A Nutrition and Food Security Assessment of the Dry Zone of Myanmar in June and July 2013

Save the Children, WFP and the Ministry of Livestock, Fisheries and Rural Development

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ACRONYMS

ANC	Ante Natal Care
ARI	Acute Respiratory Infection
BCC	Behaviour Change Communication
BMI	Body Mass Index
CED	Chronic Energy Deficiency
CSI	Coping Strategies Index
DEFF	Design Effect
FCS	Food Consumption Score
FSIN	Food Security Information Network
GAM	Global Acute Malnutrition
GIS	Geographic Information Systems
HAZ	Height for Age Z-Score
HDDS	Household Dietary Diversity
HH	Household
HEA	Household Economy Assessment
IDDS	Individual Dietary Diversity Score
IGA/IGS	Income Generating Activities / Schemes
IHEA	Individual Household Economy Assessment
IPC	Integrated Food Security Phase Classification
IYCF	Infant and Young Child Feeding
LBW	Low Birth Weight
MICS	Multiple Indicator Cluster Survey
MUAC	Mid-Upper Arm Circumference
MNP	Micro Nutrient Powder
ORS	Oral Rehydration Solution
PLW	Pregnant and Lactating Women
PNC	Post Natal Care
RHC	Rural Health Centre
SAM	Severe Acute Malnutrition
SC	Save the Children
SD	Standard Deviation
TBA	Traditional Birth Attendant
VAM	Vulnerability Analysis Mapping
VIP	Ventilated Improved Pit latrine
VSG	Village Savings Group
WASH	Water, Sanitation and Hygiene
WAZ	Weight for Age Z-score
WFP	World Food Programme
WHZ	Weight for Height Z-score

EXECUTIVE SUMMARY

OVERVIEW

This assessment of the rural Dry Zone reveals the nutrition situation to be a concern, with high rates of wasting and medium rates of stunting, high rates of low birth weight and high rates of undernutrition among mothers; particularly those who are pregnant and/or lactating. The pattern of indicators suggests that flood plains and irrigated areas are best off, and the highlands may be worst, but the situation is far from acceptable in the Dry Zone as a whole. A wide range of likely causes of undernutrition needs addressing. Acute and chronic malnutrition have shared determinants and there is a need to tackle one to tackle the other. Children's and mother's nutrition status are associated, and a child's birth weight is an important determinant of their later nutrition status. This reminds us of the importance of the 1000 day window of opportunity between a child's conception and their second birthday, and the need to take a life-cycle approach; paying particular attention to pregnant and breastfeeding mothers. Dietary factors and their determinants seem likely to be particularly important drivers of undernutrition as do deficiencies in water, sanitation, hygiene and the public health environment. An absence of consistent associations between household economic status and nutrition indicators is likely in part because of widespread poverty as well as the focus on data from the current situation. However, analysis of associations revealed only small contributions of any specific explanatory variable to the variance of any of the nutrition outcomes (including indicators of food security) which together with analysis of risk factors reinforces that there is not just two or three important causes of undernutrition in the Dry Zone. Rather, a multi-sector approach is required for malnutrition prevention and nutrition status improvement.

INTRODUCTION

This nutrition and food security assessment was carried out by WFP, Save the Children and the Ministry of Livestock, Fisheries and Rural Development in the rural wards of the central Dry Zone of Myanmar between June 24th and July 18th 2013. The Dry Zone was divided in to three agroecological zones (see below).

The aims of the survey were to estimate the prevalence of indicators of undernutrition and infant and young child feeding practices rates and to assess the differences in the nutrition situation by agroecological zone and the likely reasons, through examining the food security situation and associations between nutrition indicators and food security, livelihoods and other variables. Notwithstanding the limitations of cross sectional data (whereby cause and effect cannot be determined with certainty), the overall objective of the survey was to improve understanding of the determinants of undernutrition, in particular those related to food security, to improve programme design and decision making. WFP have written a complementary report which provides detailed analysis of food security data and provides additional recommendations for this sector.

Agroecological zone number	Agroecological zone name	Characteristics
1	Dry land farming	1. Low land, not flood prone, no irrigation 2. Suitable soil for cultivation 3. Only single or double cropping possibilities
2	High land with sloping agriculture	1. High land (greater than 300 meters) 2. Soil suitable for orchards, plantations, forest 3. Sloping/ shifting cultivation agriculture practiced
3	Flood plains and irrigated areas	1. Flood plain with good soil fertility 2. Irrigated land 3. Multi-cropping possibilities year round

METHODS

The survey followed a two-stage, random, cluster design of all rural villages of the Dry Zone within which there were three nested surveys of the agroecological zones. A sample size of 1,800 0-59 month old children was calculated (including 522 0-24 month olds); 12 children in 50 village clusters in each zone. All mothers of sampled children were also included. Indicators of food security, livelihoods and other household level variables were collected from a sample of 1,500 households representative of the Dry Zone, with and without children under five years of age; minimum 10 households in 50 village clusters in each zone. It was estimated that this would create a sample of 560 households with food security data and nutrition data from children under five years of age to explore associations.

Data were collected using six questionnaires. Anthropometric measurements were collected for all surveyed children and mothers using standard techniques and equipment. Nine data collection teams comprising six staff members were hired as enumerators, with an additional 10 enumerators from the Ministry of Livestock, Fisheries and Rural Development. Staff received two weeks of training. Data entry and cleaning was completed in October 2013. Anthropometric indices were calculated in ENA for SMART (2011) before the data were imported to STATA (12.0) for analysis using the *'svy'* analysis module for clustered survey data. The estimates were weighted at the cluster and agroecological zone level for child /mother /household level estimates and at the agroecological zone level for analysis of village data.

KEY RESULTS

Proportions and prevalence rates are presented with 95% confidence intervals and sample size. Means are presented with standard deviations and sample size. Medians are presented with range and sample size. Estimates were tested for differences between agroecological zones. Significant differences are marked as follows: * is considered good evidence of difference ($p<0.05$), ** is strong evidence ($p<0.01$), and *** is very strong evidence ($p<0.001$).

	Dry land farming zone (1)	Highland farming zone (2)	Flood plains/irrigated zone (3)	Dry Zone total
		Nutrition		
% Global Acute Malnutrition (WHZ <-2, children 0-59 months)	13.9 (11.1, 16.7) (n=687) **1 and 3*	12.2 (8.7, 15.8) (n=668)	9.5 (6.9, 12.0) (n=661)	**12.3 (10.5, 14.2) (n=2036)**
% Severe Acute Malnutrition (WHZ <-3, children 0-59 months)	0.5 (0.0, 0.9) (n=687)	0.9 (0.1, 1.8) (n=668)	0.4 (0.0, 0.8) (n=661)	**0.5 (0.2, 0.8) (n=2036)**
% Stunting (HAZ <-2, children 0-59 months)	30.8 (26.9,34.6) (n=686) **1 and 3*	27.3 (22.9, 31.7) (n=684)	21.4 (17.1, 25.7) (n=660)	**27.5 (24.6, 30.0) (n=2030)**
% Underweight (WAZ <-2, children 0-59 months)	31.2 (27.5, 34.9) (n=687) ****1 and 3* ****1 and 2*	29.2 (25.0, 33.3) (n=688)	19.0 (15.3, 22.6) (n=661)	**27.2 (24.5, 30.0) (n=2036)**
% Low Birth Weight (children 0-59 months with documentary evidence)	36.2 (19.1, 53.2) (n=25) ***1 and 2* ***1 and 3*	7.8 (0, 15.7) (n=40)	9.1 (2.2, 16.0) (n=55)	**17.2 (8,2, 26,2) (n=120)**
% Body Mass Index < 18.5 kg/m² (non-pregnant mothers >19 years)	20.6 (15.2, 26.0) (n=556)	21.9 (17.3, 26.7) (n=563)	17.3 (12.4, 22.2) (n=570)	**19.7 (16.4, 23.1) (n=1689)**
Mean Mid Upper Arm Circumference/cm – pregnant and lactating mothers	25.4 (2.2) (25.0, 25.7) (n=406) ****1 and 3*	25.3 (4.9) (24.9, 25.8) (n=417) **2 and 3*	26.0 (3.3) (26.0, 26.3) (n=353)	**25.5 (2.9) (25.3, 25.8) (n=1176)**
Mean Mid Upper Arm Circumference/cm – non-pregnant and lactating mothers	26.3 (2.6) (25.6, 26.9) (n=182) **1 and 3*	26.9 (4.8) (26.3, 27.5) (n=176)	27.3 (3.5) (26.6, 28.1) (n=245)	**26.8 (3.4) (26.3, 27.2) (n=603)** ****Mean MUAC of pregnant and lactating mothers and non-pregnant and lactating mothers*
		Diet / Infant and Young Child Feeding practices		
% Timely initiation of breastfeeding (0-<24 month olds)				**34.6 (28.8, 40.4) (n=814)**
% Exclusive breastfeeding (0-<6 month olds)				**37.5 (26.3, 48.7) (n=55)**
% Timely complementary feeding (6-9 month olds)				**97.4 (94.4, 100) (n=152)**

	Dry land farming zone (1)	Highland farming zone (2)	Flood plains/irrigated zone (3)	Dry Zone total
% Continued breastfeeding at 2 years (20-<24 month olds)				**90.6 (84.0, 97.2) (n=128)**
% Minimum meal frequency (breastfed children 6-<24 months old)				**56.6 (51.3, 62.0) (n=548)**
% Minimum dietary diversity (6-<24 month olds)				**19.4 (15.0, 23.7) (n=167)**
% Minimum Adequate Diet (breastfed children 6-<24 months old)				**10.5 (6.2, 14.9) (n=546)**
Mean Individual Dietary Diversity Score – mothers (/max 9)	4.3 (1.3) (4.2, 4.5) (n=584) *** 1 and 2*	4.0 (1.8) (3.8, 4.2) (n=576) *** 2 and 3*	4.4 (0.9) (4.1, 4.6) (n=590)	**4.3 (1.2) (4.2, 4.4) (n=1750)**
- **Pregnant and lactating mothers**	4.3 (0.9) (4.1, 4.4) (n=404)	4.0 (1.9) (3.8, 4.1) (n=405)	4.3 (1.3) (4.1, 4.6) (n=349)	**4.2 (1.2) (4.1, 4,4) (n=1158)**
- **Non pregnant and lactating mothers**	4.5 (0.9) (4.2, 4.7) (n=180)	4.1 (1.7) (3.8, 4.4) (n=171)	4.5 (1.4) (4.2, 4.8) (n=241)	**4.4 (1.2) (4.3, 4.6) (n=592)** ** pregnant and lactating mothers and non-pregnant and lactating mothers*
		Disease		
% Child sickness (last two weeks, 6-59 months old)	27.9 (22.1, 33.7) (n=687) **1 and 2*	37.2 (30.2, 44.1) (n=688) **2 and 3*	24.0 (16.0, 32.0) (n=661)	**28.0 (23.8, 32.2) (n=2036)**
% Children with diarrhoea fed more (6-59 months old)				**2.9 (0, 6.6) (n=141)**
% Children with diarrhoea given ORS (0-59 months old)				**37.1 (21.7, 52.4) (n=146)**
		Public health environment		
Median travel time to Health Centre in rainy season/hours (villages without HC)	0.7 (0.2 – 1.0) (n=38) **** 1 and 2*	2.0 (0.3 – 24) (n=34) **** 2 and 3*	0.5 (0.1 – 9) (n=42)	**1.0 (0.1, 24.0) (n=114)**
% Bed net use (0-59 month olds)	84.9 (79.6, 90.2) (n=687) ****1 and 3*	93.3 (89.3, 97.3) (n=689) **1 and 2*	95.9 (93.7, 98.0) (n=660)	**89.4 (85.9, 92.8) (n=2036)**

	Dry land farming zone (1)	Highland farming zone (2)	Flood plains/irrigated zone (3)	Dry Zone total
% Vitamin A in last 6 months (6-59 month olds)	71.9 (61.7, 82.1) (n=613)	58.6 (49.6, 67.6) (n=594) **2 and 3*	74.1 (64.4, 83.7) (n=587)	**70.8 (64.2, 77.5) (n=1794)**
% Mothers' postpartum vitamin A	30.9 (23.5, 38.4) (n=572)	35.0 (26.7, 43.3) (n=577)	32.0 (25.0, 39.2) (n=583)	**31.8 (26.9, 36.7) (n=1732)**
% Antihelminth in last 6 months (12-59 month olds)	44.4 (36.2, 52.7) (n=523)	41.8 (32.1, 51.5) (n=505)	53.0 (44.1, 61.8) (n=530)	**46.8 (41.3, 52.3) (n=1558)**
% BCG (0-59 month olds)	89.7 (85.6, 93.8) (n=687)	85.8 (80.7, 91.0) (n=689)	90.9 (85.3, 96.5) (n=661)	**89.5 (86.6, 92.5) (n=2037)**
% Measles vaccination (card/recall) (12-24 month olds)	91.8 (87.0, 96.6) (n=153)	89.8 (80.0, 99.6) (n=126)	89.7 (83.7, 95.7) (n=122)	**91.0 (87.4, 94.5) (n=401)**
% Mothers receiving ANC from midwife	54.8 (38.5, 71.1) (n=591)	58.8 (44.6, 73.0) (n=598)	54.0 (40.7,67.3) (n=599)	**55.1 (45.0, 65.2) (n=1788)**
% Mothers taking vitamin B1 supplements	53.7 (45.4, 62.0) (n=587)	46.6 (39.1, 54.1) (n=574)	59.9 (51.6, 68.2) (n=581)	**54.7 (49.3, 60.1) (n=1733)**
% Mothers taking antenatal iron supplements	85.6 (81.1, 90.0) (n=586)	77.6 (70.0, 82.3) (n=591)	86.0 (81.0, 90.9) (n=590)	**84.7 (81.5, 87.8) (n=1767)**
% HH with year round access to protected water (incl. rainwater)	58.0 (39.9, 76.1) (n=617)	61.5 (47.0, 76.1) (n=573)	77.5 (66.5, 88.5) (n=612)	**64.5 (53.1, 75.9) (n=1802)**
% HH without latrine	29.0 (17.3, 40.7) (n=617)	16.5 (9.6, 23.3) (n=573)	21.7 (14.5, 28.9) (n=612)	**25.1 (17.7, 32.4) (n=1802)**
Household food security				
Median travel time to market in rainy season/hours (villages without market)	2.0 (0.3 – 24.0) (n=51)	2.0 (0.3 - 72.0) (n=49)	0.9 (0.2 - 9.0) (n=48)	**1.8 (0.2 – 72) (n=148)**
% HH with problems to meet food needs in last 12 months	42.4 (34.3, 44.5) (n=617)	35.9 (28.4, 43.4) (n=574)	35.4 (28.3, 42.6) (n=612)	**39.4 (34.3,44.5) (n=1803)**
% HH with problems to meet food needs in last 7 days	29.6 (18.9,40.3) (n=617)	25.2 (18.9, 31.5) (n=574)	23.2 (17.7, 28.7) (n=612)	**27.0 (20.5, 33.5) (n=1803)**
% HH 'adequate' on Coping Strategy Index	76.5 (68.3, 84.7) (n=617)	82.8 (78.2, 87.4) (n=574)	83.3 (77.8, 88.8) (n=612)	**79.4 (74.2, 84.7) (n=1803)**
% HH with adults (≥15 years) eating 3 meals a day	93.6 (90.6, 96.7) (n=616)	89.2 (83.3, 92.8) (n=574)	88.4 (84.0, 92.8) (n=612)	**91.4 (89.0, 93.9) (n=1802)**

