva 1984

Lartey A. Maternal and child nutrition in sub-saharan Africa: challenges and interventions. Department of Nutrition and Food Science, University of Ghana. Proc Nutr Soc 67 (1): p. 105-8, 2008

Leitzmann C Vegetarian diets: what are the advantages? Diet diversification and health promotion. Forum Nutr Basel (57): p. 147-56, 2005

Madise NJ, Mathews Z, Mpoma M. Child malnutrition and feeding practices in Malawi. Food Nutr Bull 18 (2): p. 190-201, 1997 (http://www.unu.edu/unupress/food/V182e/ch13.htm#b5-multivariate%20results, latest access July 2008)

Mahidol University. Food composition table. Mahidol University Bangkok 1972

Martorell R, Mendoza F, Castillo R. Poverty and stature in children. Linear growth retardation in less developed countries, p. 57-73. In: JC Waterlow (ed.), Nestle Nutrition Workshop Series 14, Vavey/Raven Press New York 1988

Maxwell S, Frankenberger TR. Household food security: concepts, indicators, measurements – a technical review, 274 p. UNICEF and IFAD, Rome and New York 1992

Meusch E, Yhong-Aree J, Friend R, Funge-Smith S. The role and nutritional value of aquatic resources in the livelihoods of rural people. A participatory assessment in Attapeu province, Lao PDR, 34 p. International Union for Conservation of Nature (IUNC), World Wild Life Foundation and FAO Regional Office Asia and Pacific Bangkok 2003

MI and UNICEF. The micronutrient report. Current progress and trends in the control of vitamin A, iodine and iron deficiencies, 79 p. School of Public Health and Tropical Medicine, Canada 2001

Mihrshahi S, Ichikawa N, Shuaib M, Oddy W, Ampon R, Dibley MJ, Kabir AKM, Peat JK. Prevalence of exclusive breastfeeding in Bangladesh and its association with diarrhoea and acute respiratory infection: results of the multiple indicator cluster survey 2003. J Health Popul Nutr 25 (2): p. 195-204, June 2007

MoH. Children and women in Lao PDR. 183 p. UNICEF Vientiane 1992

MOH. National vitamin A survey – Lao PDR. Final Report, 26 p. MoH, WHO and UNICEF Vientiane 1995

MoH. Workplan for nutrition activities, 1998-2000. Presented at the national workshop on nutrition, 17 p. MoH Vientiane November 1997

MoH. Prevalence and causes of anaemia amongst women of child-bearing age in Vientiane province, Lao PDR, 1998. Report on a collaborative project of the of the Council of Medical Sciences Lao PDR and the Institute for Medical Research Malaysia, supported by the Ministry of Health Malaysia, Kuala Lumpur 2000

MoH. Health status of the people in Lao P.D.R. Report on the National Health Survey 2000, 144 p. State Planning Committee, NSC, MoH, Vientiane January 2001

Moser P, White D, Hauser M. New technologies and changing livelihoods: how are households and community traditions affected in Laos. Brief, 1 p. NAFRI, AusAid, CIAT, Vientiane 2007
www.ciat.cgiar.org/epmr_ciat/pdf/poster_54_epmr07.pdf, latest access September 2008)

MSF. Nutrition Guidelines. First edition, 191 p. Paris 1995

Mueller O, Krawinkel M. Malnutrition and health in developing countries. Can Med Assoc J 173 (3): 279–286, 2005

Mueller O, Garenne M, Kouyate B, Becher H. The association between protein energy malnutrition, malaria morbidity and all-cause mortality in West African children. Trop Med Int Health 8 (6): p. 507-11, 2003

Mukudi E. Education and nutrition linkages in Africa: evidence from national level analysis. Int J Educat Dev 23 (3): p. 245-56, 2003

Mullany LC, Katz J, Li YM, Khatry SK, LeClerq SC, Darmstadt GL, Tielsch JM. Breast-feeding patterns, time to Initiation, and mortality risk among newborns in Southern Nepal. J Nutr 138: p. 599-603, March 2008

NAFRI, NAFES, NUOL. Upland food security and nutritional diversity. p. 107-12. In: Improving livelihoods in the uplands of Lao PDR: a source book, initiatives and approaches. Volume 1, 262 p. NUOL Vientiane 2005

Naidu AN, Neela J, Rao NP. Maternal body-mass-index and birth weight. Nutr News Hyderabad 12 (2), 1991

New Agriculturist. Laos country profile. New Agriculturist online, reporting agriculture for the 21 century, Wrenmedia UK 2005 (http://www.new-agri.co.uk/05-1/countryp.html, latest access September 2008).

NSC. Poverty in Lao PDR during the 1990's. 59 p. Committee for planning and cooperation, NSC and World Bank Vientiane 2002

NSC. Introduction on poverty measures in Lao PDR. By Xaovanna V, State Planning Committee and NSC, 8 p. Vientiane no date (estimated at 2001-2002) http://www.unescap.org/Stat/meet/povstat/pov7_lao.pdf, latest access September 2008)

NSC. Results from the population census 2005. State Planning Committee, NSC; Vientiane 2005

NSC. Food insecurity assessment based on food consumption statistics derived from the 2002/2003 Lao PDR expenditure survey. Summary report, 39 p. EC-FAO Food Security Information for Action Programme. NSC and Committee for Planning and Investment, Vientiane August 2007

NWSEHP. Sanitation and hygiene promotion in Lao PDR. Learning from the national water supply and environmental health programme. Field note by Phouangphet K., Chanthaphone S, Santanu Lahiri S, Chander Badloe C. for NWSEHP (MoH), Water and Sanitation Programme, East Asia and Pacific (WSP-EAP, World Bank), Water and Environmental Sanitation Section (WES, UNICEF), 7 p. Vientiane March 2000

Osmani SR. Poverty and nutrition in South Asia, p 23-51. The Abraham Horwitz Lecture. ACC/SCN symposium report, nutrition and poverty, Nutrition Policy Paper 16, 103 p. Kathmandu November 1997

Oxfam. The Oxfam handbook for development and relief. Volume 2, Oxfam publications, 1028 p. Oxfam Oxford 1995

Pelletier DL, Frongillo EA, Schroeder DG, Habicht JP. The effects of malnutrition on child mortality in developing countries. Bull World Health Organ 73 (4): p. 443-8, 1995

Pelletier DL, Frongillo EA. Changes in child survival are strongly associated with changes in malnutrition in developing countries. J Nutr 133: p. 107-19, January 2003

Phimmasone K, Douangpoutha I, Fauveau I, Pholsena P. Nutritional status of children in Lao PDR. J Trop Pediatr 42 (1): p. 5-11, February 1996

Pinstrup-Anderson P, Pandya-Lorch R, Rosegrant MW. Global food security: a review of the challenges, p. 7-17. In: IFPRI. The unfinished agenda. Perspectives on overcoming hunger, and poverty and environmental degradation, 301 p. IFPRI, Washington DC 2001

Prüss-Uüstün A, Corvalan C. Preventing diseases through healthy environments. Towards an estimate of the environmental burden of diseases, 104 p. WHO Geneva 2006

Quisumbing A. Male-female differences in agricultural productivity. World Development 24 (10): p. 1579-95, 1996

Reddy V, Shekar M, Rao P, Gillespie S. Nutrition in India. ACC/SCN country case study supported by UNICEF, National Institute of Nutrition, Hyderabad, India 1992 (http://www.unsystem.org/scn/archives/india/index.htm, latest access September 2008)

Reinhard I. Food security, nutrition security and poverty in Central Flores, Indonesia. Situation after four years implementation of an Integrated Food Security Project. Dissertation zur Erlangung des Doktorgrades beim Fachbereich Ernaehrungswissenschaften der Justus-Liebig-Universität Giessen, 212 p. Giessen 1996

Rim H-J, Jong-Yil C, Duk-Young M, Seung-Yull C, Eom KS, Sung-Jong H, Woon-Mok S, Tai-Soon Y, Giovanni D, Standgaard H, Phommasack B, Cheong-Ha Y, Eui-Hyug H. Prevalence of intestinal parasite infections on a national scale among primary schoolchildren in Laos. J Parasitol Res 91 (4): p. 267-72, October 2003

Rivera JA, Ruel MT, Santizo MC, Lönnerdal B, Brown KH. Zinc supplementation improves the growth of stunted rural Guatemalan infants. J Nutr 128 (3): p. 556-62, March 1998

Rosegrant M. Alternative futures for food security. p. 44-49. In: IFPRI. Sustainable food security for all by 2020. Proceedings of an international conference held in September 2001 in Germany, 281 p. IFPRI Washington DC 2002

Ruel MT, Graham J, Murphy S, Allen L. Validating simple indicators of dietary diversity and animal source food intake that accurately reflect nutrient adequacy in developing countries. Report submitted to Global Livestock – CRSP California 2004

Ruel MT, Can food based strategies help to reduce vitamin A and iron deficiencies? A review of recent evidence, p. 201-3. In: Braun v J, Pandya-Lorch R. Food policy for the poor, expanding the research frontieres, highlights from 30 years of IFPRI Research, 253 p. IFPRI Washington DC 2005

Sainju MM. Malnutrition in developing countries, generating capabilities for effective community action. Workshop proceedings. Fiuggi, Italy 2001

Schenk-Sandberger L, Choulamany-Khamphoui O. Women in rice fields and offices: irrigation in Laos. 127 p. Empowerment Heiloo Netherlands 1995

Schöneberger H. Food security and nutritional well-being in the context of structural poverty alleviation - an example from the extremely deprived Andean Region in Bolivia, p. 297-307. In: Kracht U and Schulz M (eds.). Food security and

nutrition, the global challenge, 692 p. Lit Verlag, St. Martins Press, New York 1999

Schultink W, Phan Ju Lan M.A, Usafar A, Gross, R. The nutritional and poverty situation in PPSTN villages in East Lombok - improvements between 1990 and 1996. Regional SEAMEO Center for Community Nutrition, University of Indonesia Jakarta 1996

Schweigert F, Klingner J, Hurtienne A, Zunft HJ. Vitamin A, carotenoid, and vitamin E plasma concentrations in children from Laos in relation to sex and growth failure. Nutrition Journal 2: p. 17-22, November 2003

Seidlein v L, Jammeh K, Bailey R, Doherty T. The utility of using a distended abdomen to predict intestinal parasites in asymptomatic children. J Trop Pediatr 43 (5): p. 311-12, 1997

Setboonsarng S. Child malnutrition as a poverty indicator: an evaluation in the context of different development interventions in Indonesia. ADB Institute Discussion Paper 21, 22 p. ADB Manila 2005 (http://www.adbi.org/files/2005.01.14.dp21.malnutrition.poverty.indonesia.pdf, latest access January 2008)

Sevenhysen GP, Gebriel ZW. Pregnancy outcome and maternal weight in an Ethiopian famine relief camp. Ecol Food Nutr 22: p. 11-7, 1988

Shetty PS, James WP. Body-mass-index: a measure of chronic energy deficiency in adults. Food and Nutrition Papers 56: p. 1-57, FAO Rome 1994

Shimbo S, Kimura K, Imai K, Yasumoto M, Yamamota K, Kawamura S, Watanabe T, Iwami O, Nakatsuka H, Ikeda M. Number of food items as an indicator of nutrient intake. Ecol Food Nutr 32: p. 197-206, 1994

Shoham J, Watson F, Dolan C. The use of nutritional indicators in surveillance systems. Theme 2. Nutrition Works, ODI, DFID support to FAO's FIVIMS, 42 p. FAO Rome 2001 (http://www.odi.org.uk/plag/resources/workingpapers/fivims_support_paper2.pdf, latest access September 2008)

Sidavong B, Vythilingam I, Phetsouvanh R, Chan ST, Phonemixay T, Lokman Hakim S, Phompida S. Malaria transmission by Anopheles dirus in Attapeu province, Lao PDR. Southeast Asian J Trop Med Public Health 35 (2): p. 309-15, June 2004

SIWI and WHO. Securing sanitation. The compelling case to address the crisis, 40 p. SIWI Stockholm 2004 (http://www.who.int/water_sanitation_health/hygiene/securingsanitation.pdf, latest access September 2008)