	Dry land farming zone (1)	Highland farming zone (2)	Flood plains/irrigated zone (3)	Dry Zone total
% HH with Household Dietary Diversity Score > 4 *(FSIN suggested 'adequacy threshold')*	90.7 (87.3, 94.2) (n=617)	87.0 (84.0, 90.0) (n=574)	91.3 (88.2, 94.5) (n=612)	**90.4 (88.2, 92.6) (n=1803)**
Mean HDDS (/max 12)	6.0 (1.0) (5.8, 6.3) (n=617) **1 and 3*	6.0 (2.2) (5.8, 6.3) (n=574) **2 and 3*	6.5 (1.6) (6.2, 6.8) (n=612)	**6.2 (1.4) (6.0, 6.4) (n=1803)**
% HH with adequate Food Consumption Score	83.5 (77.4, 90.0) (n=617) ***proportions by FCS category, 1 and 2*	70.5 (64.9, 76.1) (n=574) ****proportions by FCS category, 2 and 3*	85.7 (80.4, 91.0) (n=612)	**82.4 (78.4, 86.4) (n=1803)**
Mean FCS	54.0 (11.2) (51.7, 56.3) (n=617) **1 and 2*	49.3 (23.5) (47.0, 51.5) (n=574) ****2 and 3*	58.6 (17.5) (54.5, 62.7) (n=612)	**54.8 (15.5) (52.9, 56.7) (n=1803)**
% HH landless (no access to land)	39.9 (31.5, 48.3) (n=617) ****proportions of landownership category, 1 and 2*	29.5 (23.3, 35.8) (n=574) ***proportions of landownership category, 2 and 3*	41.9 (33.8, 50.1) (n=612)	**39.1 (33.7, 44.6) (n=1803)**
% HH with <1 months cereal stock	70.1 (61.9, 78.4) (n=617)	53.2 (44.0, 62.4) (n=574)	59.5 (51.0, 68.0) (n=612)	**64.6 (58.7, 70.5) (n=1803)**
% households with iodised salt	70.9 (61.5, 80.2) (n=610)	75.3 (64.5, 86.1) (n=567)	75.5 (67.2, 83.8) (n=608)	**72.9 (66.8, 79.0) (n=1785)**
Household income/poverty				
% HH with livestock	75.3 (68.8, 81.7) (n=617) ***1 and 3*	82.3 (77.8, 86.7) (n=574) **** 2 and 3*	59.88 (53.4, 66.3) (n=612)	**71.5 (67.2, 75.7) (n=1803)**
Mean HH income / last month (kyat)	70,460 (108,364) (52,092, 88,829) (n=617) ***1 and 3*	90,539 (659,852) (36,439, 144,639) (n=574)	134,147 (280,521) (91,956, 176,338) (n=612)	**92,760 (241,462) (73,992, 111,527) (n=1803)**
Median # HH income sources/ annually	2 (0-9) (n=617)	2 (0-6) (n=574)	2 (0-7) (n=612)	**2 (0-9) (n=1803)**
Mean % HH expenditure on food, last 30 days	57.3 (16.2) (52.3, 62.4) (n=604) **1 and 3*	57.1 (33.7) (54.5, 59.7) (n=560) ***2 and 3*	50.8 (22.7) (46.9, 54.6) (n=591)	**55.3 (21.3) (52.0, 58.6) (n=1755)**

	Dry land farming zone (1)	Highland farming zone (2)	Flood plains/irrigated zone (3)	Dry Zone total
% HH in debt	81.5 (76.2, 86.8) (n=617)	75.3 (69.3, 81.3) (n=574)	76.0 (70.0, 81.9) (n=612)	**79.0** **(75.3, 82.7)** **(n=1803)**
Mean % HH below national poverty line (likelihood probability)	27.5 (14.5) (24.3, 30.8) (n=611) **1 and 3*	26.7 (28.3) (24.7, 28.8) (n=566) ** 2 and 3*	23.2 (17.8) (20.9, 25.4) (n=607)	**26.1 (18.2)** **(24.0, 28.2)** **(n=1784)**
		Demography		
Median HH size	4 (1-12) (n=614)	4 (1-13) (n=573)	4 (1-14) (n=612)	**4** **(1-14)** **(n=1799)**
Mean dependency ratio	0.4 (0.2) (0.3, 0.4) (n=614)	0.3 (0.4) (0.3, 0.4) (n=573)	0.3 (0.3) (0.3, 0.3) (n=612)	**0.3 (0.2)** **(0.3, 0.3)** **(n=1799)**
Mean age of mothers at first delivery (years)	23.4 (3.8) (22.5, 24.3) (n=591)	22.7 (6.7) (22.2, 23.2) (n=597) **2 and 3*	23.8 (5.1) (23.1, 24.5) (n=599)	**23.4 (4.8)** **(22.9, 24.0)** **(n=1787)**

CONCLUSIONS

The survey was conducted during the hunger gap, a time of annual food insecurity in the rural Dry Zone and also the rainy season. The situation is characterised by high rates of low birth weight, wasting and stunting in children and high rates of undernutrition in mothers; with an indication that the nutritional status of mothers who are pregnant or lactating is worse than those who are not. The rate of wasting is of 'high' public health concern (WHO 2000) and the rate of stunting is of 'medium' public health concern (WHO 1995). Given the political stability, the absence of extreme weather conditions at the time of the assessment and the seasonally typical food security indicators, including indicators of adequate household food access and consumption, these nutrition indicators are concerning.

The pattern of nutrition, health, food security and poverty indicators and their significant differences between agroecological zones all suggest that the flood plains/irrigated zone 3 is 'best off'. There are some indications that highland farming zone 2 may be the worst; particularly in relation to some health and diet indicators. However, there are only limited differences between zones and the situation is far from acceptable in the rural Dry Zone as a whole.

The similar pattern of differences between zones for nutrition and food security and poverty indicators suggest that these are key drivers of undernutrition, as expected. However there is an absence of evidence of many significant associations between nutrition outcomes and indicators of food security and poverty revealed in further analyses at the Dry Zone level. Three main reasons are likely: firstly, a focus on the recent situation (30 days income/expenditure); secondly widespread inadequacy of many indicators across the Dry Zone e.g. low incomes and high indebtedness; and thirdly, other (confounding) causal factors are also driving undernutrition patterns, e.g. differences in topography between zones will affect food security but also service access and infrastructure as well as disease risk.

The survey reveals positive nutrition-relevant practices in the rural Dry Zone, such as: almost universal breastfeeding of children to two years of age; a range of good preventative and curative health practices; small family sizes and average age of first delivery after the adolescent period; and adequate meal frequency for older children and adults and some indicators of adequate food access.

However, there are, as expected, a wide range of likely causes of undernutrition which need addressing. Significant associations were found between indicators of children's nutrition status, highlighting the shared determinants of acute and chronic malnutrition and the need to tackle one to tackle the other. Significant associations were also found between the nutrition status of children and their mother's and between a child's birth weight and their later nutrition status, reminding us of the need to take a life cycle approach to improve and protect nutrition status in the short and longer term, particularly through focusing on the 1000 day window of opportunity. Particular attention needs to be paid to the nutrition status of pregnant and breastfeeding mothers in their own right, as well as for their children's sake. Dietary factors and their determinants seem particularly important drivers of undernutrition among children and mothers in this context.

Analysis of associations revealed only small contributions of any specific explanatory variable to the variance of any of the nutrition outcomes (and this includes indicators of food security and poverty), which together with analysis of risk factors reinforces that there is not just two or three important causes of undernutrition in the Dry Zone. Rather, this reminds us that a multi-sector approach is required for malnutrition prevention and nutrition status improvement, bolstering delivery of direct nutrition interventions whilst strengthening the likely nutrition impacts of other sectoral responses. Problems to focus on in the Dry Zone include:

Poor diets: poor breastfeeding and complementary feeding practices (late initiation at birth and non-exclusive breastfeeding to 6 months, and poor diet diversity and infrequent meals from 6 months of age) and poor quality of mothers' diets (particularly those who are pregnant and/or lactating)

Sickness and deficiencies in the public health environment, including poor water, sanitation and hygiene: inequitable access to health care and high rates of childhood illness (particularly fevers, coughs and diarrhoea, particularly among older children and in highland zone 2); inadequate care of sick children; low micronutrient supplementation coverage; use of unprotected water sources; poor hygiene practices and suboptimal access to latrines

Household food insecurity and income poverty: high levels of landlessness and low acreage of accessible land for those who do cultivate. A reliance on market purchase for food access in a context of low, undiversified, agriculture-based incomes, high debts and reliance on credit.

Indicative recommendations are suggested in this and in WFP's report.

PLEASE SEND QUESTIONS OR FEEDBACK TO VICKYSIBSON@HOTMAIL.COM

1. INTRODUCTION

1.1 LOCATION, DEMOGRAPHY AND CLIMATE

The Dry Zone in central Myanmar covers large parts of the Magway, Mandalay and lower Sagaing Divisions, including 58 townships (See figure 1). The area covers about 13 percent of the country's total area and has a population of roughly 14.5 million - close to a third of the country's population. Typical households contain five to seven people and the land is densely populated (JICA 2010). Members of the Chin ethnic group reside in the eastern borders of the Dry Zone whilst the majority of the Dry Zone are not from a minority ethnic group (Stimson 2014).

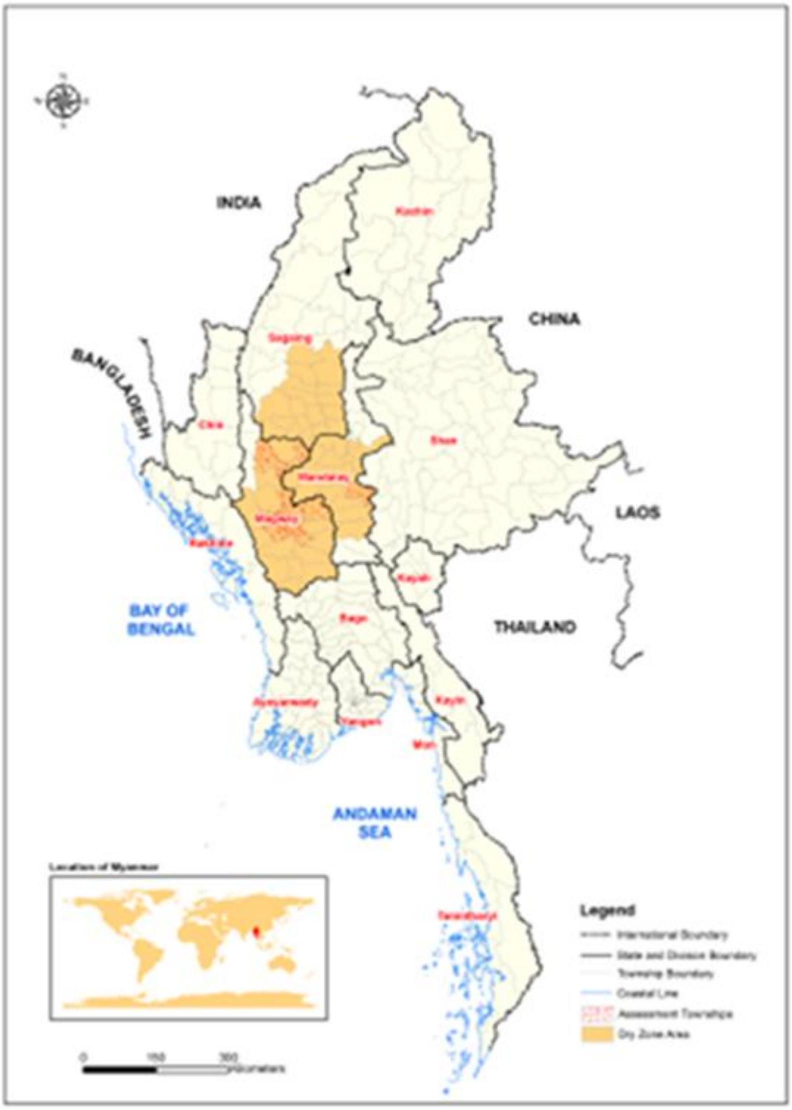

Figure 1: Map of the Dry Zone of Myanmar

Climatically, the area is prone to erratic rainfall and prolonged dry spells. Average annual rainfall is low with a wide range from 50cm to 1m compared to 5m in other parts of the country. The rainy season is mostly confined to the period mid-May to October followed by a dry cool spell from mid-October to mid-February and a hot dry season from mid-February to mid-May (JICA 2010).

The soils are clay and sand-rich and have a high risk of erosion by water and wind leading to land degradation. Agriculture is heavily dependent on the south-west monsoon but low annual precipitation with an irregular and unpredictable distribution over time and space causes both water shortages and localised flooding. This poses a regular threat to rural, agriculture dominated livelihoods, causing localised crop failures and losses. Consequently, the Dry Zone is one of the most food insecure areas in the country (JICA 2010).