SMART 2006. Measuring mortality, nutritional status, and food security in crisis situations: SMART (Standardized Monitoring and Assessment of Relief and Transitions) methodology. Version 1, 129 p. April 2006

(http://www.smartindicators.org/SMART_Methodology_08-07-2006.pdf, latest access September 2008)

Smith LC, Haddad L. Explaining child malnutrition in developing countries, a cross country analysis. Research report 111, 112 p. IFPRI Washington DC 2000

Smith LC, Haddad L. Overcoming child malnutrition in developing countries: past achievements and future choices. IFPRI brief no. 64, 53 p. IFPRI Washington DC February 2000b
(www.ifpri.org/2020/BRIEFS/number64.htm, latest access September 2008)

Smith LC, Ramakrishnan U, Ndiaye A, Haddad L, Martorell R. The importance of women's status for child nutrition in developing countries, p. 207-9. In: Braun v J, Pandya-Lorch R. (eds). Food policy for the poor, expanding the research frontieres, highlights from 30 Years of IFPRI Research. 253 p. IFPRI Washington DC 2005

Soares MJ, Piers S, Shetty PS, Robinson S, Jackson AA, Waterlow JC. Basal metabolic rate, body composition and whole-body protein turn-over in Indian men with differing nutritional status. Clin Sci 81 (3): p. 419-25, September 1991

Sphere Project. The humanitarian charter and minimum standards in disaster response. First edition, 339 p. Geneva 2004

Susilowati D, Karyadi D. Malnutrition and poverty alleviation. Asia Pac J Clin Nutr 11 Suppl: p. 323-30, 2002
(http://www.popline.org/docs/1675/301014.html, latest access September 2008)

Swindale A, Ohri-Vachapati P. Measuring household food consumption, a technical guide. FANTA Project, revised edition, 88 p. FANTA Washington DC 2004

Tomkins A, Watson F. Malnutrition and infection - a review. Nutrition policy discussion paper no. 5, reprinted 1993, 136 p. ACC/SCN Geneva 1989

UNAIDS/WHO. Lao PDR: epidemiological fact sheets on HIV/AIDS and sexually transmitted infections. UNAIDS/WHO working group on global HIV/AIDS, 14 p. WHO Geneva 2002

UNDP. National human development report Lao PDR. Advancing rural development, 189 p. UNDP Vientiane 2001
(http://www.undplao.org/whatwedo/factsheets/humandev/nhdr%20final.pdf, latest access September 2008)

UNDP. Human development report. Beyond scarcity: power, poverty and global water crisis, 422 p. UNDP New York 2006
(http://www.waterwiki.net/images/2/29/HDR06-complete.pdf, latest access Sepember 2008)

UN 2008. The millenium development goals report 2008. 51 p. UN Headquarter New York August 2008 (http://www.un.org/millenniumgoals/pdf, latest access September 2008)

UNDP. Facts Lao PDR, UNDP Juth Pakai educational forum, Vientiane 2007 (http://www.undplao.org/newsroom/juthpakai.php, latest access February 2008)

UNESCO. Education in Lao PDR. Statistics in brief. UNESCO Institute for statistics, Montreal 2006 (http://stats.uis.unesco.org/unesco, latest access June 2008)

UNICEF. Strategy for improved nutrition of children and women in developing countries, 36 p. UNICEF New York 1990

UNICEF. The care initiative: assessment, analysis and action to improve care for nutrition. Engle PL, Lhotska L, Armstrong H. UNICEF New York 1997

UNICEF. Determinants of malnutrition, household food security, care and health. Yambi O, Kavishe FP. UNICEF ESARO, Nairobi, Kenia, paper prepared for BASIS (Broadening access and strengthening input market systems), 13 p. UNICEF Narobi no date (http://www.ies.wisc.edu/ltc/live/basissem9911.pdf, latest access September 2008)

UNICEF/UNU/WHO/MI. Preventing iron deficiency in women and children. Technical consensus on key issues. International Nutrition Foundation, p. 1-60. Boston 1999

UNSIAP. Millennium development goals and initiatives in Asia and the Pacific. Sub-regional training course on Statistics for MDG indicators. Module two – MDG indicators. UNDP Project RAS/04/060. UNSIAP Bangkok 2004

USAID. Nutrition, IYCF section (online) 2008 (http://www.usaid.gov/our_work/global_health/nut/techareas/childfeeding.html, latest access August 2008)

Walker TS, Ryan JG. Village and household economics in India's semi-arid tropics. 394 p. The Johns Hopkins University Press, Baltimore 1990

Watson L. Malaria in Lao PDR: a review. Unpublished report. The actmalaria information resource center supported by EU and USAID/Asia, 3 p. Manila 1999

Weingärtner L. Report on an anthropometric follow-up survey to a baseline survey conducted in the intervention area and a control area of the IFSP Mulanje. IFSP/GTZ Malawi, 13 p. Rottenburg 2002

Welch RM, House WA. Meat factors in animal products that enhance iron and zinc bioavailability: implications for improving the nutritional quality of seeds and grains. Cornell-Nutrition-Conference-for-Feed-Manufacturers, p. 58-66, 1995

WFP. Food and nutrition handbook. Strategy and Policy Division, Nutrition Support Service, 123 p. WFP Rome 2002

WFP. Food for nutrition: mainstreaming nutrition in WFP. WFP/EB.A/2004/5-A.1. 17 p. Rome May 2004a (www.wfp.org/eb, latest access September 2008)

WFP Annual reporting exercise. Guidelines, 119 p. WFP Rome 2004b

WFP. Indicator compendium. Results based management. Draft 16 September 2005, 71 p. WFP Rome June 2005a

WFP. Emergency food security assessment handbook (EFSA). Methodological guidance for better assessments. First edition, 142 p. ODAN Emergency Needs Assessment Branch WFP Rome June 2005b (http://documents.wfp.org/stellent/groups/public/documents/manual_guide_proced/wfp142691.pdf, latest access September 2008)

WFP. Comprehensive food security and vulnerability analysis (CFSVA): an external review of WFP guidance and practice. Development information services international, Strengthening Emergency Needs Assessment Capacity (SENAC) programme, 112 p. WFP Rome 2006a

WFP. LAO PDR: Comprehensive food security and vulnerability analysis (CFSVA). Strengthening Emergency Needs Assessment Capacity (SENAC) programme, 141 p. WFP, Rome December 2006b

WFP/CDC. A Manual: measuring and interpreting malnutrition and mortality. WFP Rome July 2005

WHO Energy and protein requirements. Report of a joint FAO/WHO/UNU expert consultation. WHO technical report series 724, 206 p. WHO Geneva 1985

WHO. Physical status: the use and interpretation of anthropometry. Report of a WHO expert committee, WHO technical report series 854, 452 p. WHO Geneva 1995

WHO. Working group on infant growth: An evaluation of infant growth: the use and interpretation of anthropometry in infants. Bull World Health Organ 73: p. 165-74, 1995b

WHO. Global database on child growth and malnutrition. Programme of nutrition, WHO/NUT/97.4, 710 p. WHO Geneva 1997

WHO. The management of nutrition in major emergencies. WHO/UNHCR/IFRC/WFP, 236 p. WHO Geneva 2000

WHO. Fact sheet on childhood malnutrition. Global database on child growth and malnutrition. Paper prepared for the IUNS international nutrition conference. IUCN Wien 2001

WHO. Global strategy for infant and young child feeding, 30 p. WHO/UNICEF Geneva 2003a

WHO. Diet, nutrition and prevention of chronic diseases. Report of the joint WHO/FAO expert consultation, WHO technical series 916, 149 p. WHO Geneva 2003b

WHO. Guiding principles for feeding infants and young children during emergencies, 84 p. WHO Geneva 2004

WHO. Child growth standards: length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body-mass-index-for-age. Methods and development. WHO Multicenter for Growth Reference Study Group, 312 p. WHO Geneva 2006a (http://www.who.int/childgrowth/publications/technical_report_pub/en/index.html, latest access September 2008)

WHO. WHO growth standard based on length/height, weight and age. WHO Multicenter for Growth Reference Study Group. Acta Paediatrica, Suppl. 450: p. 76-85, 2006b http://www.who.int/childgrowth/standards/Growth_standard.pdf (latest access January 2008)

Wilcock D. Access to food: how much has changed for the poor since the WFS in 1996? Civil society and the UN System: debate in the food security arena. ACC/SCN News 23, p. 14-15. ACC/SCN Geneva 2001

World Bank. Poverty and hunger - issues and options for food security in developing countries. A World Bank policy study, 80 p. World Bank Washington DC 1986

World Bank. World development report 1993. Investing in health, 77 p. Oxford University Press, Washington DC 1994

World Bank. Consulting with caregivers. Using formative research to improve maternal and newborn care and infant and young child feeding in Lao PDR. Health, nutrition and population discussion paper prepared by Gillespie A, Creed-Kanashiro H, Sirivongsa D, Sayakoummane D, Galloway R. 40 p. World Bank, Washington DC October 2004

World Bank Lao PDR gender profile. Gender Resource Information and Development Center (GRID), 87 p. World Bank November 2005 http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/LAOPRDEXTN (latest access July 2008)

World Bank. Repositioning nutrition as central to development. A strategy for large scale action. 246 p. World Bank, Washington DC 2006

World Bank. From agriculture to nutrition. Pathways, synergies, and outcomes. Agriculture and Rural Development Department, 102 p. World Bank Washington DC 2007

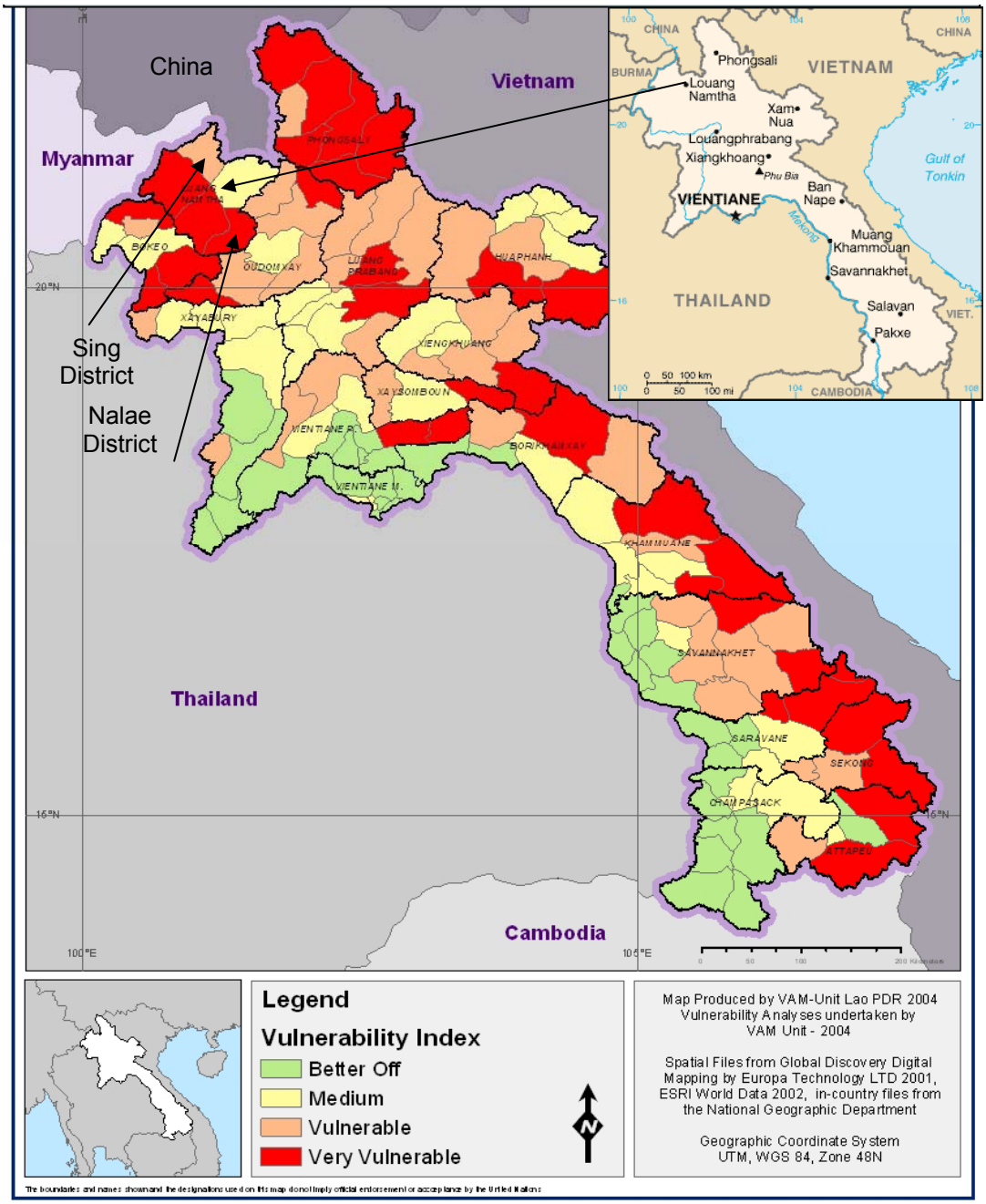
World Bank. Addressing the food crisis: the need for rapid and coordinated action. Group of eight. Meeting of finance ministers, 27 p. Osaka, June 2008