1.2 UNDERNUTRITION CAUSAL FRAMEWORK ANALYSIS

Figure two illustrates the range of causes of undernutrition.

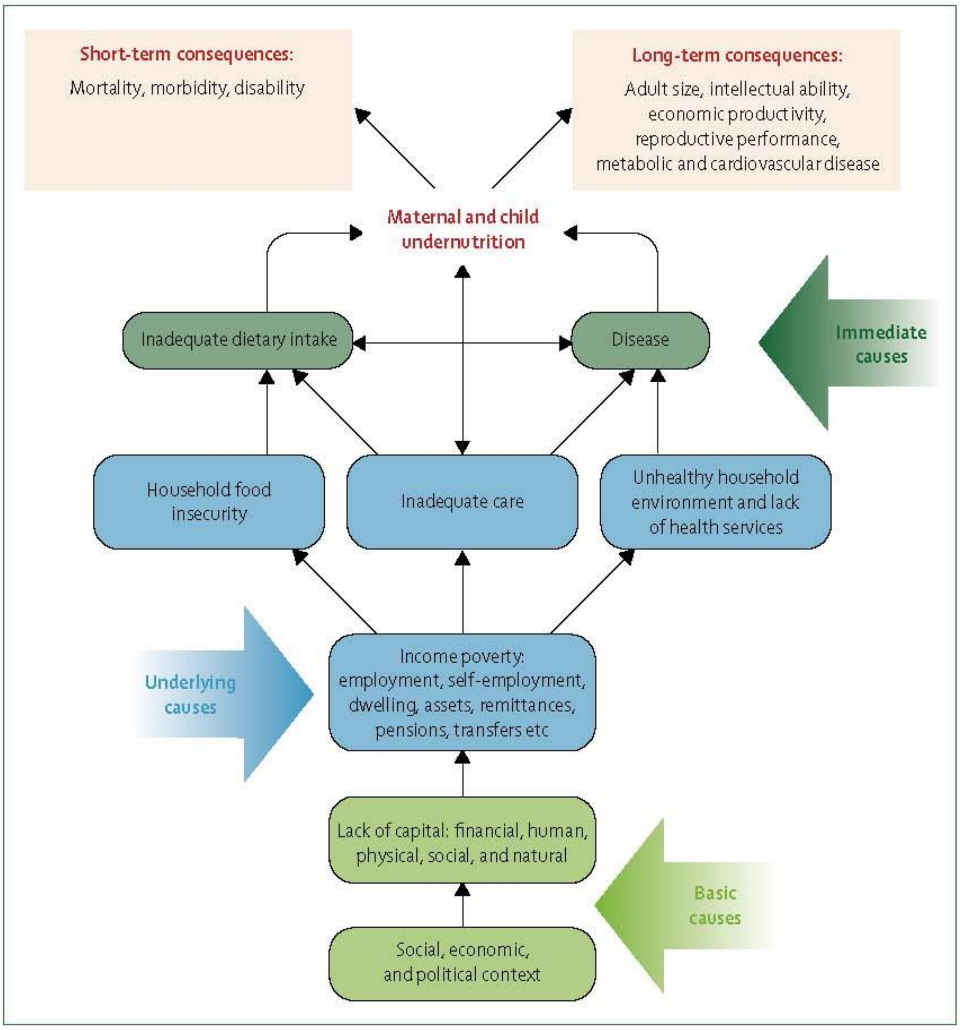

Figure 2: Framework of the relations between poverty, food insecurity, and other underlying and immediate causes to maternal and child undernutrition and its short-term and long-term consequences (Black et al 2008)

Health, nutrition and food security data are not available for the Dry Zone as a whole. Instead, in figure three, data from the three regions in which the Dry Zone falls are synthesised to create a pre-assessment picture of the likely situation and causes of undernutrition in the Dry Zone, supplemented by localised assessments (most of which have been done in Magway). A full narrative description is provided in annex 1.

Table one indicates the number and proportion of rural villages in the Dry Zone between the three agroecological zones defined for this survey (see section 3.1).

Table 1: Number and proportion of villages by agroecological zone in each region overlapping the Dry Zone

	Region			**Total rural villages in Dry Zone, between agroecological zones (n/%)**
	Magway	**Mandalay**	**Saigaing**	
Dry land farming zone (1)	1492 (45.9%)	2613 (66.7%)	1443 (45.4%)	5548 (53.6%)
Highland farming zone (2)	776 (23.9%)	1074 (27.4%)	1404 (44.2%)	3254 (31.4%)
Flood plains/irrigated zone (3)	983 (30.2%)	230 (5.9%)	332 (10.4%)	1545 (14.9%)
Total rural villages in Dry Zone, between regions (n/%)	3251 (100%)	3917 (100%)	3179 (100%)	10,347 (100%)

Table two provides the definitions of undernutrition used in this report.

Table 2: Definitions of undernutrition

Cause	Outcome	Indicator	
Children 0-59 months			
Acute malnutrition	Wasting / bilateral pitting oedema	"Global Acute Malnutrition"† Moderate Acute Malnutrition Severe Acute Malnutrition	WHZ<-2 and/or oedema WHZ<-2 and ≥-3 WHZ<-3 and/or oedema
Chronic malnutrition	Stunting	Stunting Moderate stunting Severe stunting	HAZ<-2 HAZ<-2 and ≥-3 HAZ<-3
Acute and/or chronic malnutrition	Underweight	Underweight Moderate underweight Severe underweight	WAZ<-2 WAZ<-2 and ≥-3 WAZ<-3
Children 6-59 months			
Acute malnutrition*	Low MUAC	Acute malnutrition† Moderate Acute Malnutrition Severe Acute Malnutrition	MUAC <125mm and/or oedema MUAC<125mm and ≥115mm MUAC<115mm and/or oedema
Non pregnant mothers >19 years of age			
Acute and/or chronic malnutrition	Underweight	Chronic Energy Deficiency Chronic Energy Deficiency grade 1 Chronic Energy Deficiency grade 2 Chronic Energy Deficiency grade 3	BMI < 18.5 kg/m^2 BMI 17.5 - 18.4 kg/m^2 BMI 16.0 – 17.4 kg/m^2 BMI < 16.0 kg/m^2
All mothers			
Acute malnutrition*	Low MUAC	Acute malnutrition	MUAC <21.0cm

†"GAM" should only be used to refer to population prevalence of wasting using the indicators WHZ<-2 and/or oedema, among children aged 0/6-59 months. MUAC is an alternative diagnostic tool for acute malnutrition which is currently valid only in children from 6-59 months of age, and is also commonly used for screening pregnant and lactating women**.**

* MUAC is used as an independent criteria for diagnosing severe acute malnutrition in children 6-59 months of age (WHO 2000) and typically for diagnosing acute malnutrition in pregnant and lactating women (e.g. the Sphere guidelines recommend an admission criteria between 21.0 and 23.0cm (Sphere 2011)). However the causes of low MUAC are likely to include more than acute malnutrition (SCUK/ENN 2012).

Figure 3: Pre-assessment causal framework: a summary of secondary data for Magway, Mandalay and Saigaing Divisions, overlapping the Dry Zone[1]

Undernutrition:
Child stunting *high†*: 31.5 - 38.6% <-2 Height for Age Z-score; Child wasting *poor‡:* 7.1 - 10.4% <-2 Weight for Height Z-score (1.7-3.2% severe, <-3 WHZ). No sex differential except for stunting (higher in boys); wasting higher in children 12 – 23 months (1); Low Birth Weight 7.1% - 9.9% (1)
Maternal undernutrition *high**: BMI < 18.5 kg/m^2: 33.6% (3)

Inadequate diet: (Infant and young child feeding):
Exclusive breastfeeding *poor/fair*** 7.9% (2), 28.9 - 34.9% (1); timely complementary feeding *good***: 84.6 - 85.7%, continued breastfeeding (to 20-23 months): 72.1 - 94.8%, adequate feeding (6-11 months) 53.6 – 69.4% (1); meal frequency: 73.8% (2); dietary diversity: 29.4% (2); minimum adequate diet: 23.6% (2)

Disease:
Cough/ARI, malaria, diarrhoea and dysentery most prevalent diseases (6)
Diarrhoea prevalence variable: 2.5-16.5% (1,2), ORS use: 30% (1)
Knowledge of at least 2 danger signs of pneumonia: 10% (1)

Household food insecurity:
Main crops: rice, pulses and legumes incl. oil seeds, some vegetables and fruit trees. Rainfed ag greater diversity in cropping patterns. Constraints to production incl: traditional farming practices, poor seed quality, limited inputs, erratic weather. 40-50% landlessness. Livestock: cattle, pigs, chickens, shoats. Limited seasonal variation in availability and cost of food (4). Rains April/June – August/October. Main rice harvest December. Main lean period Jan-Apr/May and Oct/Nov. 82% coverage of iodised salt (3). Purchase dominates food access (>50% of expenditure) (4) Widespread seasonal labour migration (January, May, November. December)

Inadequate care environment:
Women's decision making (child feeding and health seeking) and autonomy likely good (3). Likely that mother's spend little time away from young children (2)

Poor public health environment:
Health care:
Rural health centre access: 1 RHC : 1,680 population in Magway, 1:31,990 in Mandalay and 1:23,725 in Saigaing (6)
BCG coverage: 90%,
Measles vaccination coverage (below int. standard): 60% (2)
Antihelminth coverage: 18.5% of 12-23 month olds (2);
Vitamin A coverage: children 43.9% - 81.2%, postpartum mothers: 68.2-79.0% (1)
Skilled antenatal care coverage >80% (1); antenatal vitamin B1 and FeFol supplementation mostly >80% (1)
Water, sanitation and hygiene:
Poor hygiene practices despite adequate access: water source, treatment and distance variable: on the premises 5.6-41%, travel time otherwise 7-13 minutes one way, protected water use >80%, treatment 21.8-43.6% (1)
Access to improved sanitation: >80% (1)
Latrine disposal of child faeces & handwashing with soap:<40% (2)

Household poverty:
Food costs 43% of daily wage (3) total income strongly correlated with food spend (4), some payment in kind, widespread credit (4); unaffordable cost of healthy diet: 22% food expenditure, 35% total income (5) Widespread use of credit, loans, mortgaging land, pawning, receiving advance earnings. Diverse small scale income generation opportunities

1. MICS (2011) (data from Magway, Mandalay and Saigaing divisions)
2. Save the Children (2009) Report of a Nutrition Survey. Magway division, Magway, Minbu, Pakkoku and Pwint Phyu townships
3. WFP (2005) Nutrition survey in WFP project areas in Magway, Lashio, Kokang and Wa. April-June 2005.
4. Save the Children (2009) European Commission 2007 Food Security Programme for Burma/Myanmar Pre-Intervention Individual Household Economy Survey Results
5. Save the Children (2009) Cost of Diet Assessment and Analysis Report. Magway division: Magway, Minbu, Pakkoku and Pwint Phyu townships
6. Township health reports (2009)
† WHO 1995 Expert committee; ‡ WHO 2000 Expert committee; * WHO 1995 Expert committee
** WHO (2003). Infant and young child feeding: A tool for assessing national practices, policies and programmes

2. AIMS AND OBJECTIVES

AIMS

The survey was commissioned in order to address the limitations of the existing data which, for food security, is sparse or localised, and for health and nutrition is available only in administrative regions or at townships level. Estimates by agroecological zone are required to investigate associations between nutrition and food security indicators. Notwithstanding the limitations of cross sectional data (whereby cause and effect cannot be determined with certainty), the goal is to better understand the causes of undernutrition and to use this understanding to improve programme design and decision making.

OBJECTIVES

1. Estimate the prevalence of indicators of undernutrition in the three different agroecological zones of the Dry Zone and the Dry Zone as a whole,
2. Estimate infant and young child feeding practice rates,
3. Assess the differences in the nutrition situation by agroecological zone and the likely reasons, examining the associations between nutrition indicators and food security, livelihoods and other variables;
4. Make recommendations for programming, policy and advocacy

3. METHODS (see annex two for more detail on methods)

Table 3: Names and features of the three agroecological zones of the Dry Zone

Agroecological zone number	Agroecological zone name	Characteristics
1	Dry land farming	1. Low land, not flood prone, no irrigation 2. Suitable soil for cultivation 3. Only single or double cropping possibilities
2	High land with sloping agriculture	1. High land (greater than 300 meters) 2. Soil suitable for orchards, plantations, forest 3. Sloping/ shifting cultivation agriculture practiced
3	Flood plains and irrigated areas	1. Flood plain with good soil fertility 2. Irrigated land 3. Multi-cropping possibilities year round

3.1 STUDY DESIGN

A cross sectional, two stage, random cluster survey was carried out in rural wards of the three agroecological zones of the Dry Zone. Table three provides details of the agroecological zones determined by WFP through categorisation according to topography, land cover, land utilization and meteorological factors, using layers such as soil type, slope, elevation, rainfall, flood prone areas (using satellite data from MODIS[2]) and land cover data (also using satellite data from Landsat 7 ETM+[3]).