World Bank/UNICEF. Towards a common understanding of malnutrition. Assessing the contributions of the UNICEF framework. David L. Pelletier. World Bank/UNICEF nutrition assessment, background papers, 24 p. World Bank, Washington, New York 2002 (http://www.tulane.edu/~internut/publications/WB_Bckgrd_Pprs/Narrative/NarrativeonePelletierfinal.doc, latest access September 2008)

Annex

Annex

Annex 1: Map of Lao PDR, Luang Namtha province, Nalae and Sing district (WFP District Vulnerability Analysis Mapping 2004)



Annex 2: The Integrated Food Security Programme Nalae and Sing district

Annex 2a: Background information, planning approach, implementation structure and activities

The situation in the IFSP area

The IFSP was implemented in two districts, Nalae and Sing district, in the northern, mainly mountainous province of Luang Namtha, neighbouring the China, Thailand and Myanmar. The economy was dominated by subsistence agriculture, practicing slash and burn shifting cultivation. The mountainous areas were difficult to access and communal infrastructure, markets and social services hardly existed. Yields at upland rice fields were declining due to depletion of soil fertility and erosion caused by shortening the cycle of production and fallow periods ('rotation cycle'). Aiming to avoid starvation resulted in an expansion of rice fields at the expenses of the natural forest resources.
A growing number of people were planning to leave their place of origin in the mountainous areas seeking better living conditions mainly at locations of lower altitude, mostly looking out more productive agricultural areas and fertile land, better access to markets, health and education services.

Target group

The IFSP was implemented mainly in most remote and mountainous areas of the two districts. In Nalae district, the population and geography was relatively homogeneous, also in matters related to food security, poverty and nutrition. Here the IFSP supported the entire district population (Austro-Asiatic groups, 90% of target group, mainly Khamu and Lamet and 10% Lao Tai). Sing district comprised of a low-land area, were the district capital was located, where the Lao-Tai were the predominantly inhabitants. While the Hmong-Mien, particularly the sub-group of Akha, originally resided in mountainous areas of the district. Disparities between flatland areas and mountain areas regarding culture and tradition but also regarding access to resources, food security and poverty were large.

Programme phases

The IFSP was composed of two programme phases, the first phase running from 1993 to the end of 1997. Following a programme progress review in 1997 the IFSP was extended for another term of three years, a second phase, running from 1998 to the end of 2000. Beyond 2000 the IFSP shifted from the Integrated Food Security Programme to a broader approach of Poverty Reduction and Regional Rural Development focusing pre-dominantly on human resource development and capacity building in mountainous areas in Northern Laos.

The first phase of the IFSP focused on building contacts and confidence to the people living in mountainous areas, supporting the implementation of the project like simple community infrastructure, and elaborating implementation structures, and supporting partner institutions to build up capacities for providing community based services. Activities were defined and implemented on a pilot basis.

The second phase defined its goal, purpose and results more precisely, but principles of programme approach and strategy remained similar: aiming to achieve food security and to alleviate poverty. The 'sector' of education and health more precisely had to focus on nutrition and food security relevant activities, while fewer resources were available for construction of infrastructure. Additional aspects were included, such as the design of a up-land development concept, strengthening extension services in the agriculture and health sector and elaborating financial systems to attain sustainability. Considerable changes were undertaken concerning the formerly defined 'women specific' activities. Gender issues

became a crosscutting issue, integrated in all sectors relevant. Measured to reduce opium demand and production became an additional component of the IFSP in Sing district.

Following the Logical Framework developed for programme implementation the IFSP stated one 'overall goal', three 'programme purposes' and five 'results' to be achieved. Each level had one to three indicators set to measure and demonstrate target achievements at all levels.

Implementation structure

The programme was implemented under the Ministry of Health at the national level, which also provided the programme co-ordinator. At province and district level the programme was under the responsibility of the government's provincial and district office.

Implementation structures were different in the two districts. In Sing district, the number and qualification of government staff was insufficient to ensure adequate service provision in remote locations. Before the start of the IFSP services, largely, concentrated on the lowlands; language barriers hindered close cooperation between population groups. In order to extent and improve service provision to those locations, the IFSP established 'service-centers' in mountainous areas being the base for development workers providing services to the surrounding villages. A 'service-centre'- development team comprised of an agriculture, health and education specialist. Nalae district, being a mountainous district throughout, was more homogeneous in culture and tradition. Here differences in cultural or language were less invasive, and the government showed a high commitment to ensure support to most remote locations. Therefore, the IFSP in Nalae district did not create a 'service-center' structure, but supported the expansion of government's line departments and services, and provided technical, financial and logistical support to start up, consolidate and expand development services.

IFSP activities

The IFSP designed its set of activities in relevance to meet the basic needs of the target population, formulated as improving food security and alleviate poverty. The inter-sector programme implemented activities in the sector of agriculture (food as well as cash crop production), health, education and infrastructure. This was in line with the government policy, which defined the same four sectors in its comprehensive poverty reduction strategy as being the main pillars for poverty alleviation. In Muang Sing district, activities for drug control and prevention were added in 1998. The programme focussed specifically on the development of human resources at various levels, at village level and also within institutions acting at sub-district and district level.

Food aid was used as a flexible instrument mainly in form of Food for Work (FFW), and some "Cash for Work" through monetised food aid. It was mainly used to support the construction of social infrastructure and for agricultural production schemes. The FFW programmes were implemented with a high degree of community participation. Part of the food aid were kept as contingency to cover sudden emergency needs (i.e. cholera outbreak in Nalae district, loss of food stocks due to outbreak of fire or sudden migration).

Health activities comprised of preventive and curative primary health care measures. With the aim to ensure effective health care provision at community level, the programme supported the set up, training and equipment of district and sub-district health centres and mobile teams. At village level village health volunteers and traditional birth attendants were recruited in an interactive and participatory way, trained and supervised. A cost sharing system was implemented, initially focusing on a drug revolving fund, in Nalae district gradually expanding to partially cover the costs due to the maintenance of primary health care services as well. Measures on environmental hygiene, sanitation and clean water supply were largely implemented through the health sector.

Knowledge is the basis for improving attitudes and behaviour. Education is an ideal means to enhance life skills and to convey messages related to the improvement of food and nutrition security as an immediate means and is a key to a sustainable reduction poverty and malnutrition in a longer term. Therefore, the IFSP supported the education sector to improve access to good quality of formal primary as well as non-formal education. The IFSP supported the improvement of school infrastructure for primary and boarding schools, particularly during the first phase, supported teacher's formal training and in-service training and supported the district government to ensure regular supervision. The development of teaching material, systematically integrating aspects of food, nutrition and life skills was supported, particularly for the non-formal sector and women's education. Solar equipment was specifically installed for the non-formal education activities to allow for teaching outside in the evenings.

Agriculture plays a key role when aiming at food security and rice sufficiency was the main concern of villagers and government officials. The agricultural sector was composed of a wide range of activities aiming to stabilise and increase food as well as cash crop production. The set of activities was tailored to meet the needs and potential of the respective location. Improved rice production was always of highest priority among the target group and the aim was to improved productivity though flat land rice production, including the introduction of small-scale irrigation. Attempts were made for diversifying permanent crop production. The development of an up-land agriculture system included the introduction of intercropping systems, such as the introduction of leguminous plants and nutritious vegetables with the aim to increase the availability of non-staple foods at household level and to diversify households food consumption. Improved soil management systems, i.e. the introduction of alley cropping or terracing were part of the improved up-land techniques. Gardens were implemented partly as commercial as well as vegetable demonstration gardens, this allowed introducing new products, and developing and demonstrating appropriate cropping methods. Simultaneously, extensions services and trainings were being provided relevant to nutrition, food security and economic development. Healthy nutrition, nutritious value as well as best use and preparation of newly introduced food crops were integrated into nutrition education services.

Livestock extensions services were set up, involving training of village volunteers, and the introduction of improved stocks (breeds) and environmentally sound techniques, set-up of a vaccination chain aimed to improve livestock raising for both purposes, to increase household income as well as to contribute to increased food consumption.

The IFSP was engaged in the construction of physical infrastructure: roads, drinking water supply, health posts, district hospital and market buildings. In addition, the IFSP invested in improving agricultural production through a twin track approach, ensuring immediate food needs and simultaneously investing in food security relevant infrastructure, such as opening of new and permanent rice fields, the establishment of terraces, alley cropping systems, irrigation systems and fish ponds. The food transfer releases the villagers from their hard workload in the up-land rice field, frees up time to invest into the implementation of new production systems with supporting them at least with a minimum of their rice requirements.

Drug addiction and its consequences resulted in an increased number of households whose food security situation deteriorated. Starting in 1999 the IFSP in Sing district integrated components of the regional Lao-German co-operation on 'promotion of drug control', which refers to a three-fold approach, 1) focusing on prevention of drug consumption; here public information campaigns were undertaken 2) measures of alternative development aiming to reduce opium production. Potential and promising initiatives were the introduction of sugar cane, coffee, cardamom, and fruit tree cultivation, as well as the introduction of fish raising through fish ponds and improved animal raising, and 3) detoxification and rehabilitation and reintegration of formerly addicted people who were actively seeking help.

Annex 2b: Logical framework, indicators and monitoring

1) The 'Logical Framework' 1998 – 2000

Overall Goal: **A sustainable development process is initiated in the districts of Sing and Nalae in Namtha province, Northern Laos.**

Indicator OG: It was suggested to apply the indicators of chronic malnutrition: the stunting rate of children under five will be reduced from 69% in 1997 to 48% in 2001 in both districts. Means of verification: baseline and follow-up nutrition survey.

Purpose (PP): **The living conditions of disadvantaged groups in the province of Luang Namtha, in the districts of Muang Sing and Muang Nalae are improved by overcoming the nutrition risk.**

Indicator PP 1: Mortality rate of children under five years is reduced by 20% in villages with intensive interventions by 12/2000.

Indicator PP2: 75% of the households are able to cover their basic food requirements by 12/2000.

Indicator PP 3: Primary education attendance rate in the target villages reaches district level in Muang Sing and National level in Nalae (65%) by 12/2000, the participation of girls is 40%.

Result 1.0: **Sustainable agricultural practices are applied.**

Indicator 1 A: Concept and strategy for sustainable up-land farming system developed in co-operation with involved institutions in Lao P.D.R. and agreed upon by 12/1999.

Indicator 1 B: In 25% of the villages on-farm demonstrations/trials of important elements of the up-land farming system including improved methods and alternatives to slash and burn are successfully implemented together with farmers by 7/2000.

Indicator 1 C: In 50% of the villages more than 40% of the households have integrated at least one improved and economically viable practice into their production system by 6/2000.

Result 2.0: **Aspects of health service with relevance to nutrition are established in the project villages.**

Indicator 2 A: In 30% of the villages at least 3 preventive measures are adopted by 12/2000.

Indicator 2 B: 70% of the villages have access to curative services for at least 3 main diseases by 12/2000.

Result 3.0: **Aspects of the education and advisory curriculum with nutrition relevance are communicated.**

Indicator 3 A: The curriculum of non-formal education is developed and tested by 6/1998.

Indicator 3 B: In 60% of the villages non-formal education takes place by 12/2000.

Indicator 3 C: The number of school places increased by 20% compared to 1997.

Result 4.0: **The rural infrastructure (feeder roads, health posts, rice stores, and schools built with simple technology) is improved.**

Indicator 4 A: Based on the results of participatory needs assessment infrastructure development is completed with appropriate standards by 12/2000.

Indicator 4 B: Procedures for operation and maintenance of infrastructure and related services are effectively implemented not later than 12 months after the completion.

Result 5.0: **The co-operation among governmental, non-governmental and village institutions involved in the programme is improved.**

Indicator 5 A: 90% of the project plan implemented according to acceptable standards by 12/2000.

Indicator 5 B: The results of project monitoring used for annual plan adjustment.

Remarks on the IFSP indicators and the hierarchy of effects

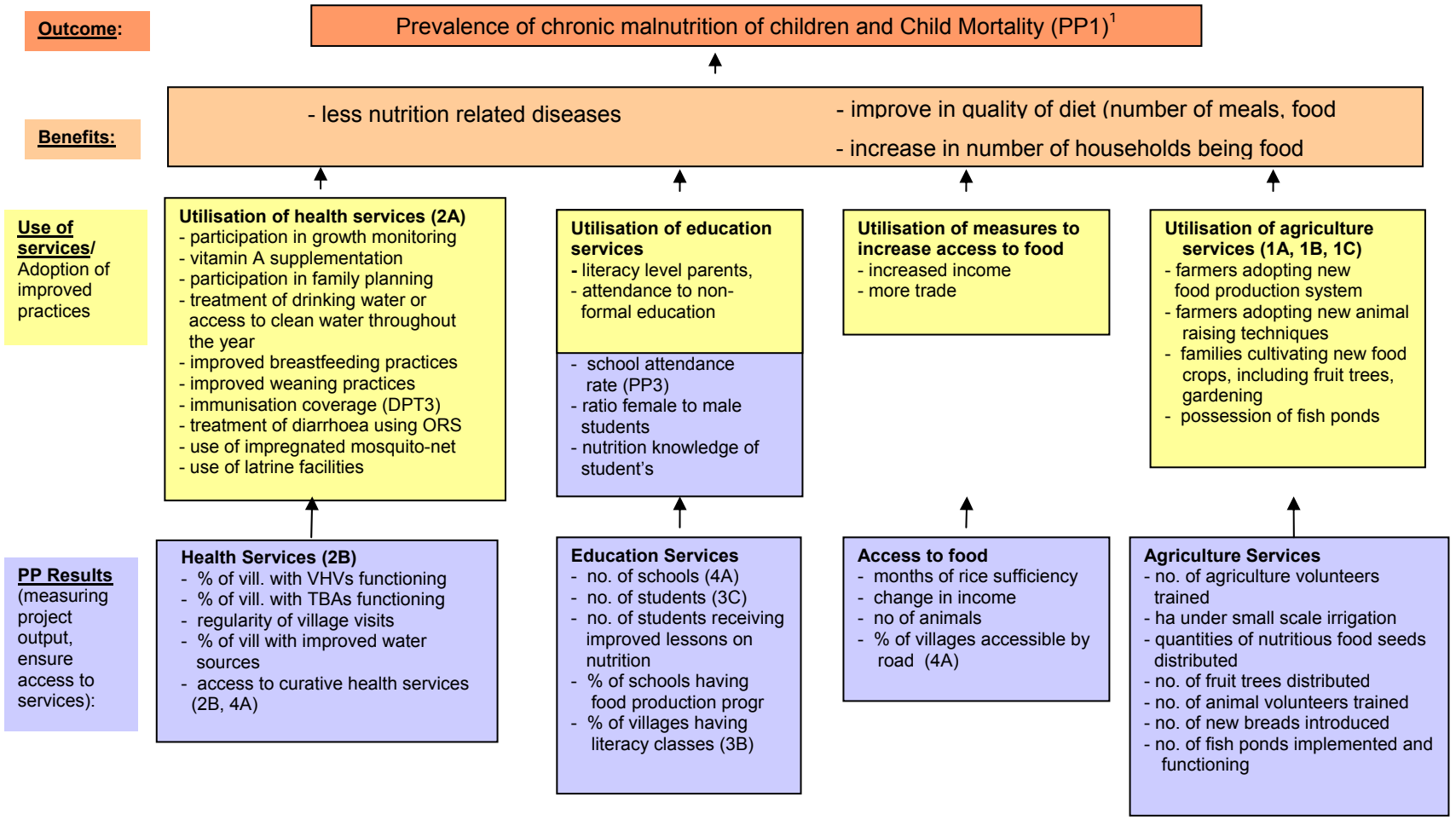
Indicators defined at result level should assess the quantity and quality of project outcome or services. Additionally, indicators are required to measure the utilisation of services (e.g. participation in growth monitoring), the adoption of new practices and techniques (e.g. improved animal raising techniques) or behavioural changes (e.g. breastfeeding practices). Beyond that, monitoring of target group's benefit and achievements at project purpose and goal level complete the picture of impact oriented monitoring.

The indicators formulated and documented above do not always match with the logical hierarchy of effects expected. Indicators were primarily selected and formulated to be realistic and easy to monitor, appropriate for the institutional framework and capacity of partner institutions.

The level of utilisation of services was not included in the project-planning document as a separate level to be monitored. Still, indicators measuring the utilisation of services were either included at result level or at project purpose level, specifically for the set of activities formulated for each result (e.g. school attendance). When developing the system of impact oriented monitoring indicators are classified according to the respective level of the logical hierarchy of effects.

Here three indicators are formulated at project purpose level, representing a higher level of effects of the three sector-results, agriculture, health and education, separately. The indicator at project purpose level for the sector of education e.g. is the school attendance. Keeping in mind the logical hierarchy of the project effects, the school attendance rate indicates the utilisation of services. The benefit could be measured by the reduction of the percentage of the population being illiterate. Moreover, a better educational status is expected to contribute towards an improved food and nutrition security at household level. Therefore, impact monitoring should go beyond the reduction of illiteracy, measuring the impact on the nutritional status.

Annex 2b –Figure 1- Overview – Indicators for monitoring and evaluation



[1] Abbreviations and numbers in brackets refer to the indicators listed at the logical framework document, annex 2b

Annex 2b – Matrix 1: Determinants of malnutrition, corresponding interventions and indicators[26]

Determinants of malnutrition	Intervention	Indicator	Method of monitoring and evaluation
Use and utilisation			
Morbidity	**Improvement of preventive and curative health services, including mother and child health care, concentration on:**		
Diarrhoea ARI Anaemia Swollen abdomen	Prevention of most common diseases (Diarrhoea, ARI, Malaria), Treatment of intestinal parasites Water and sanitation programme	Prevalence of Malaria Diarrhoea ARI Anaemia Distended abdomen	Participatory village evaluation (three times per year, village meetings, group discussions) Health statistics, distribution of micro-nutrients, de-worming programme End-term evaluation
		Participation in bednet impregnation	Summary of impregnation activities (yearly, after campaign), discussion with villagers
		Treatment of diarrhoea at household level	Mid-term evaluation survey End-term evaluation
Availability and use of health services			
Immunisation	Immunisation programme	Immunisation coverage	Immunisation summary, End term evaluation
Birth spacing	Promotion and measures of family planning	Participation in family planning programme	Health statistics (every three months) End-term evaluation

[26] All determinants listed were statistically significantly related to the nutritional status of children (chronic malnutrition) applying unifactorial analysis (chi-square, and analysis of variance). However, the matrix presents interventions corresponding to the determinant. The IFSP implemented additional interventions, expected to contribute to improved food and nutrition security (e.g. infrastructure, village rice stores, etc.). Those interventions are more likely measured through process and activity monitoring; their effect will be reflected in improved outcomes.

Environment and sanitation			
Treatment of drinking water	Measures to improve quality of drinking water (co-operation with NGO, water supply)	% of hh boiling drinking water % of villages having improved water sources	Mid-term evaluation survey Summary of clean water supply statistics End-term evaluation
Using latrines	Latrine programme	% of households having latrines	Summary of latrine programme (ongoing) End-term evaluation
Food intake	**Promotion of healthy nutrition and IYCF**		
Children's food intake			
Breastfeeding practices	Promotion of breastfeeding	% of children receiving breast-milk after birth	Mid-term evaluation survey End-term evaluation
Weaning practices (sample size too small, but association observed)	Improve of complementary food for children (type, quality, frequency and time)	% of children receiving weaning food within the recommended age	Mid-term evaluation survey End-term evaluation
Adults food intake	**Healthy nutrition of adults, diversity of food intake** **Healthy nutrition for pregnant and lactating mothers**		
Diversity of meals		Three meals per day containing different dishes	Mid-term evaluation survey End-term evaluation
Fruit snacks		% of households having snacks in between main meals	Mid-term evaluation survey End-term evaluation
Food restrictions after delivery		% of mothers following food restrictions after delivery	Mid-term evaluation survey End-term evaluation
Nutritional status of mothers		BMI of non pregnant mothers	Mid-term evaluation survey End-term evaluation
Literacy level	**Improve education services** - formal education - non-formal education - improvement of nutrition lessons in schools - school food production	- No. of learning spaces - No of teachers - School attendance - Ration girls to boys - % of vill. having literacy classes	Education statistics (yearly summary)

	programme, including animal raising programme	- No of school food production programmes functioning (%)	Summary of activities, Discussions with teachers (twice per year)
Literacy level of mothers Literacy level of fathers		- Attendance of literacy classes - % of illiterate adults (male/female)	End-term evaluation survey Education statistics (yearly summary)
Access to food	**Improve of economic situation**		
Cash income	Animal raising programme to improve household income, non timber forest products	Increase in yearly cash income	Mid-term evaluation survey End-term evaluation
Close distance to district centre		% of households having improved access to the district centre by small feeder roads	District statistics (summary of activities)
Decision power of women on household expenditures	Increase gender awareness as a cross sectional aspect	- participation of women in village evaluation meetings - participation of women in agriculture extension sessions - participation of women in health education sessions	Statistics of extension teams (summary of activities)
		- more decision power of women	End-term evaluation
Availability of food	**Improvement of agriculture services to increase food production**		
Sufficiency of last rice harvest Animal raising (pigs, chicken, ducks)	- increase rice production - diversity of food production - animal raising - fish raising	- % of farmers adopting new food production system (SALT) - % of hh cultivating new food crops, including fruit tree gardens - % of hh owning fish ponds - ha of small scale irrigation functioning and under production - quantity food seeds distributed - no. of fruit trees distributed - no. of animal volunteers trained - no. of new animal breeds introduced - % of farmers adopting new animal raising techniques	Summary of agriculture activities Yearly agriculture survey Participatory village evaluation End term evaluation

Annex 3: Population statistics and list of villages

Distribution of sampled units over sub-district and ethnic group

The following demographic information presents the numbers at baseline. Since the same villages were survey in 2001 the share and percentages did not change noticeably. The two districts are divided into a number of sub-districts (5 in Nalae district and 4 in Sing district). Each sub-district is characterised by its specific ecologic, socio-economic and cultural conditions. For additional information table 3.1 present the number of households and individuals sampled by sub-district and ethnic group for each district.