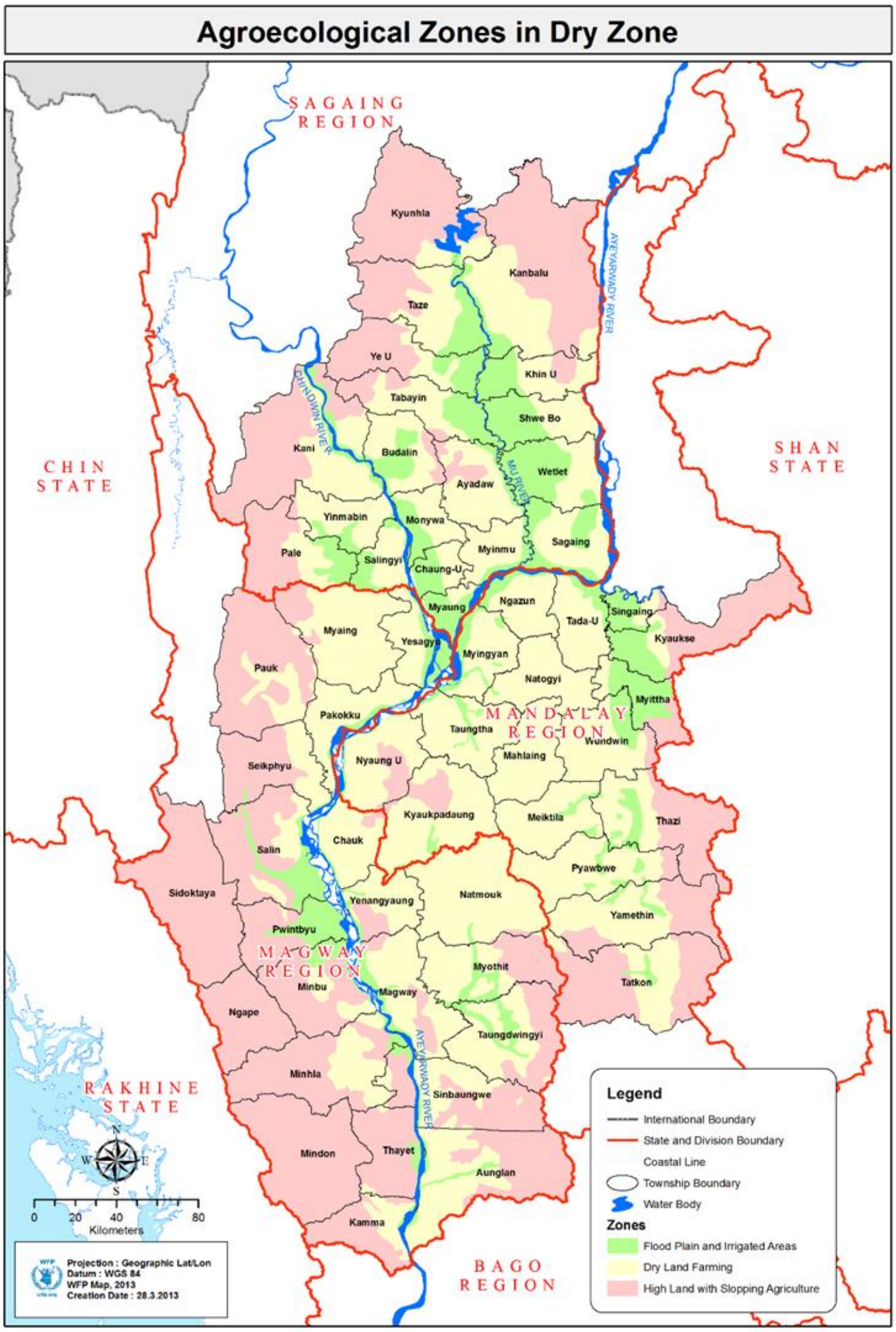

Figure 4: Map of the agroecological zones of the Dry Zone

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[2] http://modis.gsfc.nasa.gov/

[3] http://landsat.gsfc.nasa.gov/?page_id=2

3.2 SAMPLING

SAMPLING METHOD

The two-stage, random, cluster sample survey had three strata; the main sample frame was the Dry Zone within which there were three nested surveys of the agroecological zones.

In stage one 50 clusters were randomly selected from a list of all villages of rural wards in each agroecological zone, listed alphabetically by zone, township and English village name. No exclusions were made from the sample frame. In the absence of population data the sampling interval was calculated by dividing the total number of villages by 50. A random number between zero and the first sampling interval was drawn to determine the first cluster and the sampling interval was then systematically added to the cumulative population until 50 clusters were selected.

In stage two, 40 households were randomly selected within the selected village most often using simple random sampling from a complete village household list, but occasionally using systematic random sampling with or without prior segmentation if a list was not available or the village was very large.

Out of these 40 households there were two sample frames for household selection: 12 households with children under five years of age and 13 households with or without children under five.

All children between the ages of 0- 59 months in each selected household were included in the sample, including all those in the last household to avoid bias induced by the need to choose between children. If individuals were absent the team re-visited the house again at the end of the day before recording absence. If the 40 households did not contain a minimum of 12 households with 12 children under five, an additional random sample of households was selected using the same procedure as for the initial selection.

The food security/household survey was conducted in every third household (three, six, nine etc from the list of 40) regardless of whether there were any children under five.

SAMPLE SIZE

The sample size for estimation of nutrition indicators considered the need to estimate stunting, underweight and wasting prevalence but also IYCF indicators with a useful, but also feasible degree of precision. Using a prevalence of stunting of 39%, desired absolute precision of 5%, 90% power and a design effect of 1.5 (informed by the 2011 MICS), and allowing 10% refusal, yielded a need for 426 children under five years old per agroecological zone (total 1278). Using a prevalence of exclusive breastfeeding of 8%, precision of 5%, 90% power and a design effect of 1.5, and multiplying by four as a practical means of determining a sample size for other IYCF indicators in the 0-24 month age group, yielded a need for 480 children under two years old (total 1440). Examining the low likely percentage of households with under 5s (estimated at 8.8%) and lower under twos (estimated at 2.6%) it was decided to settle on a minimum sample of 12 children aged 0-59 months in each of the 150 village clusters, or 1,800 under-fives, including 522 under twos. The sample was powered to estimate stunting/underweight and wasting precisely in each agroecological zone but to estimate IYCF precisely only for the Dry Zone as a whole. A pragmatic approach was taken to setting the sample size for mothers, whereby these data were limited to mothers of sampled children. Indicators of food security, livelihoods and other household level variables needed to be collected at the household level from a representative sample of households with and without children under five years of age in each agroecological zone. Working with an arbitrary prevalence of 50%, 10% precision and a design effect of 5, a sample size of 340 households per agroecological zone was calculated (total 1020). To increase the number of sampled households likely to have children under five in order to enable examination of associations, the sample was raised to a minimum of 10 per cluster (total 1500). It was estimated that this would create a sample of about 560 households with food security data and children under five. See annex two for more detail on sample size calculations.

3.3 DATA COLLECTION AND MANAGEMENT

QUESTIONNAIRES

Following a thorough background information review and in light of the specified objectives of the assessment, six quantitative questionnaires were developed (see Annex 3), as follows.

Village profile: Recording the total number of households and total population of each sampled village, main crops produced and their yields, market, clinic and water source access and distance by season, and common diseases affecting children. This questionnaire was addressed to the village leaders and a mixed sex group of community representatives.

Household: Recording written consent from a household representative and household characteristics, including name and sex of the household head, the number (age and sex) of household members and whether (and how many) household members were currently away having migrated.

Mother: the mother's age and anthropometric measurements, birth history and antenatal care and 24 hour recall of food consumption.

Household Food Security, wealth/poverty and WASH: Recording indicators of household food security, wealth and poverty and including water and sanitation access.

Child under 5: Recording age, sex and anthropometric measurements for children under 5, recent sickness, supplementation and vaccination status and their mother's hygiene practices when caring for the child

Child under 2: Infant and young child feeding practices for children under 2 years of age

Household and Food Security questionnaires were undertaken in 13 households with or without children under 5, as outlined above. Household, mother and the two child questionnaires were undertaken in the first 12 households with children under 5 only, out of the 40 (or more) randomly sampled households. Questionnaires were field tested during training and amended as appropriate. Written informed consent was taken from a household representative on behalf of his/her family.

MEASUREMENTS AND EQUIPMENT

Height/length and weight data was collected for all surveyed children using standard techniques and height boards and regularly calibrated portable electronic or hanging scales. Scales were calibrated using sealed jerry cans of vegetable oil of a known weight. Weight was recorded to a precision of 0.1Kg using locally purchased digital bathroom scales or SECA hanging scales. Children were weighed naked or in lightweight underpants where naked measurement was unacceptable. Scales were tared before every measurement. Length for children <24 months and height for children ≥24 months, was measured to a precision of 1mm using locally made wooden height boards. MUAC bracelets were used to measure MUAC to a precision of 1mm on the left arm. The presence of bilateral pitting oedema was also observed by applying moderate pressure with the thumb on the dorsal surface of the child's two feet for three seconds and registering the presence of an enduring indentation following removal of the thumbs. Look up weight-for-height charts were used to assess and interpret a child's weight-for-height (according to WHO growth standards for girls and boys) in the home. Date of birth was estimated by asking the mother/carer and validating through comparison to any available certification and/or use of the Myanmar 100 day religious calendar.

The mother's weight was recorded to a precision of 0.1kg using the same locally purchased digital bathroom scales. Mother's standing height was measured to a precision of 1mm using a locally made wooden height board or commercially produced board. Mother's MUAC was also measured to a precision of 1mm on the left arm using an adult insertion tape.

The salt iodisation test was manufactured by MBIKITS and permitted estimation of the iodisation of salt against a threshold of 50 parts per million (http://www.mbikits.com/the-mbi-kit/)

FIELD LOGISTICS

Teams and training

Nine data collection teams comprising six staff members were hired as enumerators to conduct the survey, with an additional 10 enumerators from the Department of Rural Development supporting the teams to create a total of 64 staff. All staff were recruited for the survey and most did not have survey experience. All received two weeks of, including a practical anthropometry session, measurement practice on volunteer children under five years of age (for those individuals allocated as measurers and team leaders, who were trained and assessed using intra-observer and inter-observer technical error of measurement using ENA for SMART software (ENA/SMART 2009) and a pilot test in local villages not selected for fieldwork.

Implementation

The fieldwork was conducted between the 24th of June and the 18th of July. All teams were visited by the lead consultant. Three Save the Children employed nutritionists and five WFP VAM specialists provided additional supervision throughout the fieldwork so that 50% of the total fieldwork days had supervisor support.

DATA MANAGEMENT

Processing

Anthropometric indices were calculated in ENA for SMART (2011) before the data were exported to Excel and imported to STATA (12.0). The data were imported in to STATA (12.0) and files sequentially merged to form three databases: database one the child database (household, mother, food security and child data and the village profile matched for each child under five years of age sampled for the nutrition survey), database two the household database (household and food security data and the village profile matched for each household sampled for the food security survey) and database three, the village profile.

Weighting

The estimates were weighted at the cluster and strata level for child/mother/household level estimates and at the strata level for analysis of the village profile data. This ensured that the contribution of sample from the larger villages was given more weight in the aggregate estimate (whether at agroecological zone or Dry Zone level), and the sample from the smaller villages the opposite. It also ensured that the contribution of the smallest stratum (zone 3) was given the least weight in the aggregate estimate (at Dry Zone level), and the largest the most (zone 2).

ANALYSIS

The analysis was undertaken using the *'svy'* analysis module for clustered survey data in STATA (12.0).

The analysis followed a predefined analytical plan as follows:

Step 1: Calculation and descriptive weighted analysis of all pre-defined indicators, including: characteristics of the sampled villages and households with children under five years of age, and households sampled to be representative of the population as a whole, the nutrition and health status of children under five years of age, the infant and young child feeding practices of children under two years of age, the nutrition status and care of the mothers of the sampled children, and household food security, wealth and poverty and water and sanitation. All continuous variables were checked for normality and if found to be skewed, the median and range is presented alongside the untransformed mean. Where possible, variable was transformed to a different scale that will render it closer to a normal distribution (determined using the results of the gladder and ladder commands in STATA). Interpretation focused on assessing adequacy of each indicator against available norms/thresholds and secondary data where this was available.

Step 2: Systematic testing for indicator differences between agroecological zones using Chi-squared tests for prevalence rates and proportions and Wald-tests (for pairs of zones) for means. Where data were transformed, statistical tests for differences were performed on both, transformed and untransformed values. Where *p*-values differed these are presented for the transformed values (noting that non-parametric tests are not possible using the *svy* module of STATA). *P*-values of <0.05 are judged to provide good evidence, (marked *), <0.01 strong evidence (marked **) and <0.001 very strong evidence (marked ***) to reject the null hypothesis for each statistical test. This step was undertaken to try and understand differences between zones but is also used to understand potential causes of undernutrition, one of the aims of the survey.

Step 3: Multivariable analysis of associations was performed using linear and logistic regressions obtaining coefficients of determination and odds ratios[4], respectively. Explanatory variables were selected according to prior knowledge of plausible causal pathways, generally and locally, and an indicators framework was later refined on the basis of the results observed in step 2 (see figure 58). This step was intended to provide additional information to strengthen the causal analysis.

LIMITATIONS

The main limitation is the cross-sectional nature of a survey design which means that it is not possible to test and determine causality for observed and known causes associated with malnutrition. In addition, a survey design does not allow for adequate ranking by importance between all malnutrition-related factors. See annex two for additional limitations.

4. RESULTS (see annex four for additional results tables[5])

The results are presented as follows:

1. Characteristics of the villages visited, from the village profile data;
2. Characteristics of the sampled households with and without children (the sample frame for the food security/household data), which are representative of the zones, followed by the characteristics of the households with children under five;
3. Descriptive analysis (broadly organised along the lines of the undernutrition causal framework presented in figure two) of the nutrition and health data from children and from mothers, the infant and young child feeding data and mothers diet data then household food security, wealth/poverty and WASH data;
4. Lastly, analysis of associations according to step three of the analytical plan outlined above, intended to strengthen understanding of the plausible causes of undernutrition.

The bulk of interpretation is left to the discussion section in section 5.

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[4] The *svy* module in Stata does not calculate relative risks

[5] These are referred to in the text for ease of reference, labelled "table #A". Nb. error bars are not provided on the figures. Instead those readers requiring information about the statistical significance of differences between zone estimates should see the confidence limits provided in these tables.

Table 4: Maximum final sample sizes compared to planned sample sizes

	Dry land farming zone (1)	Highland farming zone (2)	Flood plains/ irrigated zone (3)	Dry Zone total	Planned sample size
Villages	51	50	51	**152**	**150**
Households (with children <5 years of age)	601	607	600	**1808**	**ND**
Households (with/without children <5 years of age)	617	574	612	**1803**	**1500**
Children <5 years of age	687	689	600	**2037***	**1800**
Children <2 years of age	290	289	243	**822****	**522**
Mothers of children <5 years of age	591	598	599	**1789**	**ND**

* 2036 children had anthropometric measurements taken

** 835 children were under two years of age but only 822 had IYCF data collected

4.1 CHARACTERISTICS OF SAMPLED VILLAGES

Table four shows that all 150 randomly selected villages were surveyed, as well as an additional two (because the selected village was too small to achieve the required sample size). This section reports the results of the 'village profile' questionnaire.