Table 3.1: Number of households, children sampled and frequency distribution by geographical zone

District	Sub-districts	Hh studied n	% within total sample	Children studied, n	% within total sample
Nalae	Thontrone	60	12.1	69	11.2
	Ohm	60	12.1	82	13.4
	Saken	42	8.5	51	8.3
	Chomsy	43	8.7	54	8.8
	Phu Hoen	48	9.6	61	9.9
Sub-total Nalae district		253	50.8	317	51.6
Sing	Thong Mai	61	12.3	72	11.7
	Muang Mom	59	11.9	69	11.2
	Ban Xai	47	9.5	62	10.1
	Xieng Khaeng	77	15.5	94	15.3
Sub-total Sing district		244	49.2	297	48.3
Total (both districts)		497	100	614	100

In Nalae district 6 sub-ethnic groups were studied, 80% officially classified as Lao Theung or Khamu, which is the local word for people living on the slope of the hill, 20% belong to the ethnic group of Lue, classified as Lao Loum. The Lue live within the mountainous area of the district, but close to the riverside, also following the traditional slash and burn cultivation pattern. They form part of the target population.

This ethnic situation is different for Sing district, here, at the start of the programme, the target communities existed of Akha ethnic groups only. Hence, in Sing district only Akha villages were studied. The ethnic group of Akha officially belongs to the major group of Hmong-Mien (formerly Lao Soung). Three subgroups of Akha were studied. Non-Akha families (n = 2) not belonging to the Akha ethnic groups but living within Akha villages were also included in the study. The number of ethnic groups studied and distribution within the survey is shown in table 3.2.

Table 3.2: Number of households, children sampled and frequency distribution by ethnic group

District	Ethnic Group	Hh studied n	% within total sample	Children studied, n	% within total sample
Nalae	Khamu Rok	89	18	89	18.0
	Khamu Lue	56	11.3	56	11.1
	Tai Lue	48	9.7	48	10.3
	Khamu Youan	37	7.5	37	8.0
	Lamet	20	4.0	20	3.8
	Quen	2	0.4	2	0.3
	Others	1	0.2	1	0.3
Sub-total Nalae district		253	50.8	317	51.6
Sing	Akha Buli	155	31.3	155	30.4
	Akha Ti Tchor	80	16.2	80	16.2
	Akha Phen	5	1.0	5	1.0
	Dai Lue	1	0.2	1	0.2
	Others	1	0.2	1	0.3
Sub-total Sing district		244	49.2	297	48.4
Total (both districts)		497	100	614	100

Table 3.3: List of villages and households studied in 1997 and 2001

Vill. code	Villages	Sub-group	Geographical zone (stat code)	1997 n		2001 n			
				HH	Chil	HH	Chil	Village interview	No. of groups
I Nalae district[1]									
1	Hatchala	Khamu L.	Thonthrone (1)	20	24	22	33	yes	0
2	Thonthrone	Khamu L.	Thonthrone (1)	20	20	24	35	yes	3
3	Mok Kham Phang	Khamu L.	Ohm (2)	10	13	migrated in 1998 to Long Moon and Phutin			
4	Phutin (old and new)	Khamu L.	Ohm (2)	12	17	20	33	yes	1
5	Konkhout Gau	K. Rok	Saken (3)	10	11	10	17	yes	0
5.2	Konkhout Mai	K. Rok	Saken (3)	moved in 2000/2001		5	7	yes	0
6	Kanha	K. Rok	Saken (3)	12	15	17	25	yes	1
7	Sakaen	K. Rok	Saken (3)	20	25	19	34	yes	1
8	Chomsy Gau	Lamet	Chomsy (4)	20	23	19	31	yes	1
9	Khonsalay	K. Youan	Chomsy (4)	4	6	migrated in 2001 to Saleuang Bang			
9	Saleuang Bang	K. Youan	Chomsy (4)	not included		25	32	yes	1
10	Saleuang Bang Gau	K. Youan	Chomsy (4)	19	25	16	26	yes	1
11	Phu Hoen	K. Rok	Phu Hoen (5)	20	25	24	37	yes	1
12	Tavan (old and new)	K. Rok	Phu Hoen (5)	10	16	18	30	yes	0
13	Phukor	K. Rok	Phu Hoen (5)	4	5	in 1998/99 to Hatdao and out of the province			
14	Hatdao	K. Rok	Phu Hoen (5)	14	16	25	34	yes	1
15	Phavy	Lue	Ohm (2)	18	24	16	19	yes	3
16	Ohm	Lue	Ohm (2)	20	28	24	37	yes	3
17	Vaen	Khamu L.	Thonthrone (1)	20	25	26	39	yes	2
	Sub-total Nalae	**5 Groups**	**5 Zones**	**253**	**317**	**310**	**469**	**16**	**11**
II Sing district[2]									
20	Hua Na Gao	Buli	Vieng (6)	12	12	migrated in 1998 to Hua Na Mai			
20.2	Hua Na Mai	Buli	Vieng (6)	8	10	24	27	yes	2
21	Pi Yer	Buli	Thong Mai (6)	16	18	24	29	yes	3
21.2	Mona	Buli	Thong Mai (6)	4	6	14	16	yes	2
22	Uela Mai	Buli	Thong Mai (6)	15	17	21	24	yes	3
22.2	Huai Na Gang	Buli	Thong Mai (6)	6	9	22	29	yes	2
23	Bouak Khou	Tchi Tchor	Muang Mom (7)	20	24	23	23	yes	2
24	Phabat Noy	Buli	Muang Mom (7)	12	15	13	17	yes	0
24.2	Bouakya Xai Mai	Buli	Muang Mom (7)	8	9	25	31	yes	1
25	Law Meu	Tchi Tchor, Buli	Muang Mom (7)	19	21	24	31	yes	3
26	Chawang Mai	Sapo	Ban Say (8)	17	21	15	19	yes	3
26.2	Lang Pha	Buli	Ban Say (8)	10	13	13	22	yes	2
27	Seuadeng	Buli	Ban Say (8)	8	10	6	8	yes	2
27.2	Chaintakilli	Tchi Tchor	Ban Say (8)	12	18	23	32	yes	3
28	Loku	Buli	Xieng Khaeng (9)	19	24	25	28	yes	2
29	Chakeun	Buli	Xieng Khaeng (9)	20	23	25	36	yes	2
30	Padeng	Tchi Tchor	Xieng Khaeng (9)	20	25	25	25	yes	0
31	Chaputon	Tchi Tchor	Xieng Khaeng (9)	18	22	30	26	yes	0
	Sub-total Sing	**3 Groups**	**4 Zones**	**244**	**297**	**342**	**423**	**17**	**14**
	Grand total	**8 Groups**	**9 Zones**	**497**	**614**	**684**	**892**	**33**	**25**

[1] Austro-Asiatic (90%) and Tai-Kadai (10%)

[2] Hmong-Mien (Akha sub-group)

Annex 4: Statistical analysis – levels and sectors

Levels (I to II) and sectors (1 to 8) tested for their effect on the nutritional status:

I. *Direct causes and selected indicators*

1 Family's food intake (diversity of meals, food consumed derived from own production, food items from forest resources)

2 Early infant feeding practices (initiation of breastfeeding, provision of colostrums, pre-lacteal feeding, and quality of complementary food)

3 Young child feeding practices: timely introduction of complementary food, introduction of plant and animal products, duration of breastfeeding, and reasons to stop breastfeeding)

4 Health situation (point prevalence of diseases, unspecified fever, ARI, diarrhea diseases, episodes of diarrhea over the previous 6 months, distended abdomen)

II. *In-direct causes and selected indicators*

5. Food security and livelihood: farming system, rice production, possession of small livestock, cash income, housing)

6. Access and utilization of health services (immunization coverage: DPT3)

7. Water and hygiene (water source, treatment of drinking water, hygienic housing)

III *Basic causes and selected indicators*

8. Educational situation (literacy level of parents), social status of women (decision power over household resources: rice, poultry, handicrafts, cash expenses), accessibility of location

Annex 5: Malnutrition and mortality

Table 5.1: Severe and moderate chronic malnutrition by district in 1997 and 2001 (in %)

	Nalae		Sing		Total	
	1997 n = 307	2001 n = 465	1997 n = 293	2001 n = 417	1997 n = 614	2001 n = 882
Severe chronic malnutrition (< -3 z-score)	37.2	26.0[1]	41.9	31.4[2]	39.6	28.5
Moderate chronic malnutrition (-3 to <-2 z-score)	31.9	32.5	27.6	27.3	30.0	30.0
Normal (≥ -2 z-score)	30.9	41.5[1]	30.5	41.2	30.7	41.4

[1] Chi-square, Fisher exact test, p< 0.001
[2] Chi-square, Fisher exact test, p< 0.01

Table 5.2: Chronic malnutrition by age group and by district in 1997 and 2001 (in %)

	Sing Chronic malnutrition		Nalae Chronic malnutrition		Total Chronic malnutrition	
Age group (in months)	1997 n = 293	2001 n = 417	1997 n = 307	2001 n = 465	1997 n = 600	2001 n = 882
< 12	31.0	21.1	40.9	38.8	36.3	30.2
12 - < 24	81.9	70.0	76.6	66.1	79.4	67.9
24 - < 36	68.3	58.7	68.5	55.8	68.4	57.1
36 - < 48	75.0	78.1	76.9	67.9	76.0	72.6
>= 48	90.9	86.7	88.5	72.4	89.7	79.7
Total	69.9	59.0	69.1	58.3	69.3	58.6

Table 5.3: Acute malnutrition by age group and by district in 1997 and 2001 (in %)

	Sing Acute malnutrition		Nalae Acute malnutrition		Total Acute malnutrition	
Age groups (in months)	1997 n = 292	2001 n = 416	1997 n = 305	2001 n = 461	1997 n = 597	2001 n = 877
< 12 months	1.8	4.7	7.9	1.0	5.0	2.8
12 - < 24	2.8	8.0	15.4	8.9	8.8	8.5
24 - < 36	3.3	2.7	5.5	0	4.5	1.2
36 - < 48	0.0	2.7	13.5	3.6	7.0	3.2
≥ 48	1.8	0	7.7	3.4	4.7	1.7
Total	2.1	4.1	9.8	3.5	6.0	3.8

Table 5.4: Causes of child death (as reported by the mothers studied; n = 476 women; reported number of death = 534; 31.6% in Nalae district and 24.2% in Sing district could not specify causes of death, in %)

Causes	Nalae	Sing	Total
Not known	31.6	24.2	28.3
Fever	24.4	35.0	29.1
Malaria	6.9	11.2	8.8
Diarrhoea	8.4	11.9	10.0
ARI	14.2	5.7	10.4
Measles	4.8	3.3	4.1
Others	9.7	8.7	9.3

Table 5.5: Immunisation coverage for children between 1 and 2 years of age in 1997 and 2001 by district (in %)

	Nalae (Children between 1 to 2 years)		Sing (Children between 1 to 2 years)	
Antigens	1997 n = 67	2001 n = 106	1997 n = 72	2001 n = 81
Polio 3	46.3	78	34.3	29.6
DPT 3	10.4	57.8	25.7	3.7
Measles	28.4	79.2	34.3	33.3
BCG vaccine	43.3	92.5	55.7	32.1
Vitamin A	65.1	86.9	70.8	44

Annex 6: Food intake

6.1. Food consumption pattern, food groups and food items consumed

Food group 1: Animal products

Table 6.1.1: Food group 1 - Animal products from domestic production (in %)

Food from animals raised	Nalae n = 254	Sing n = 244	Total n = 497
Eggs (chicken or duck)	4.3	3.2	3.2
Chicken	5.1	3.7	4.4
Pork or pork fat	8.7	12.7	10.7
Buffalo and cattle	7.1	5.7	6.4
Goat	0.8	0.4	0.6
Total consumption of food of raised animals			
Not consuming any	74.7	76.6	75.7
Consuming one item	24.5	22.1	23.3
Consuming two different items	0.8	1.2	1.0

Table 6.1.2: Food group 1 - Animal products derived from forest (hunted or gathered, in %)

Food item consumed	Nalae n = 254	Sing n = 244	Total n = 497
Bird	5.5	3.3	4.4
Squirrel	3.6	1.2	2.4
Deer (small and big)	2.0	2.9	2.4
Wild pig	2.4	0.8	1.6
Frog or snake (including snake eggs)	2.0	0	1.0
Forest Rats	1.2	0	0.6
Mole (dto un, on)	0.4	0	0.2
Insects (ants, termites, including termite eggs, grass-hopperssnails, bamboo worms, bee-larva, and different kinds of other larvae)	1.2	0.8	1.0
Other forest animals (mountain goat; ibex)	0.4	1.6	1.0
Total consumption of animal products (hunted or gathered)			
Not consuming any	83.0	91.0	86.9
Consuming one item	15.4	7.4	11.5
Consuming two different items	1.6	1.6	1.6

Table 6.1.3: Food group 1 - Aquatic products, natural sources, gathering (in %)

Collected food item	Nalae n = 254	Sing n = 244	Total n = 497
Fish	40.7	20.5	30.8
Shrimps or crapes	12.3	1.2	6.8
Shell or oyster	7.5	0	3.8
Total consumption of fresh water animals			
Not consuming any	54.2	78.7	66.2
Consuming one item	36.0	20.9	28.6
Consuming two different items	5.1	0.4	2.8
Consuming three different items	4.8	0	2.4

Food group 2 – Vegetables (Non-DGLV)

Table 6.2.1: Food group 2 –Vegetables cultivated (in %)

Cultivated vegetables	Nalae n = 254	Sing n = 244	Total n = 497
Chinese cabbage	5.5	24.6	14.9
Pumpkin, gourd, squash	5.1	2.5	3.8
Eggplants	2.8	3.7	3.2
Other cultivated vegetables (Cauliflower, cabbage, tomatoes)	3.2	2.9	3.0
Grown DGLV (Food Group 3) (morning glorry, pumpkin leaves)	1.2	1.2	1.2
Total consumption of the cultivated vegetables listed above			
Not consuming any cultivated vegetable	83.8	67.6	75.9
Consuming one cultivated vegetable	14.6	29.9	22.1
Consuming two different cultivated vegetables	1.6	2.5	2.0

Table 6.2.2: Food group 2 - Vegetables collected (in %)

Collected non-DGLV	Nalae n = 254	Sing n = 244	Total n = 497
Bamboo	11.5	81.1	45.7
Banana-flower	24.5	1.2	13.1
Stamp of banana-tree (yok)	4.7	0	2.4
Rattan	4.7	0	2.4
Other non-DGLV	3.2	0	1.6
Total consumption of non-DGLV collected in the forest (listed above)			
Not consuming any collected non-DGLV	58.9	18.0	38.8
Consuming one col. non-DGLV	33.6	81.6	57.1
Consuming two different col. non-DGLV	7.5	0.4	4.0

Food group 3 – DGLV

Table 6.3: Food group 3 - DGL-vegetables (gathered, in %)

Collected DGLV	Nalae n = 254	Sing n = 244	Total n = 497
Pak Hag	19.1	0.4	9.9
Taro leaves (includ. *Bon heng*)	11.1	0	5.6
Sour leafy vegetable (*Lom som*)	9.1	0.4	2.8
Sweet leafy vegetable (*Pak wan*)	2.8	0.4	1.4
Other *DGLV (pak koot (fern), pak hay, pak ka, pak nor etc.)*	39.1	38.1	38.6
Un-identified collected DGLV	7.5	5.7	6.6
Total consumption of DGLV collected in the forest (listed above, (p<0.001)			
Not consuming any collected DGLV	34.4	58.6	46.3
Consuming one col. DGLV	47.8	38.1	43.1
Consuming two different col. DGLV	16.6	3.3	10.1
Consuming three different col. DGLV	1.2	0	0.6

Food Group 4: Fruits

Table 6.4: Food group 4 - Fruits (grown and collected, in %)

Fruits consumed	Nalae n = 254	Sing n = 244	Total n = 497
Banana	9.9	1.2	5.6
Water melon	0	3.7	1.8
Guava	2.8	0	1.4
Tamarind	0.8	0.8	0.8
Mak Goor (*or Mak gook*)	3.6	0	1.8
Other fruits (Mango, Mak lot, Mak fei, etc.)	4.3	0.8	2.6
Total consumption of fruits			
Not consuming any	82.2	93.4	87.7
Consuming one item	14.2	6.6	10.5
Consuming two different fruit items	3.6	0	1.8

Food Group 5: Herbs, spices, condiments

Table 6.5: Food group 5 - Consumption of herbs, spices and other condiments (in %)

Food item	Nalae n = 254	Sing n = 244	Total n = 497
Spring onions	32.0	25.4	28.5
Garlic	3.6	21.7	12.5
Ginger	3.2	2.0	2.6
Chilly	92.5	93.4	93.0
Green herbs: basil, dill, coriander, etc.	17.8	5.7	11.9
Other herb (mainly lemon grass)	6.7	0	3.4
Salt (iodised)	97.2	98.4	97.8
Glutamate	73.9	87.7	80.7

Food group 6: All other food items

Table 6.6.1: Food group 6 - Consumption of other food items cultivated (in %)

Food item	Nalae n = 254	Sing n = 244	Total n = 497
Sugar cane	0	1.6	0.8
Soy beans (fermented)	0	1.2	0.6
Sesame	2.0	0.8	1.4

Table 6.6.2: Food group 6 - Consumption of other food items collected (in %)

Collected food item	Nalae n = 254	Sing n = 244	Total n = 497
Algae (fresh water algae)	8.7	0	4.4
Mushrooms	0	7	3.4
Honey	0	2	1.0

Table 6.6.3: Food group 6 - Consumption of biscuits and alcohol (in %)

Fruits consumed	Nalae n = 254	Sing n = 244	Total n = 497
Biscuits	2.4	0.4	1.4
Alcohol (liqueur, rice wine)	1.6	12.7	7.0

Food Group - staple food: all households, without any exception, had rice as staple food for all meals consumed. In addition, 1.8% had roots, which are prepared and consumed as side dish or snack (cassava (4 households), taro (3 households), sweet potatoes (2househlds).

Table 6.7: Summary - Number of food items consumed by food groups (mean value and maximal number per day and household)

	Nalae n = 254		Sing n = 244		Total n = 497	
Food Group	Mean	Maxim.	Mean	Maxim.	Mean	Maxim.
1. Animal products	1.06	5	0.68	3	0.87	5
2. Non-DGLV	0.66	3	1.17	3	0.91	3
3. DGLV	0.85	3	0.45	2	0.65	3
4. Fruits	0.21	2	0.07	1	0.14	2
5. Herbs and spices	1.56	4	1.48	4	1.52	4
6. Other food items	0.23	2	0.18	2	0.21	2
Total ($p<0.001$)	4.57	9	4.03	8	4.30	9

6.2. Multifactorial regression, sector-wise, food intake and nutritional status (food intake as independent and nutritional status as dependant variable)

Table 6.8.1: Multiple regression analysis, sectoral analysis model including all food intake variables (n = 444)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-1.750	.795		-2.200	.028	-3.313	-.186
	No. of meals	-.277	.250	-.054	-1.108	.268	-.768	.214
	meal composition - different dishes	-.291	.141	-.109	-2.072	.039	-.567	-.015
	snacks or fruits	.190	.388	.024	.489	.625	-.573	.952
	Animal source - raised	3.84E-03	.153	.001	.025	.980	-.296	.304
	Animal source - hunted-gathered	-.202	.200	-.050	-1.010	.313	-.595	.191
	DGLV grown & collected	-5.7E-02	.133	-.022	-.431	.667	-.318	.204
	Vege-Non-DGLV grown	.241	.155	.077	1.558	.120	-.063	.544
	Vege Non-DGLV collected	-.177	.135	-.064	-1.311	.191	-.443	.088
	condiments (herbs+spices; onion,garlic, ginger, chilly, etc.)	2.47E-03	.095	.001	.026	.979	-.184	.189
	Rice per caput	.366	.426	.043	.860	.390	-.470	1.203
	Food diversity (no of food itmes)	-1.2E-02	.165	-.005	-.074	.941	-.337	.312

a. Dependent Variable: HAZ height for age z-score (hazdet, analysis of determinants)

Table 6.8.2: Multiple regression analysis including food diversity and source of foods and nutritional status as dependant variable (n = 444)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-2.511	.137		-18.277	.000
	forest products, non-DGLV, roots, hunted animals	-.395	.130	-.139	-3.047	.002
	food produced, veges and chicken or goat	.241	.134	.082	1.796	.073
	total sum of all food itmes; Vegetables, DGLV, anim.food, fruits, herbs+spices, sumothers	2.00E-02	.090	.010	.223	.824

a. Dependent Variable: HAZDET

Annex 7: Multifactorial analysis, sector-wise, IYCF practices and nutritional status

7.1. Regression, three-factorial, sector-wise analysis model, early infant feeding practices (initiation of breastfeeding, colostrums, quality of first complementary food), including children below 12 months only

Univariate analysis of variance

Between-Subjects Factors

		Value Label	N
Start breastfeeding?	1	first day of birth	94
	2	later	27
First food given to the child after being born?	1	colostrum	49
	2	other food	72
Type of first complem. food	1	mixed,3,4,7	4
	2	monoton	117

Tests of Between-Subjects Effects

Dependent Variable: HAZ height for age z-score (hazdet, analysis of determinants)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	18.711[a]	7	2.673	1.582	.148
Intercept	8.176	1	8.176	4.840	.030
ALTER	5.270	1	5.270	3.120	.080
BREASTIN	5.214	1	5.214	3.087	.082
COLOSTRU	1.534	1	1.534	.908	.343
COMPFOOD	2.171	1	2.171	1.285	.259
BREASTIN * COLOSTRU	2.143	1	2.143	1.269	.262
BREASTIN * COMPFOOD	6.141	1	6.141	3.635	.059
COLOSTRU * COMPFOOD	.192	1	.192	.113	.737
BREASTIN * COLOSTRU * COMPFOOD	.000	0	.	.	.
Error	190.904	113	1.689		
Total	571.445	121			
Corrected Total	209.616	120			

a. R Squared = .089 (Adjusted R Squared = .033)

Estimated marginal means

1. Start breastfeeding?

Dependent Variable: HAZ height for age z-score (hazdet, analysis of determinants)

Start breastfeeding?	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
first day of birth	-.987[a,b]	.324	-1.629	-.346
later	-1.846[a,b]	.490	-2.817	-.876

a. Evaluated at covariates appeared in the model: Age of the child in months = 6.4773.

b. Based on modified population marginal mean.

2. First food given to the child after being born?

Dependent Variable: HAZ height for age z-score (hazdet, analysis of determinants)

First food given to the child after being born?	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
colostrum	-1.483[a]	.413	-2.301	-.665
other food	-1.472[a,b]	.459	-2.381	-.563

a. Evaluated at covariates appeared in the model: Age of the child in months = 6.4773.

b. Based on modified population marginal mean.

3. Type of first complem. food

Dependent Variable: HAZ height for age z-score (hazdet, analysis of determinants)

Type of first complem. food	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
mixed,3,4,7	-1.150[a,b]	.691	-2.520	.219
monoton	-1.724[a,b]	.148	-2.018	-1.431

a. Evaluated at covariates appeared in the model: Age of the child in months = 6.4773.

b. Based on modified population marginal mean.

7.2. Regression, multi-factorial, sector-wise, IYCF and nutritional status

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.438[a]	.191	.156	1.28696

a. Predictors: (Constant), Age of the child in months, Lactation stop reason, Weaning at 4 to 6 months, Provide colostrum, Wean animal product 4 to 6 months, Lactation, Duration, Start breastfeeding?, Wean plant 4 to 6 months

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	70.983	8	8.873	5.357	.000[a]
	Residual	299.785	181	1.656		
	Total	370.768	189			

a. Predictors: (Constant), Age of the child in months, Lactation stop reason, Weaning at 4 to 6 months, Provide colostrum, Wean animal product 4 to 6 months, Lactation, Duration, Start breastfeeding?, Wean plant 4 to 6 months

b. Dependent Variable: HAZ height for age z-score (hazdet, analysis of determinants)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.284	.922		.308	.759
	Start breastfeeding?	-5.7E-02	.232	-.018	-.245	.807
	Provide colostrum	.270	.201	.094	1.342	.181
	Weaning at 4 to 6 months	-7.9E-02	.293	-.019	-.271	.787
	Wean plant 4 to 6 months	-.252	.127	-.152	-1.983	.049
	Wean animal product 4 to 6 months	.120	.115	.081	1.050	.295
	Lactation, Duration	-.187	.109	-.119	-1.710	.089
	Lactation stop reason	-.464	.230	-.137	-2.017	.045
	Age of the child in months	-3.5E-02	.008	-.316	-4.514	.000

a. Dependent Variable: HAZ height for age z-score (hazdet, analysis of determinants)

Annex 8: Villager's perception on malnutrition, infections and seasonality

Malnutrition was traditionally described as "*kad ahan*", which can be translated as 'lack of food'. Symptoms of '*kad ahan'* were described as having a weak skinny body, pale face and no power to work hard or, for children, not being able to walk properly. The season of malnutrition, lack of food, is said to start in May, has it's peak in June and July, and ends in August. Reasons mentioned were the tremendous work load of all villagers working hard in the upland rice field during June and July not having time to search for food in the forest. Consequently not eating enough, especially no meat. Meals were explained to be very simple during this time, only rice, chilly and salt, and taken at irregular intervals, often only twice per day. Furthermore, food reserves from the previous harvest might be depleted while up-land fields have not yet provided any vegetables, maize, or pre-matured rice.