VILLAGE AGRICULTURE

Crops grown in the villages

'Main' crops: paddy, sesame, groundnuts, summer paddy, monsoon paddy, sultani, wheat, butter beans, chick peas, cotton, kantaw flowers, green gram, maize, mung beans, onion, peas, pigeon peas, sugar cane, tobacco and tomato.

'Second main' crops: groundnut, sesame, chick pea, pigeon pea, china plum, Lablab Pea, mung beans, Paddy (Summer), Red phaseolus, Wheat, beans, cauliflower, chilli, cotton , cow peas, ginger, green gram, long beans, maize, paddy, peas, red lentils, sunflower

'Third main' crops: pigeon pea, groundnut, green gram, chick pea, corn/maize, groundnut, banana, black gram, cauliflower, chilli, cotton, kentaw flowers, mung beans, onion, paddy, potato, sunflower, tobacco, tomato and wheat

Village representative reported that the main crop grown in villages in the Dry Zone was paddy followed by sesame and groundnuts. Figure five highlights that paddy dominates in zones 3 and 2 and sesame in zone 1. The second and third main crops were groundnut, sesame, chickpea, pigeon pea and green gram.

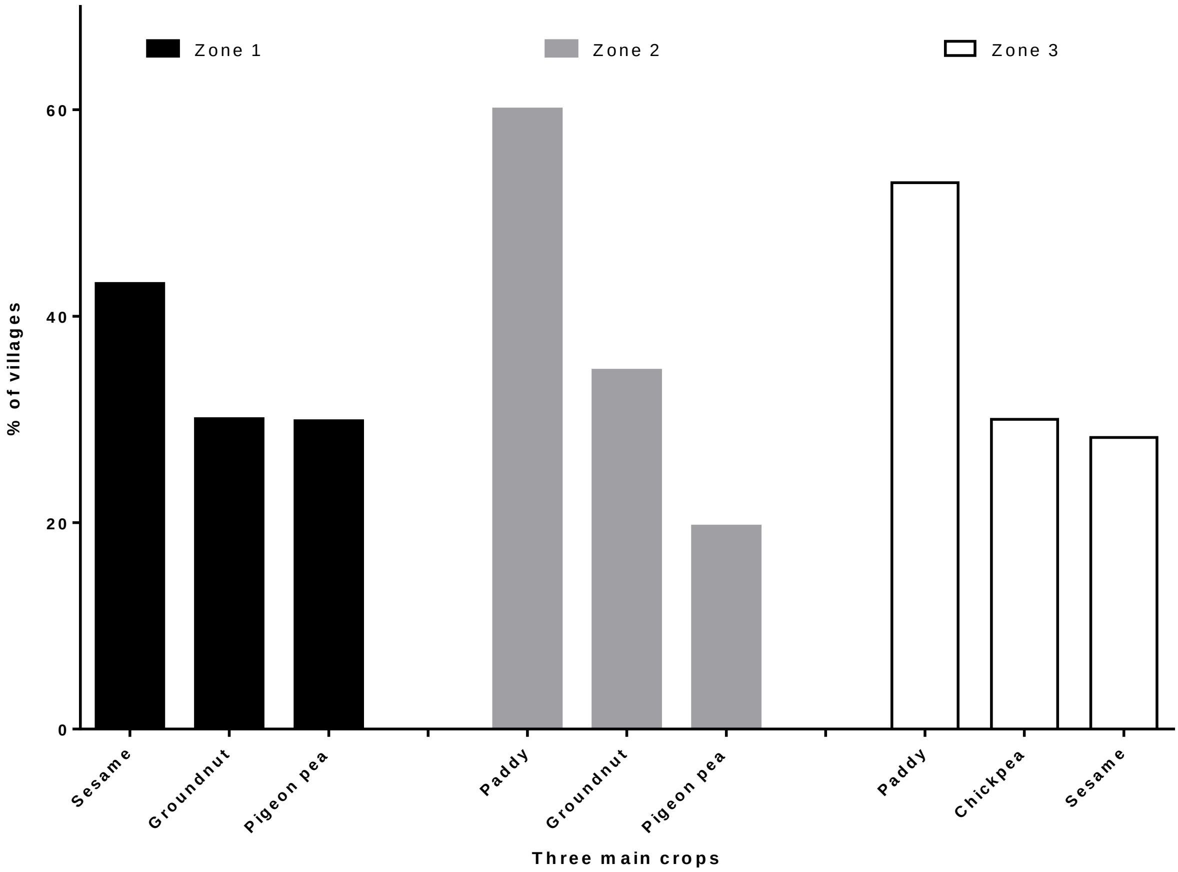

Figure 5: First, second and third main crops grown in the villages, by zone

VILLAGE LEVEL ACCESS TO AMENITIES

Market access

Village representatives in only four villages reported having a daily or periodic market (see table 1A). Figure six shows that the round trip travel times to the nearest market for those villages without markets were skewed to the shorter end of the spectrum, but ranges were wide. Travel took longest during the rains for the Dry Zone as a whole (median 1.75 hours, with a range from 10 minutes to 72 hours), but only because of a seasonal difference in zone 3. Median travel times in the winter and summer were the same in each zone. There was evidence (mostly strong, $p<0.01$) of a significant difference in travel time between zones, with times shortest and least variable in zone 3. The data suggests that market access is easiest in zone 3 and hardest in zone 2 year round.

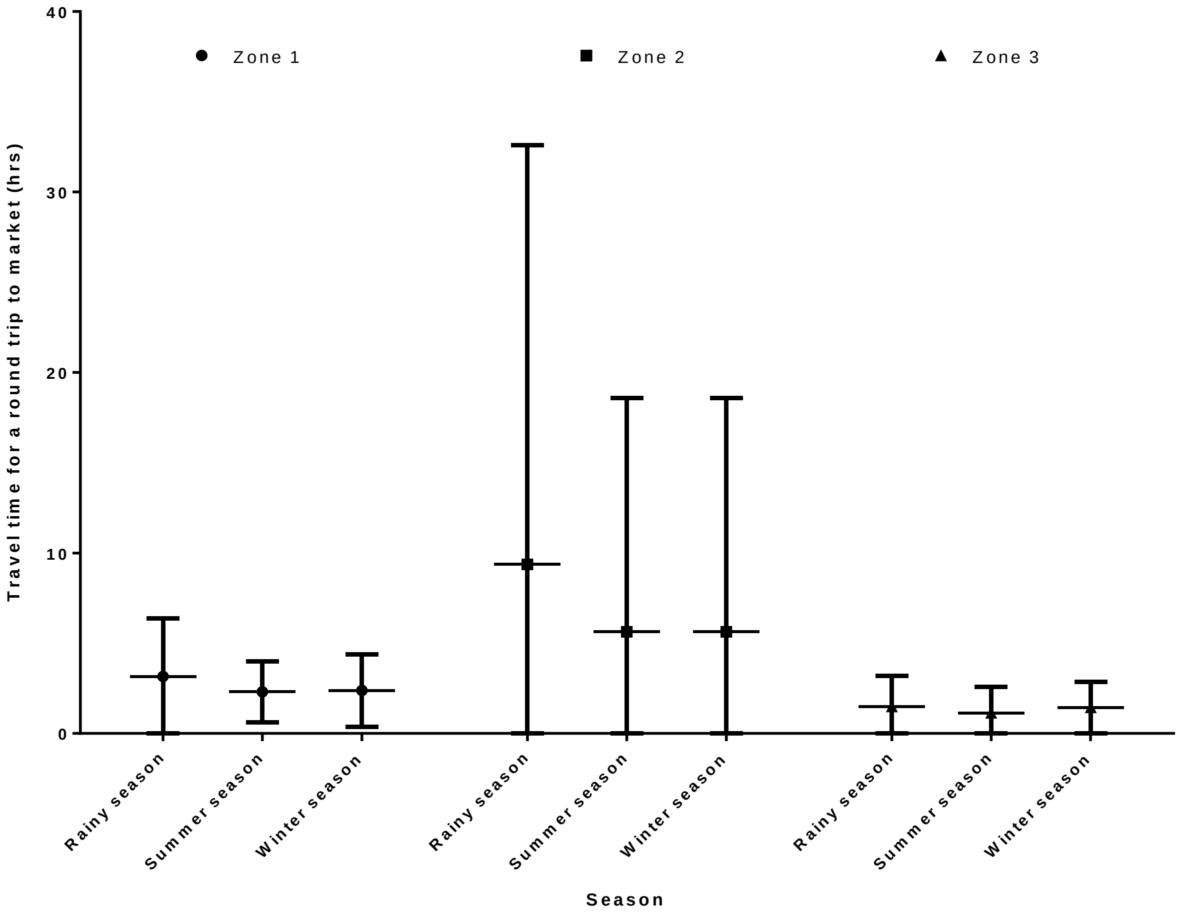

Figure 6: Median village level travel time (and range) for a round trip to the market in hours, by season, by zone

Health centre access

A quarter (24.0%) of villages had a health centre and there was no evidence of significant difference between the zones. As for market access, table five shows that the distribution of average round trip travel times was skewed. For those villages without a health centre, median round trip travel times to the nearest health centre were between 40 minutes and one hour. This was longest in the rains and there was strong evidence ($p<0.01$) of a significantly longer journey in zone 2 with a wide range (medians one and a half to two hours across the seasons, maximum 24 hour journey time in the rains) and shorter in zone 3 (median half an hour year round, maximum 9 hours). Because there is no evidence of a significant difference in the proportion of villages with a clinic, by zone, this data suggests that health centre access is easiest in zone 3 and most challenging in zone 2.

Table 5: Village level health centre access, by season, by zone

	Dry land farming zone (1)	Highland farming zone (2)	Flood plains/irrigated zone (3)	Dry zone total
% villages with health centre *(95% CI, n)*	25.5 (13.2, 37.8) (n=51)	32.0 (18.8, 45.2) (n=50)	17.7 (7.0, 28.4) (n=51)	24.0 (16.4, 31.6) (n=152)
Round trip travel time to health centre/hrs by season, for villages without a health centre				
	(n=38)	(n=34)	(n=42)	(n=114)
Rainy season:				
Median *(range)*	0.7 (0.2 – 10)	2 (0.3 – 24)	0.5 (0.1 – 9)	**1** **(0.1- 24)**
Mean (sd) *(95% CI)*	1.5 (1.5) (0.9, 2.1) **** 1 and 2* *p<0.001†*	3.9 (7.5) (2.2, 5.6) **** 2 and 3* *p<0.001†*	1.4 (2.0) (0.8, 2.0)	**1.8 (2.7)** **(1.3, 2.2)**
Summer season:				
Median *(range)*	0.7 (0.2 – 6)	1.5 (0.3 – 12)	0.5 (0.1 – 9)	**0.7** **(0.1 – 12)**
Mean (sd) *(95% CI)*	1.3 (1.0) (0.8, 1.7) *** 1 and 2* *p=0.003†*	2.7 (4.57 (1.68, 3.8) **** 2 and 3* *p<0.001†*	1.2 (1.9) (0.7, 1.8)	**1.5 (1.9)** **(1.1, 1.8)**
Winter season:				
Median *(range)*	0.7 (0.2 – 6)	1.5 (0.3 – 12)	0.5 (0.1 – 9)	**0.67** **(0.1 – 12)**
Mean (sd) *(95% CI)*	1.3 (1.0) (0.8, 1.7) *** 1 and 2* *p=0.005†*	2.6 (4.5) (1.6, 3.7) *** 2 and 3* *p=0.001†*	1.2 (1.9) (0.7, 1.8)	**1.4 (1.8)** **(1.1, 1.8)**

† comparing log transformed means

Water access

The median proportion of households in the Dry Zone with access to drinking water on the premises was 12.5% with a range from none to all (see table 2A). By zone the highest median was in zone 3 (and the difference in means was significant at $p<0.001$). Figure seven shows that the majority of villagers main water source in all seasons was a tube well/bore hole, followed by hand dug wells, followed by ponds; all considered protected sources in this context. In all seasons the median round trip travel time was only 10 minutes, with a range from zero to one hour, and across the zones and seasons there was strong evidence that travel time was shortest in zone 3 ($p<0.01$). The data suggest good access to potable drinking water across the Dry Zone, little seasonal variation and that access to drinking water is consistently easiest in zone 3.

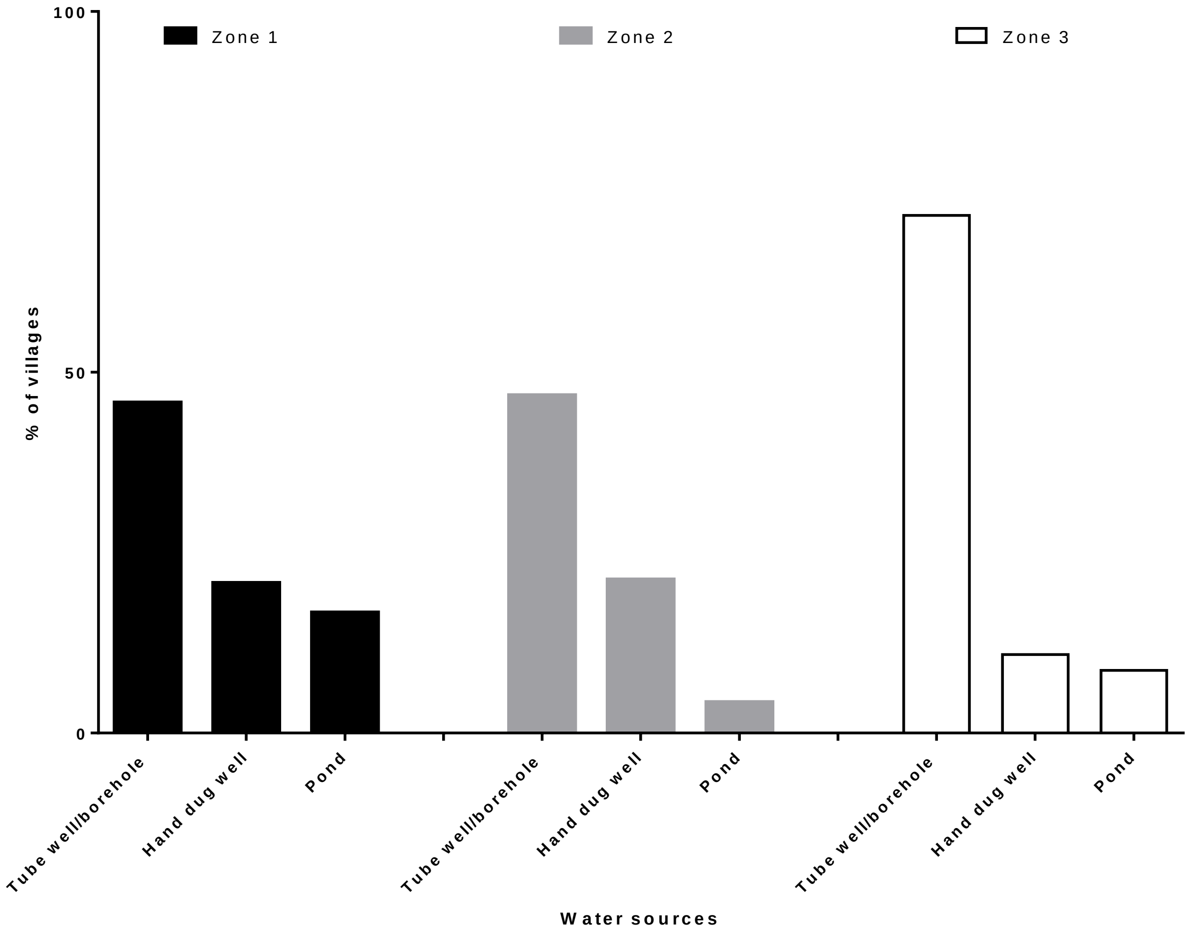

Figure 7: Village level three main water sources, by zone

Childhood illness

Figure eight compares perceived prevalence of childhood illnesses by village representatives. In all three agroecological zones, fever was the single most common illness affecting children under five years old during both rainy and summer seasons, followed by diarrhoea and cough (see also table 3A). Diarrhoea and cough were more often mentioned in the rainy season and in the winter cough was the most common illness. There were many other important sicknesses reported by season, including flu and malaria in the rainy and winter seasons and eye infections in the summer months.

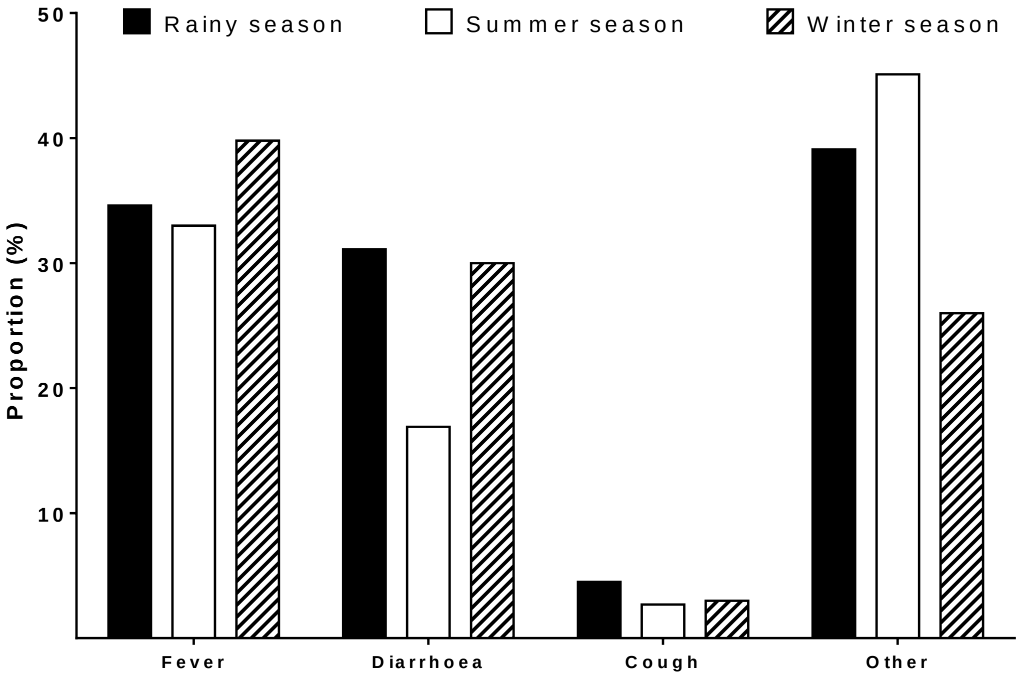

Figure 8: Most common childhood illness in the villages, by season, in the Dry Zone

4.2 DEMOGRAPHIC CHARACTERISTICS OF SAMPLED HOUSEHOLDS WITH OR WITHOUT CHILDREN

Table four shows that 1803 households with or without children under five years old were sampled to gain a sample representative of all households in the Dry Zone (and by agroecological zone), for analysis of food security and livelihoods and other household level determinants of undernutrition. The majority of households were male headed (79.0%, see table 4A) and figure nine illustrates that this did not vary significantly by zone. The most common reason given for a female headed household was that the woman’s husband had died (81.7%) (see table 6).

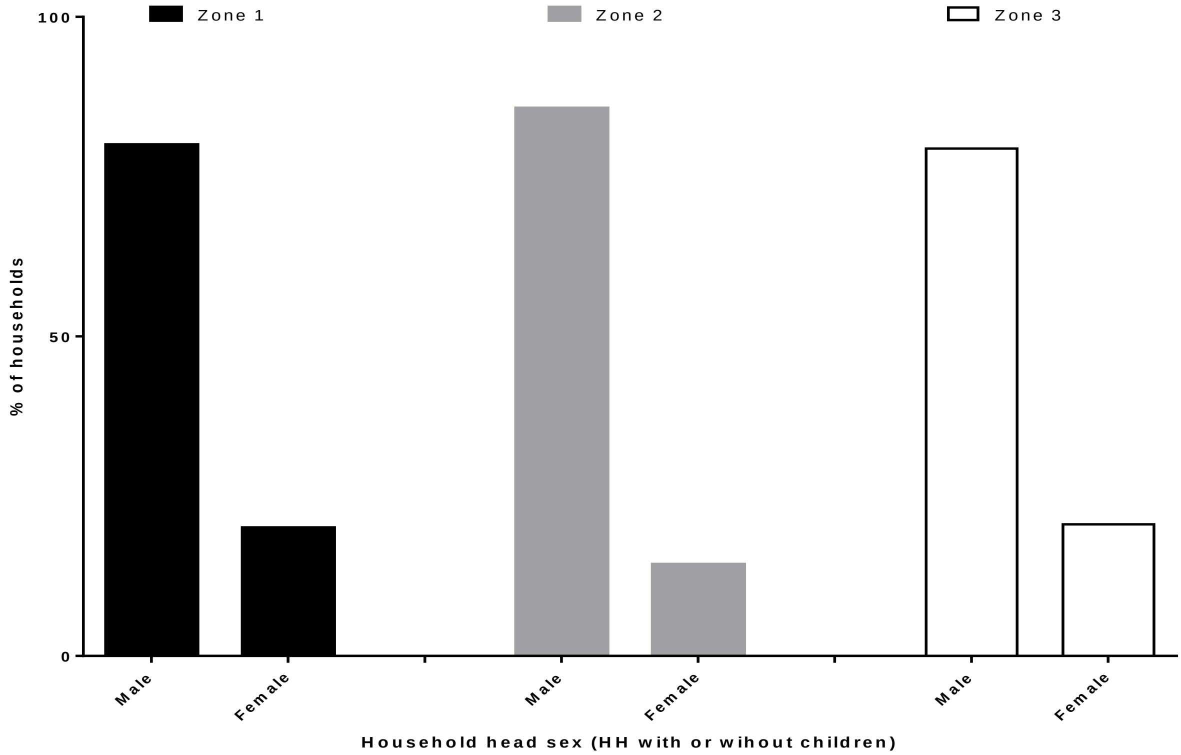

Figure 9: Sex of the head of the household (households with and without children under five years old), by zone

Table 6: Reasons for female head of household (households with and without children under five years old), by zone

	Dry land farming zone (1) (n=122)	**Highland farming zone (2) (n=82)**	**Flood plains/irrigated zone (3) (n=126)**	**Dry Zone total (n=130)**
% Husband died *(95% CI)*	79.9 (67.2, 92.6)	77.9 (64.2, 91.6)	86.4 (79.1, 93.8)	**81.7 (73.8, 89.6)**
% Husband migrated *(95% CI)*	3.6 (0.1, 7.0)	7.2 (0, 17.6)	1.9 (0, 4.5)	**3.4 (1.0, 5.8)**
% Never married *(95% CI)*	9.9 (2.6, 17.2)	7.2 (0, 16.6)	8.9 (3.1, 14.8)	**9.4 (4.6, 14.2)**
% Divorced *(95% CI)*	6.7 (8.2, 12.5)	6.8 (1.3, 12.4)	2.8 (0, 5.8)	**5.5 (1.9, 9.1)**
% Other *(95% CI)*	0 -	0.8 (0, 2.5)	0 -	**0.1 (0, 0.2)**

Table seven shows that the mean household size at the Dry Zone level was small at 4.5 individuals (sd 2.0) (median 4, range 1-14), and there was no significant difference in household size by agroecological zone. Within the households the mean proportion of under-fives was 6.8% and this was significantly higher in zone 2 ($p<0.01$). A dependency ratio was calculated using the household inventory, whereby the total number of dependents in the household (those below 15 years of age and those above 64 years of age) was divided by the number of adults aged 15-64 years old. The mean ratio was 0.3 (sd 0.2); i.e. there is on average three dependents for every productive adult. Despite a similarity in dependency ratios across zones, the pattern of migration showed marked differences. Overall 31.2% of the households reported absent migrants and there was good evidence (p=0.027) that the rate was significantly highest in zone 1 (34.9%). The mean number of migrants was 1.7 (sd 0.67) and there was also good evidence that this was more in zone 1 *(p*=0.027), although the median was 1 across the zones.

Table 7: Mean household size, dependency ratio and migration (households with and without children under five years old), by zone

	Dry land farming zone (1) (n=614)	**Highland farming zone (2) (n=573)**	**Flood plains/irrigated zone (3) (n=612)**	**Dry Zone total (n=1799)**
Household size:				
Median	4	4	4	**4**
(range)	(1 – 12)	(1 – 13)	(1 -14)	**(1 – 14)**
Mean (sd)	4.5 (1.6)	4.6 (2.8)	4.6 (2.2)	**4.5 (2.0)**
(95% CI)	(4.3, 4.7)	(4.4, 4.9)	(4.4, 4.8)	**(4.4, 4.7)**
Mean dependency ratio *(sd)*	0.4 (0.2)	0.3 (0.4)	0.3 (0.3)	**0.3 (0.2)**
(95% CI)	(0.3, 0.4)	(0.3, 0.4)	(0.3, 0.3)	**(0.3, 0.3)**
% under 5s:				
Median	0	0	0	**0**
(range)	(0 – 5.0)	(0 – 6.7)	(0 – 6.7)	**(0 – 6.7)**
Mean (sd)	6.2 (8.7)	9.6 (20.2)	6.7 (11.6)	**6.8 (11.4)**
(95% CI)	(5.0, 7.5)	(7.9, 11.2)	(5.8, 7.6)	**(6.0, 7.7)**
	**** 1 and 2 p<0.001‡*	***2 and 3 p=0.002‡*		
% households with migrants	34.9	25.4	27.0	**31.2**
(95% CI)	(27.6, 42.2)	(20.9, 29.9)	(22.1, 32.0)	**(26.5, 35.9)**
	**1 and 2 p=0.027*			
No. migrants:	1	1	1	**1**
Median (range)	(1 – 5)	(1 – 5)	(1 – 7)	**(1-7)**
Mean (sd)	1.7 (0.6)	1.5 (1.3)	1.5 (0.8)	**1.6 (0.8)**
(95% CI)	(1.5, 1.8)	(1.3, 1.7)	(1.4, 1.6)	**(1.5, 1.7)**
	**1 and 3 p=0.027*			

‡ comparing square root transformed means
† comparing log transformed means

4.3 DEMOGRAPHIC CHARACTERISTICS OF SAMPLED HOUSEHOLDS WITH CHILDREN UNDER FIVE YEARS OLD

Table four shows that the 2037 sampled children lived in 1808 households equally divided between the three agroecological zones. In 15 of the 1808 households the household questionnaire was not completed so there is no demographic data for these households. As figure 10 shows, most of the households with children under five were male headed (89.7%) and this did not vary significantly by zone (see table 5A). As for all households (with or without children), the most common reason given for female heading was that the woman's husband had died (79.0%) (see table 8).