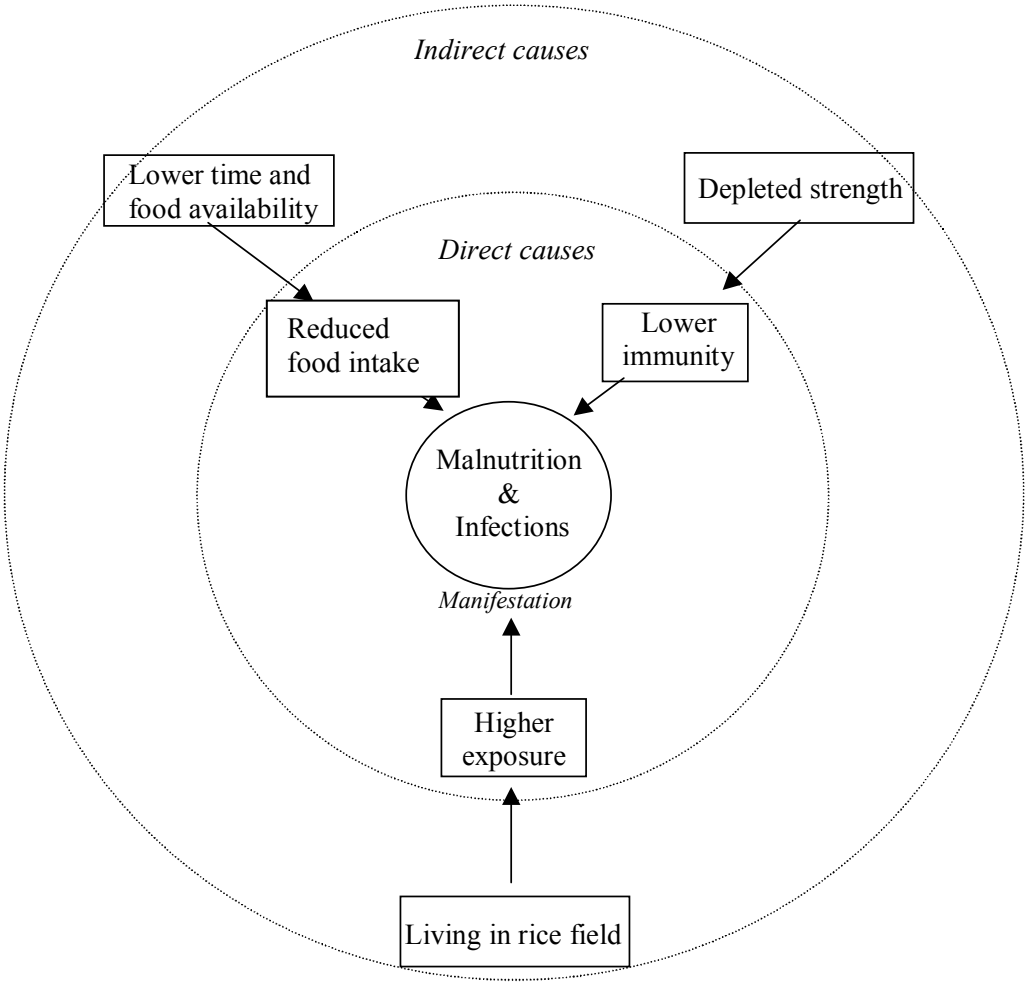
It should be recognised that villagers interpret or describe malnutrition as lack of food, determined by insufficient food availability, which again may have several reasons, such as lack of production resources, time etc. Diseases were traditionally not mentioned to be the predominant cause of malnutrition, but a close correlation was seen. Nevertheless, it was explained by the villagers that a malnourished (*kad ahan*) person is at higher risk of becoming infected. Furthermore, a person suffering from diseases becomes "*joy*", which can be translated as 'skinny' or 'thin'. Differences between skinniness (joy) and malnutrition (kad ahan) are explained by the duration of either insufficient nutrition or duration of diseases. Kad ahan predominantly is understood as a chronic state of malnutrition, too small, too short, pale face, no power, caused by chronic lack of food or frequent diseases. While joy is the actual situation mainly caused by an infectious disease, such as malaria, cough or diarrhoea.

'Kad ahan' was explained to be mainly a problem of poor families and households without male labour, performing hard slash and burn activities in the rice field. Poor vegetable production was said to be a determining factor, forest products are considered to complement the daily food but were insufficient in amount. Better production conditions were also the main reasons for migration. Places close to the river were said to provide the desired conditions, solving the food shortage by providing foods from the river, big fish, water to cultivate vegetables and better environment for animal raising.

The peak of all diseases summarised, including malnutrition (kad ahan) is seen in May, June, July and August. Which is the time where predominantly malaria, diarrhoea, and malnutrition (kad ahan), show their peak. Villagers explained the strenuous work in the up-land rice field, slash and burn, weeding and harvesting as being the core problem. Low-land cultivators were said to be healthier, a reason given was the lower work load. According to villagers perception reasons for frequent diseases and higher risk of malnutrition during times of hard work could be summarised as following

1. High work load depletes strength and lowers immunity or resistance, but increases nutrient requirements. Up-land communities said that they worked continuously in an un-healthy position; face towards the ground and back towards the sun. The hard work does not allow them to stand in up-wards position in between, while low-land cultivators could have breaks.
2. In-sufficient food intake, predominantly due to lower food availability, and partly due to lack of time for collection and preparation of food. Intensified by the period of the year where food reserves may be depleted.
3. Higher exposure to infections, due to:
   - consumption of unboiled drinking water, no water kettle, boiling water in rice pot is forbidden by the spirit
   - sleeping without a mosquito net, higher number of mosquitoes than inside the village
   - exposure to the climate, rain and sunshine, no shelter.

The lower caring capacity of families during times of high workload was stressed to be an overall problem intensifying the health problems of children.



Basic cause: high work load in up-land rice field

Figure 8.1: Factors associated slash-and-burn rice cultivation contributing to the seasonal variation of infections and malnutrition (villager's perception)

Table 8.2: Seasonality of common diseases and labour (summary of seasonal calendar - piling, women's focus groups in 10 villages).

	Summary, nominations											
Identified as a problem in n out of 10 villages	9	10	14	7	6	14	17	16	12	7	3	5
Malnutrition (n = 6)					•	••••	••••	•				
Eye infections (n = 3)												••
Skin infections (n = 3)	•	•	•			•		••	••	••	•	•
Diarrhoea (n = 9)			•••	••••	•••	••••••	••••••	••••••	•••	•		
ARI (n = 10)	•••••	••••••	•••••••	••	•							
Malaria (n = 10)	•••	•••	•••	•	•	•••	•••••••	•••••••	•••••••	••••	••	••
Intern. calendar (months)	Dec.	Jan.	Febr.	March	April	May	June	July	August	Sept.	Oct.	Nov.
Season (climate)	Cold season			Dry and hot		Start raining		Rainy season			End of rainy season	
Season (cultivation)	Transport rice to store		SLASH	BURN		SEEDING		WEEDING			HARVEST	
Work load	Leisure time (time off, repairing houses, celebrations, social events)				VERY HARD WORK Living					VERY HARD WORK in rice field		

Annex 9 – Immunization coverage and water supply

Table 9.1: Immunisation coverage for children between one and two years of age in 1997 and 2001 by district (in %)

	Nalae		Sing	
Antigens	1997	2001	1997	2001
	n = 67	n = 106	n = 72	n = 81
Polio 3	46.3	78.0	34.3	29.6
DPT 3	10.4	57.8	25.7	3.7
Measles	28.4	79.2	34.3	33.3
BCG	43.3	92.5	55.7	32.1
Vitamin A	65.1	86.9	70.8	44.0

Table 9.2: Source and treatment of drinking water and height-for-age z-score and stunting (in %)

	Drink boiled water				Drink unboiled water		
	n	%	Mean HAZ ± SD	Stunting %	n	Mean HAZ ± SD	Stunting %
River	26	100	-2.27 ± 1.49	53.8	0	0	0
Local source	131	35.1	-2.56 ± 1.11	71.0	245	-2.87 ± 1,35	74.4
Locally improved system	11	14.7	-2.17 ± 1.32	54.5	64	-2.57 ± 1.41	68.6
Total	168		-2.49 ± 1.19	67.3	309	-2.81 ± 1.37[1] (1)	73.5[1]

[1] ANOVA, p=0.0011

[2] Severe chronic malnutrition: 8.3% and 20.4% for those consuming boiled water compared to those consuming unboiled water, Chi-square, Pearson, p=0.008

Table 9.3: Treatment of drinking water and acute malnutrition

Treatment of drinking water	n	Mean WHZ ± SD[1]
Boil before drinking	170	-0.30 ± 1.05
Drink always unboiled water	310	-0.56 ± 0.99
Total	480	-0.47 ± 1.02

[1] ANOVA, unifactorial, p=0.008

Table 9.4: Purification of drinking water in 1997 and 2001 (in %)

		Dink boiled water		Always unboiled
		Always	Not always	
Nalae [1]	1997	23.4	23.8	51.6
	2001	3.7	35.0	32.4
Sing [1]	1997	8.6	13.9	75.8
	2001	14.0	30.1	55.81
Total [1]	1997	16.1	19.0	63.5
	2001	22.9	32.4	44.7

[1] Differences between 1997 and 2001 were statistically significant for the total sample as well as for the two districts independently, Pearson Chi-Square, p<0.001.

Annex 10: Income and housing and nutritional status

Tables 10.1: Income and height-for-age in 1997 and 2001

Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
YEAR	1997	Baseline	444
	2001	Follow up	642
INCOMEGR	1	<55$	388
	2	55 to 110	223
	3	110 to 220	227
	4	>220	248

Tests of Between-Subjects Effects

Dependent Variable: HAZ height for age z-score (hazdet, analysis of determinants)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	256.599[a]	8	32.075	20.943	.000
Intercept	760.242	1	760.242	496.391	.000
ALTER	207.342	1	207.342	135.382	.000
YEAR	8.093	1	8.093	5.284	.022
INCOMEGR	18.941	3	6.314	4.123	.006
YEAR * INCOMEGR	1.593	3	.531	.347	.792
Error	1649.467	1077	1.532		
Total	8668.189	1086			
Corrected Total	1906.066	1085			

a. R Squared = .135 (Adjusted R Squared = .128)

Estimated Marginal Means

1. YEAR

Dependent Variable: HAZ height for age z-score (hazdet, analysis of determinants)

			95% Confidence Interval	
YEAR	Mean	Std. Error	Lower Bound	Upper Bound
Baseline	-2.581[a]	.063	-2.704	-2.457
Follow up	-2.395[a]	.050	-2.493	-2.298

a. Evaluated at covariates appeared in the model: Age of the child in months = 29.2176.

2. INCOMEGR

Dependent Variable: HAZ height for age z-score (hazdet, analysis of determinants)

			95% Confidence Interval	
INCOMEGR	Mean	Std. Error	Lower Bound	Upper Bound
<55$	-2.665[a]	.063	-2.788	-2.541
55 to 110	-2.499[a]	.084	-2.665	-2.334
110 to 220	-2.492[a]	.085	-2.658	-2.326
>220	-2.296[a]	.085	-2.463	-2.129

a. Evaluated at covariates appeared in the model: Age of the child in months = 29.2176.