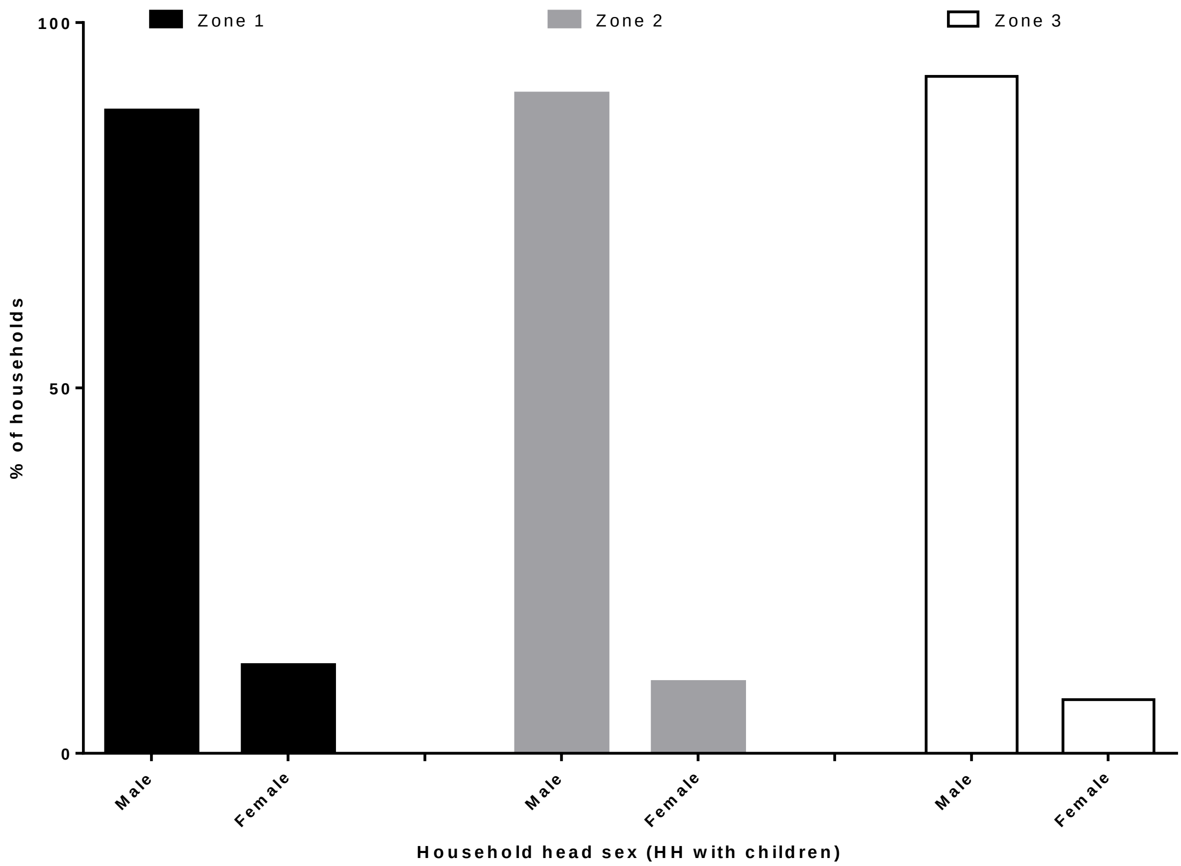

Figure 10: Sex of the head of the household (households with children under five years old), by zone

Table 8: Reasons for female head of household (households with children under five years old), by zone

	Dry land farming zone (1) (n=70)	Highland farming zone (2) (n=53)	Flood plains/irrigated zone (3) (n=55)	Dry Zone Total (n=178)
% Husband died *(95% CI)*	79.3 (68.9, 89.7)	75.6 (57.4, 93.8)	80.0 (67.2, 92.9)	**79.0 (71.3, 86.6)**
% Husband migrated *(95% CI)*	14.6 (5.8, 23.4)	19.8 (3.3, 36.3)	9.9 (0, 20.2)	**14.2 (7.7 – 20.6)**
% Never married *(95% CI)*	2.9 (0, 6.6)	0 -	10.1 (0.6, 19.6)	**4.1 (0.9, 7.4)**
% Divorced *(95% CI)*	3.3 (0, 6.9)	3.5 (0, 9.9)	0 -	**2.6 (0.2, 5.0)**
% Other *(95% CI)*	0 -	1.1 (0, 3.2)	0 -	**0.1 (0, 3.2)**

As table nine shows, the mean household size of the surveyed children at the Dry Zone level was a bit larger than for all households at 5.3 individuals (sd 1.9) (median 5, range 2-16), but there remained no evidence of significant difference between zones. Within the households the mean proportion of under-fives was 23.2% and as for all households there was good evidence (p=0.011) that this was highest in zone 2. Mean dependency ratio was a little higher for these households with children than all households: 0.4 (sd 0.2), and this was also the same across the zones. As for all households the pattern of migration showed the same marked differences. A third (30.0%) of the households of the surveyed children reported absent migrants and there was strong evidence *(*p<0.01) that the rate was significantly higher in zone 1 (36.3%). The mean number of migrants was 1.7 (sd 0.7) and there was strong evidence that this was highest in zone 1 (1.8, sd 0.8) (p=0.003), although the median remained at 1.

Table 9: Mean household size, dependency ratio and migration (households with children under five years old)

	Dry land farming zone (1) (n=596)	**Highland farming zone (2) (n=598)**	**Flood plains/irrigated zone (3) (n=598)**	**Dry Zone total (n=1792)**
Household size:				
Median	5	5	5	**5**
(range)	(2 - 12)	(2 - 16)	(2 – 14)	**(2 – 16)**
Mean (sd)	5.3 (1.4)	5.1 (2.9)	5.5 (2.1)	**5.3 (1.9)**
(95% CI)	(5.1, 5.6)	(4.8, 5.4)	(5.2, 5.7)	**(5.2, 5.5)**
Mean dependency ratio *(sd)*	0.4 (0.1)	0.4 (0.2)	0.4 (0.2)	**0.4 (0.2)**
(95% CI)	(0.4, 0.5)	(0.4, 0.5)	(0.4, 0.5)	**(0.4, 0.5)**
Proportion of under 5s:				
Median	25.0	25.0	20.0	**20.0**
(range)	(8.3 – 66.7)	(7.7 – 66.7)	(8.3 – 66.7)	**(7.7 - 66.7)**
Mean (sd)	23.3 (6.8)	24.5 (14.6)	22.3 (8.7)	**23.2 (8.8)**
(95% CI)	(22.2, 24.5)	(23.2, 25.9) **2 and 3 p=0.011*	(21.3, 23.4)	**(22.5, 23.9)**
% households with migrants	36.3	24.1	21.2	**30.0**
(95% CI)	(29.4, 43.3) ***1 and 2 p=0.0076* ****1 and 3 p<0.001*	(18.4, 29.7)	(16.0, 26.5)	**(25.2, 34.8)**
No. migrants:				
Median	1	1	1	1
(range)	(1 - 6)	(1 - 5)	(1 – 7)	(1 – 7)
Mean (sd)	1.7 (0.8)	1.4 (1.2)	1.5 (0.9)	1.7 (0.9)
(95% CI)	(1.6, 2.0) *** 1 and 2 p=0.003‡*	(1.2, 1.5)	(1.4, 1.7)	(1.5, 1.8)

‡comparing square root means

4.4 DEMOGRAPHIC CHARACTERSTICS OF SAMPLED CHILDREN

As shown in table four, 2037 children under five were surveyed, of which 822 under two year olds (out of 835) also had data collected on IYCF practices (see below). The 2037 children lived in 1808 households, the characteristics of this sample are described in section 4.3. The majority (1587) were the only children under five in their household; there were 221 pairs of siblings under five, six cases in which three children under five were captured in a single household and one household with five under-fives and another with six.

Table 10 shows the age/sex distribution of the sampled children. Among the 2037, 51.6% were male and 48.4% female, a ratio of 1.07 boys to girls, and this did not differ by agroecological zone (zone 1: 51.8% boys and 48.2% girls, zone 2: 49.0% boys and 51.1% girls and zone 3: 52.5% boys and 47.5% girls) indicating unbiased sampling. The distribution of the sample did not differ significantly by age or sex.

Table 10: Age and sex distribution of surveyed children 0-59 months old (Dry Zone), by age centred year groups

Age/months	**Boys (No.) / % age group**	**Girls (No.) / % age group**	**Total (No.) / ratio / % sample**
0 – 5.99	(96) 46.6	(110) 53.4	**(206) / 0.87 / 10.1**
6.00 – 17.99	(235) 53.4	(205) 46.6	**(440) / 1.15 /21.6**
18.00 – 29.99	(208) 49.1	(216) 50.9	**(424) / 0.96 /20.8**
30.00 – 41.99	(220) 54.3	(185) 45.7	**(405) / 1.19 / 19.9**
42.00 – 53.99	(209) 49.8	(211) 50.2	**(420) / 0.99 / 20.6**
54.00 – 59.99	(71) 50.0	(71) 50.0	**(142) / 1.00 / 7.0**
Total (n/%/95% CI)	**n=1051, 51.6 (48.3, 54.9)**	**n=986, 48.4 (45.1, 51.7)**	**n=2037 / 1.07 / 100**

4.5 CHILD NUTRITION AND HEALTH

ANTHROPOMETRY

Anthropometric measurements were taken for 2036 children under five years of age (enumerators did not measure one young baby), among whom there were six flagged anthropometric indices, all for having a Height for Age z-score of great than six. As is convention for large scale surveys (including the Myanmar MICS, a key reference for this survey), flagged values are excluded from the analysis[6].

Indicators of acute malnutrition

Weight for height

Mean WHZ among all children was -0.93 (sd 0.96) and this did not differ significantly between children by agroecological zones, or by sex (see Table 6A and figure 13 for the sample WHZ distribution). The overall prevalence of wasting defined as WHZ<-2 ('Global Acute Malnutrition'[7]) was "high" (WHO 2000) at 12.3% but the prevalence of severe wasting defined as WHZ<-3 was low at 0.5%. As figure 11 illustrates, the GAM rate did vary noticeably by

[6] The anthropometric indices of a total of 43 children were flagged in ENA for SMART where thresholds are <-3 or >3 of the sample mean: 2.2% Height for Age values, 0.3% Weight for Age values and 0.2% Weight for Height values. There were 41 flags for HAZ <-3 of the mean of the sample due to likely incorrect age or height, six flags for WAZ <-3 of the mean of the sample likely for the incorrect age, and four flags for WHZ <-3 of the mean of the sample for likely having an incorrect weight. These data are included in the analysis to avoid biasing the results.

[7] No children were found to have bilateral pitting oedema

agroecological zone from 9.5% ('poor') to 13.9% ('high'); lower in flood plains/irrigated zone 3 than low/dry land zone 1 (*p*=0.024) (see table 7A). There was no significant difference by sex.

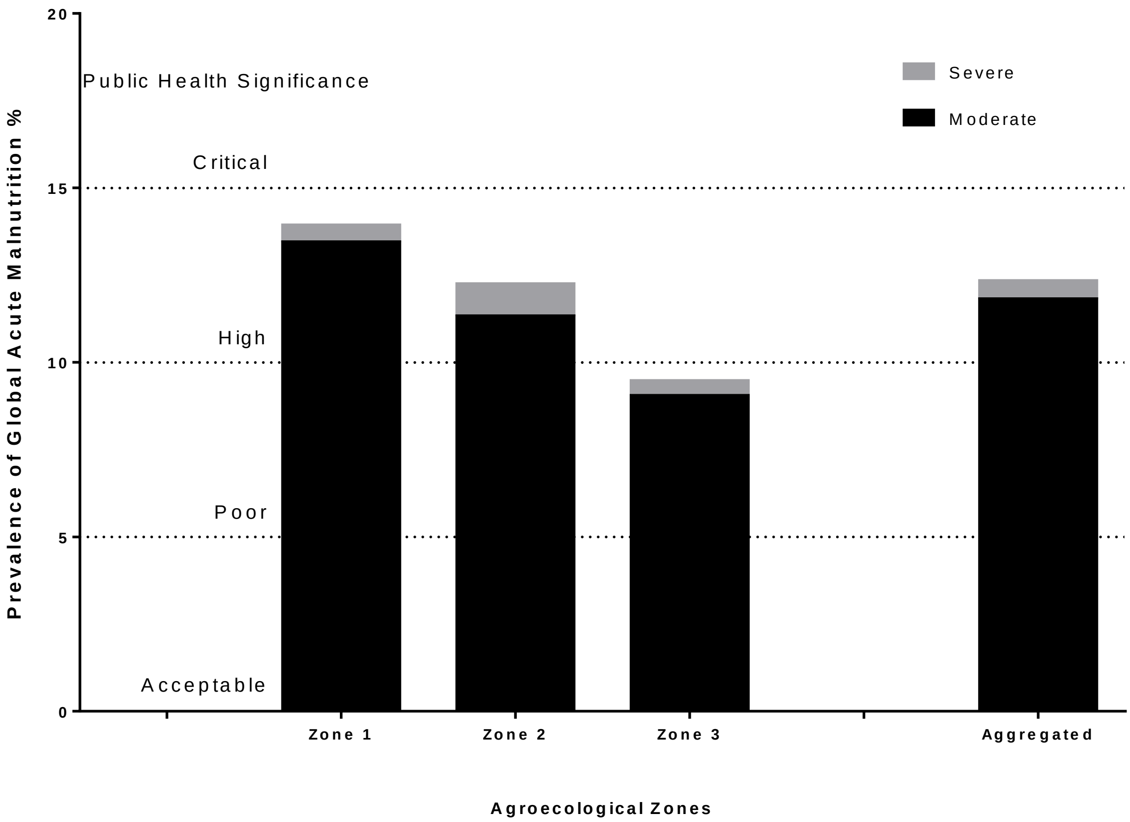

Figure 11: Global Acute Malnutrition prevalence (children 0-59 months)

The GAM rate was slightly higher among the 6-59 month age group than in the whole sample, as might be expected given the protective effect of breastfeeding; GAM 13.0% and SAM 0.6% (see table 9A).

There was no evidence of a difference in wasting prevalence by age group in the Dry Zone as a whole (see table 10A) but the situation in the different zones varied (see figure 12). There was good evidence (*p*=0.040) of a significant difference in prevalence of wasting by age groups in zone 2 with the highest rates among the 54–59 month olds (21.8%) and 42-53 months olds (20.1%). It is more typical to observe the highest wasting rates in the younger age groups when children are being weaned and exposed to pathogen contaminated complementary foods of poor nutritional quality. However this pattern reflects to some extent the trends in sickness which are also affecting older children, at least in zones 1 and 2, see figure 20 below, with high and rising rates in the 6-29 month period perhaps accounted for by poor quality complementary diets.