3. YEAR * INCOMEGR

Dependent Variable: HAZ height for age z-score (hazdet, analysis of determinants)

YEAR	INCOMEGR	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Baseline	<55$	-2.738[a]	.090	-2.914	-2.562
	55 to 110	-2.657[a]	.130	-2.912	-2.402
	110 to 220	-2.589[a]	.133	-2.851	-2.327
	>220	-2.338[a]	.142	-2.618	-2.059
Follow up	<55$	-2.591[a]	.088	-2.764	-2.418
	55 to 110	-2.341[a]	.108	-2.553	-2.129
	110 to 220	-2.395[a]	.104	-2.600	-2.190
	>220	-2.254[a]	.094	-2.439	-2.068

a. Evaluated at covariates appeared in the model: Age of the child in months = 29.2176.

Profile plots

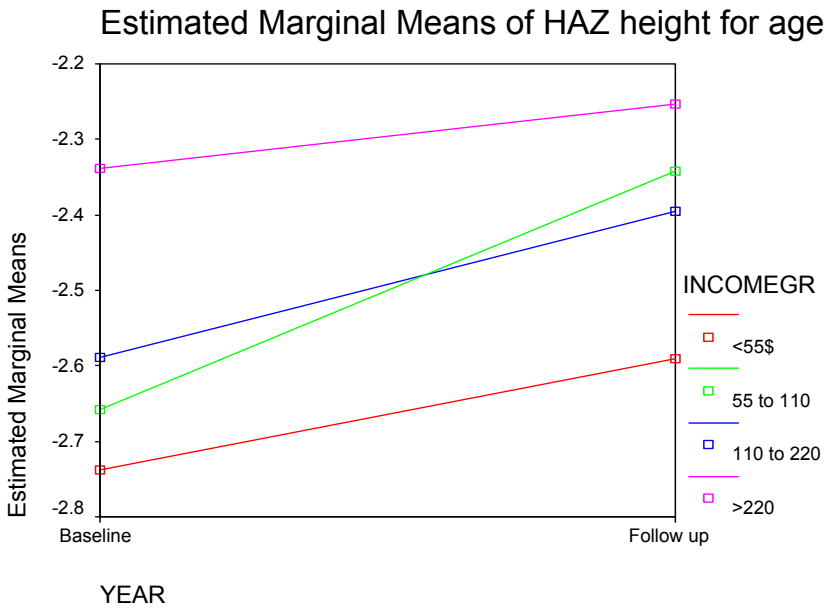


Table 10.2: Quality of housing and nutritional status

Wealth related housing conditions	Mean HAZ ± SD[1]	Stunting (3. Grade)[2] %
Construction material of the floor (n = 464)	p < 0.001	p = 0.008
Build on the ground (n = 36)	-3.29 ± 1.14	88.5% (26.9%)
Bamboo flour (n = 308)	-2.78 ± 1.31	74.4% (16.6%)
Wooden flour (n = 120)	-2.41 ± 1.28	62.5% (13.3%)
Construction material of the roof (n = 481)	p = 0.001	p = 0.029
Grass, leaves or bamboo (n = 412)	-2.78 ± 1.33	73.1% (17.3%)
Iron or fibre sheets (n = 49)	-2.13 ± 1.30	57.1% (8.2%)

[1] ANOVA [2] Chi-square, Pearson

Annex 11: Basic causes (education, decision making and nutritional status)

Table 11.1: Capability of fathers and mothers to communicate in national language (n = 497, in %)

	Fathers			Mothers		
National language skills	Nalae n = 253	Sing n = 244	Total n = 497	Nalae n = 253	Sing n = 242	Total n = 495
Does not understand	2.0	74.2	37.4	14.2	97.5	54.9
Can read and write	62.1	1.2	32.2	11.9	0	6.1

Table 11.2: Decision maker over cash expenses in 1997 (n = 495)

	Less than 1USD		1 to 5 USD		More than 5 USD	
Decision maker	n	%	n	%	n	%
Parents together	326	66%	329	67%	351	72%
Father independant	81	16%	136	27%	114	23%
Mother independant	80	16%	22	4%	15	3%

Table 11.3: Decision making over different household assets 1997 (n = 497)

	Rice		Poultry		Livestock		Handi-crafts		Opium[1]		Other Products	
Decision maker	n	%	n	%	n	%	n	%	n	%	n	%
Parents	264	74	270	73	317	83	65	61	63	55	47	59
Father	61	17	42	11	51	13	28	26	45	39	19	24
Mother	24	7	54	15	9	2	9	8	6	5	11	14
Elders	6	2	5	1	6	2	4	4	0	0	3	4
Total and %[2]	355	71	371	62	383	77	106	21	115	23	80	17

[1] Relevant for Sing district only, [2] % of households taking such decisions

Table 11.4: Decision making and height-for-age and chronic malnutrition

Decisions on the use of household assets	Mean HAZ ± SD[1]	Chronic Malnutrition[2] %
Poultry		
Both together or father independent (n = 293)	-2.71 ± 1.23	72.9
Only mother (n = 46)	-2.36 ± 1.49	58.7
	p=0.089	p=0.057
Rice		
Only father (n = 55)	-2.80 ± 1.38	75.9
Both together or independent (n = 248)	-2.75 ± 1.23	73.0
Only mother (n = 19)	-1.42 ± 1.45	31.6
	p < 0.001	p <0.001
Handicrafts		
Only father (n = 27)	-2.76 ± 1.42	74.1
Both together or independent (n = 64)	-2.46 ± 1.53	64.1
Only mother (n = 6)	-1.77 ± 0.78	16.7
	p=0.15	p=0.03

[1] ANOVA [2] Chi-square, Pearson

Annex 12: Methodological constraints to demonstrate changes in malnutrition

Over the previous decade, various international organisations, among them GTZ, FAO, IFAD and ADB discussed the use of nutritional indicators as a core indicator to measure changes induced by their nutrition or nutrition related development programmes (ADB 2005). In 2004 WFP introduced the Results Based Management System, applying nutritional indicators as key indicators to measure outcomes of their nutrition programmes (WFP 2004). Still, so far, neither evaluations nor any systematic analysis on the pre-post assessment methodology is available demonstrating changes one could expect within such a relatively short time period of a programme cycle. Hence, there is no scale which would allow any rating of changes achieved,

There are methodological difficulties to attribute changes to the supported interventions, those difficulties are widely recognised, discussed and described by the term 'attribution gap'. However, in addition there are further limitations hindering the identification of a full effect on the nutritional situation within a programme cycle or shortly after completion. Those difficulties could be described by the term 'time gap'. Programme implementation requires a certain time span from planning to full realisation and until an improved nutritional status develops. Thus, achieving measurable and, ideally, significant changes in malnutrition within a relatively short period of a programme cycle has its limitations. Such limitations are not unique and are transferable to other impact assessments applying similar designs. They are presented here in an attempt to contribute to an improved evaluation methodology:

1. A certain time span is required from programme planning to the design and implementation of first interventions. Implementation would start in selected areas, consolidate, and expand gradually based on experience evolving before full coverage can be achieved (time period from programme planning to full coverage).
2. A certain time span is required until activities are of sufficient quality and continuity to become effective (time span ensuring quality standards in interventions).
3. A number of output achievements are prerequisite to improvements in the nutritional status. A certain time span is required to produce those expected outputs. This holds particularly true for investments to develop local capacities, but is also highly relevant for direct investments such as support to improved agricultural production or food security (i.e. food and cash crop production, such as coffee or cardamom, commercial gardening, fruit tree plantations). Investments in primary education would show their effect on the nutritional status only within the next generation. Even if the interventions are highly relevant and successful, they will only bear fruits in the medium- or longer-term future. Support to the implementation of health services might show a relatively direct effect on the nutritional status compared to investments in other sectors.
4. Behavioural changes are a necessity to improved nutrition, but changes in health or hygiene behaviour are time intensive. Cultural, traditional and language barriers prolong the process (time span to fully adopt behavioural change).
5. Even highly effective intervention requires some time to show a measurable effect on an individual's nutritional status and thus on an entire population (time for individual physiological responses).

The extent to which each limitation becomes relevant is context specific. The limitations briefly presented above would require more in-depth investigation, and a systematic analysis of experience and information available. This would be a precondition to a more evidence based prediction in changes possible to achieve, thus in evaluating and judging over changes achieved.

Bullet no. 5 requires a further elaboration: Children of different ages grow at different rates. Susceptibility to poor growth is highest among the youngest age groups. Velocity to linear growth is highest at youngest age, and reduces as the child growth older (WHO 1995).

Consequently, the age of the child at the start of an intervention is central to his/her physiological response.

A simulation done by Morris and Ruel examined how long it would take for stunting to be appreciably reduced. They found that children younger than 24 months of age responded much more rapidly to the improved environmental conditions than older children. After one year of the intervention the prevalence of stunting had dropped from 12.5% to 1.3% among children below 24 months. The prevalence of stunting among children 42 months and older did not improve even after one year. This is because the expected growth rates at this age are much slower than at younger ages. The researchers estimated that it took four years of sustained improved growth for stunting to finally be eliminated among the younger age groups, and five years for the whole growth curve to be at or above the reference throughout the entire age range (Morris and Ruel, ACC/SCN 1997).

The present study evaluated a time period of four years. Children 48 to 59 months at the time of the second survey had been 0-12 months old during the first survey and when first interventions started (this equals about one fifth of the sample). Only the children younger than 48 months at the time of the second survey benefited fully from the programme interventions, hence, can be expected to show a more optimal growth from the beginning.

An impact survey after five years would include children born after the start up of the programme who fully benefited from the interventions during their most sensitive years of growth. Hence, an assessment conducted after five years would probably identify a proportionally more significant rate of change in chronic malnutrition, even if the coverage, intensity and quality of interventions were the same. It has been suggested to investigate this subject through a different research project at a later stage.

Acknowledgment

Many people have contributed to the realisation of the study and it is my desire to express my deep gratitude to all, while it is, unfortunately, impossibly to name them all.

I gratefully acknowledge the continued valuable and constructive advise and tolerant guidance provided by my supervisors, Prof. Dr. Claus Leitzmann and Prof. Dr. Michael Krawinkel, Institute of Nutritional Science of the Justus Liebig University in Giessen. I also deeply acknowledge the fruitful and motivating discussions and support from the members of the Institute's working group, especially during the final stage of the thesis. Special thanks go to the 'Institut für Medizinische Informatik' of the Justus Liebig University, particularly Wolfgang Pabst, for his patient statistical guidance throughout the entire process of designing the study, the application of statistical procedures and the interpretation of the results. His professional technical support was central to the realisation and completion of the study. Additional thanks go to Jörg Reitze, "MoRe Data" statistic office, for contributing to the final stage of data interpretation. Many thanks go to Dr. Judit Katona-Apte and Tirthankar Mukherjee who sacrificed their valuable time for correcting mistakes of the final document. However, I carry full responsibility for all those mistakes still remaining.

Deep gratitude goes to the GTZ, particularly Günther Kohl, team-leader of the IFSP, Dr. Arounny Phanlavong, programme coordinator, and Brigitte Sugiono, progamme manager, for the motivation to start and complete the study, the support to conduct the field survey and to use programme information for the purpose of the thesis. Special thanks deserve the members of the IFSP and the District Governments' Offices, particularly the health team, interviewers, as well as the supervisors, Dr. Lathawan and Dr. Sudsavian. They all worked tremendously hard to complete data collection and to ensure maximal accuracy possibly. Even when circumstances were extremely difficult, they were never tired to carry on and their passionate contribution, personal and technical, was crucial to the completion of the surveys.

I deeply acknowledge the villagers', the families', the mothers' and the children's willingness and openness to cooperate with us. They, patiently, answered all questions and provided valuable insights. They showed great hospitality, staying with them was always a pleasure as well as a learning experience, and I am full of respect for the way they manage their daily life.