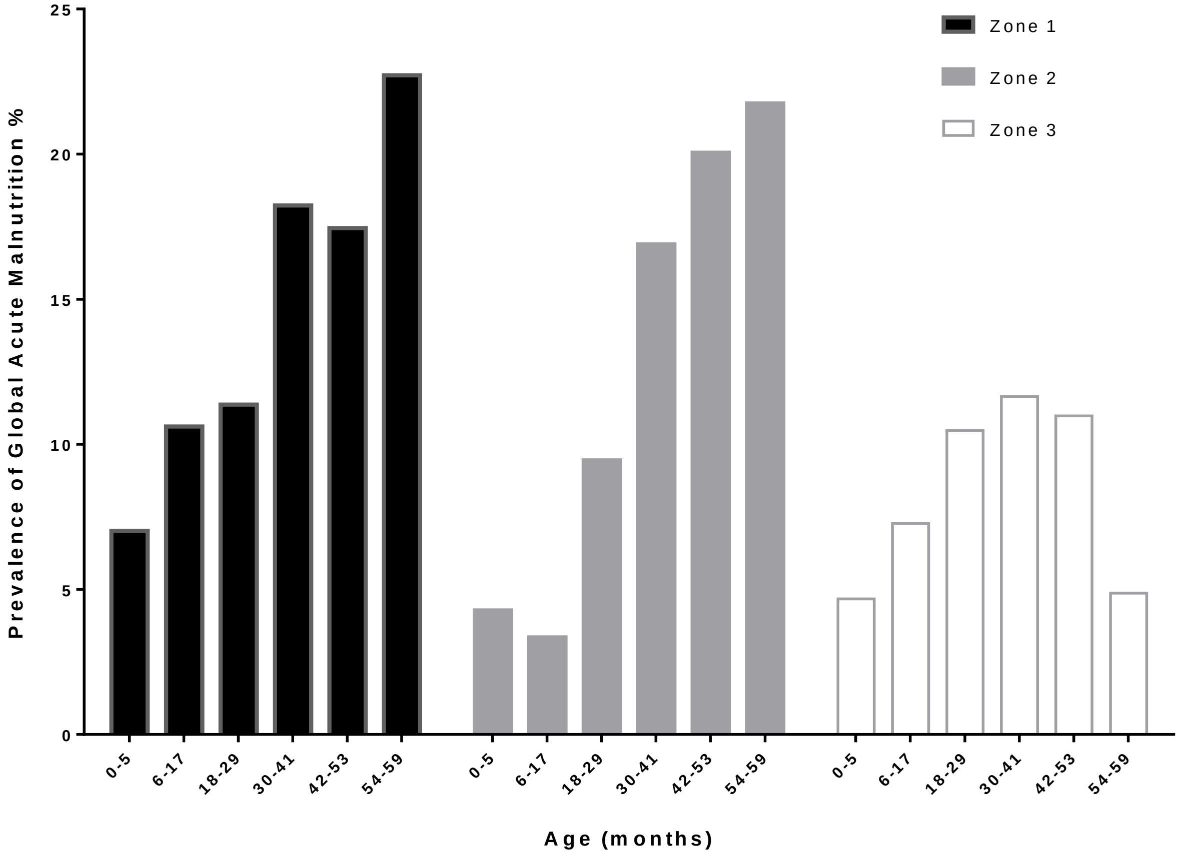

Figure 12: Prevalence of Global Acute Malnutrition by age group, by zone

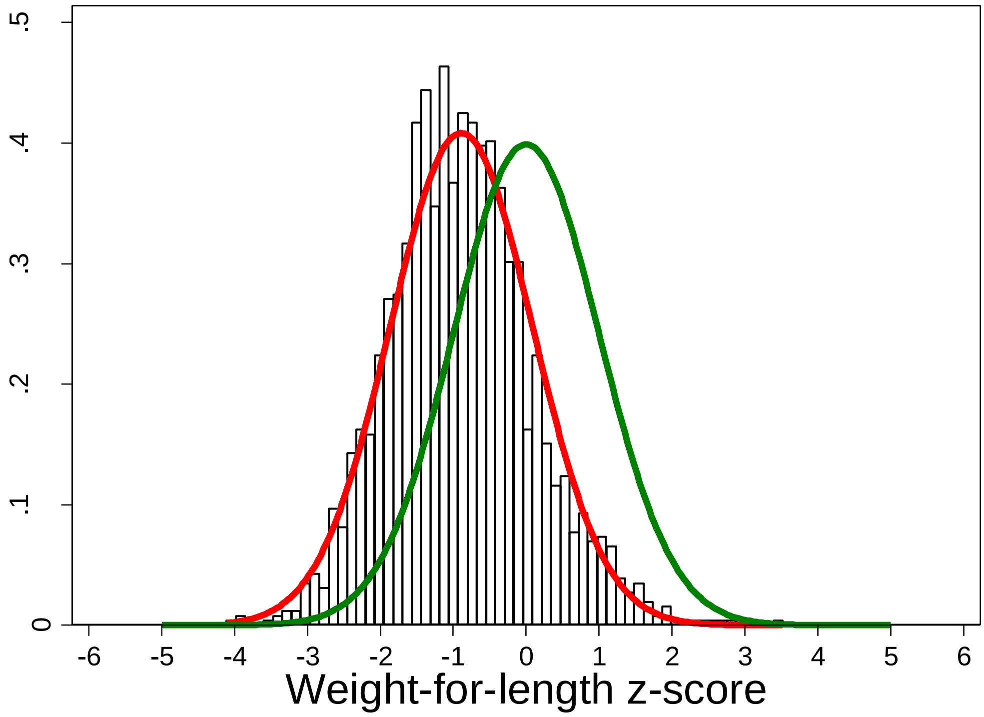

Figure 13: Dry Zone sample WHZ distribution curve (red) compared to the reference population (green)

Mid-upper arm circumference[8]

Mean MUAC in this age group was 144.0cm (sd 10.2), and, dissimilarly to WHZ, there was a significant difference by agroecological zone, with the mean MUAC lowest in zone 1 (see table 8A). Figure 14 shows that among the same age group the prevalence of acute malnutrition as classified by MUAC was only 3.1% (<125mm) with no evidence of differences between agroecological zones (see table 11A). There was weak evidence of a significant difference by sex, with the rate of MUAC <125mm in girls twice that of boys. Rates of SAM defined as MUAC <115mm were almost negligible; the Dry Zone rate was 0.2%. Overlap with the WHZ case definition was poor (p<0.001) (see table 12A). This discrepancy is typical and can be explained by how these indicators are formed; WHZ is relatively independent of age and is a statistical construct (a z-score is a standard deviation unit; -2 is used to define acute malnutrition and -3 severe acute malnutrition) whereas MUAC is an absolute value and uses a single cut off across the age group 6-59 months (see table two).

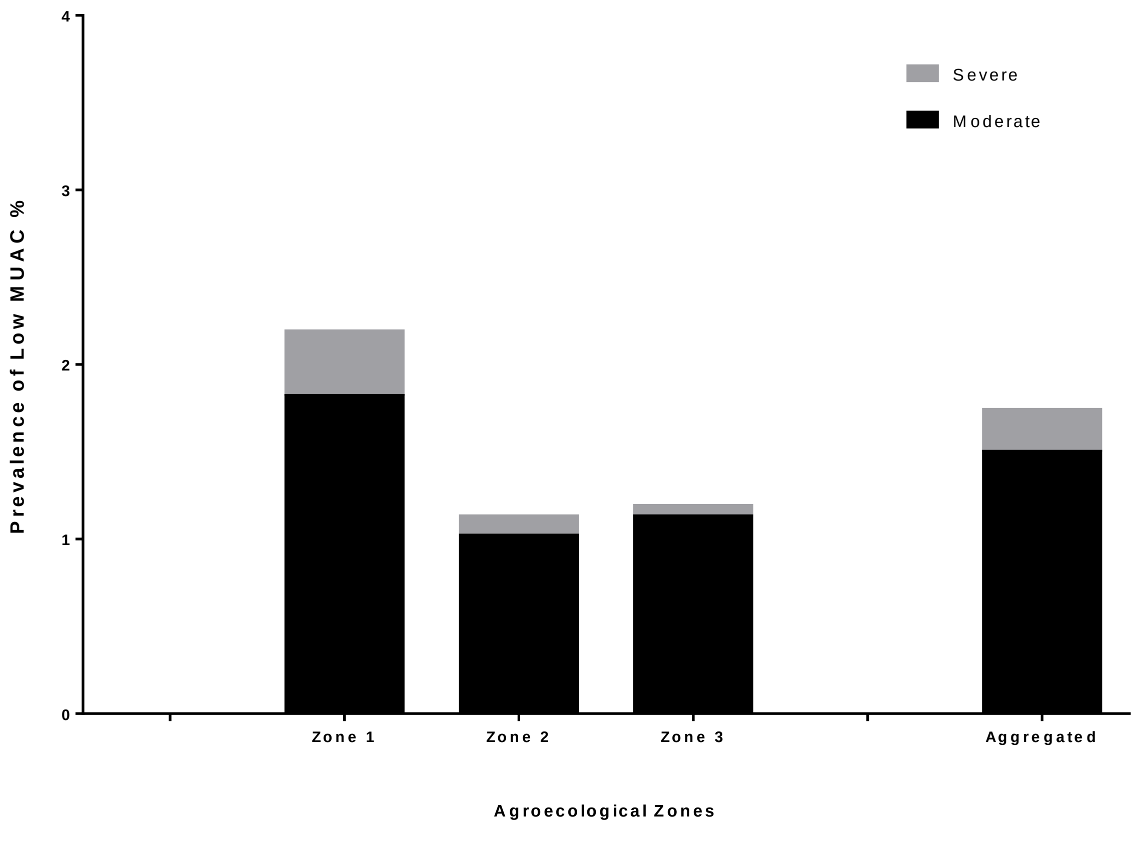

Figure 14: Prevalence of low MUAC (children 6-59 months), by zone

[8] Mid-upper Arm Circumference is also used independently of WHZ to diagnose children aged 6-59 months for acute malnutrition, particularly for Severe Acute Malnutrition in community based treatment programmes, (WHO 2000) including in parts of Myanmar outside of the Dry Zone . However, it typically identifies different children who are more likely to be younger, female and stunted (SCUK/ENN 2012) and it is not an acceptable alternative measure for the prevalence of acute malnutrition.

Chronic malnutrition

Mean HAZ among children 0-59 months of age was -1.33 (sd 1.18) (see table 6A and figure 17 for the sample HAZ distribution). There was strong evidence of a difference between children in different agroecological zones with the mean HAZ significantly greatest in zone 3 (*p*=0.009). Mean HAZ was lower in boys than girls and there was good evidence that this was significant (*p*=0.040), which is typical[9]. Figure 15 shows that more than a quarter of children under five years of age are stunted (27.5%) which is a 'high' rate according to the WHO (WHO 1995), and 1/20 were severely stunted (5.6%) (see table 7A). There was strong evidence that zone 3 had a lower rate of stunting compared with zone 1 (*p*=0.003). The significance persisted when looking at the prevalence of stunting of different grades by agroecological zone (*p*=0.008), with moderate and severe stunting significantly lower in zone 3 than 1. Boys were significantly more likely to be stunted than girls (*p*=0.008).

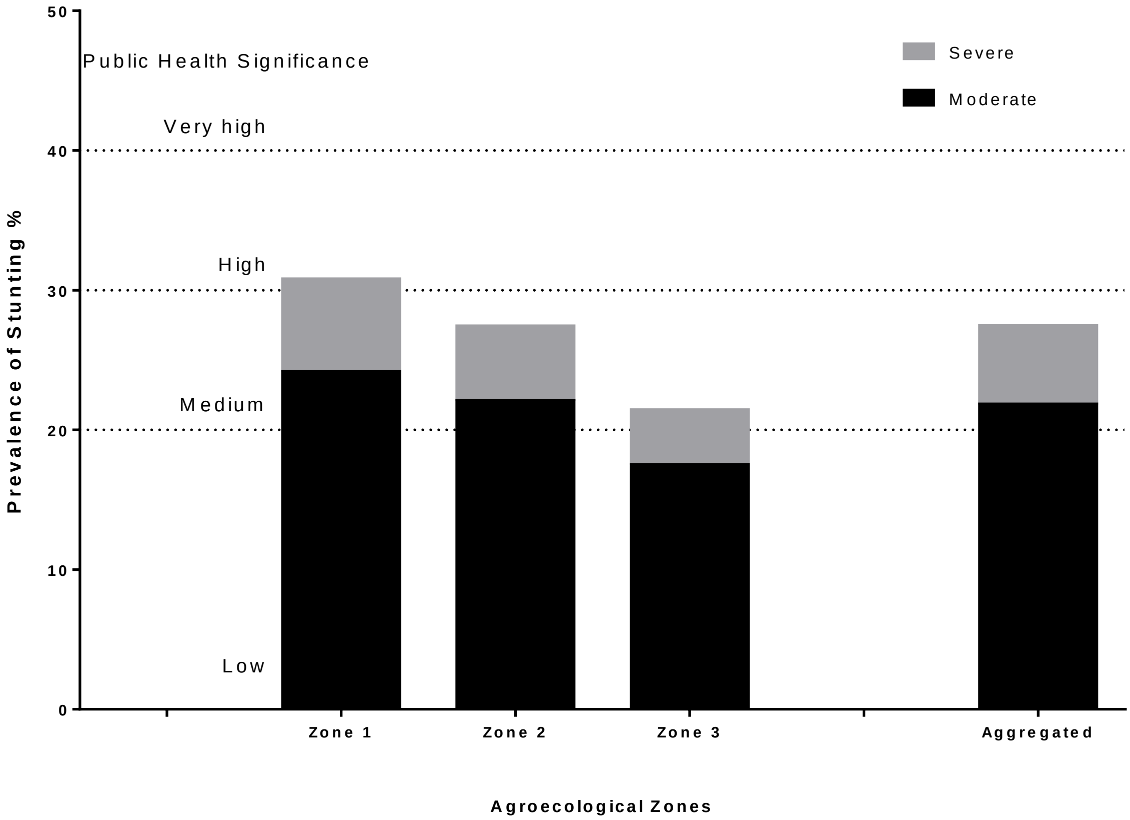

Figure 15: Stunting prevalence (children 0-59 months), by zone.

Figure 16 illustrates that stunting is evident from birth and prevalence increases significantly with age in the Dry Zone and in zones 1 and 2, but not 3 (see also table 13A). This trend very closely mirrors the trend of wasting by age described above.

[9] http://www.who.int/gho/health_equity/outcomes/stunting_children_text/en/

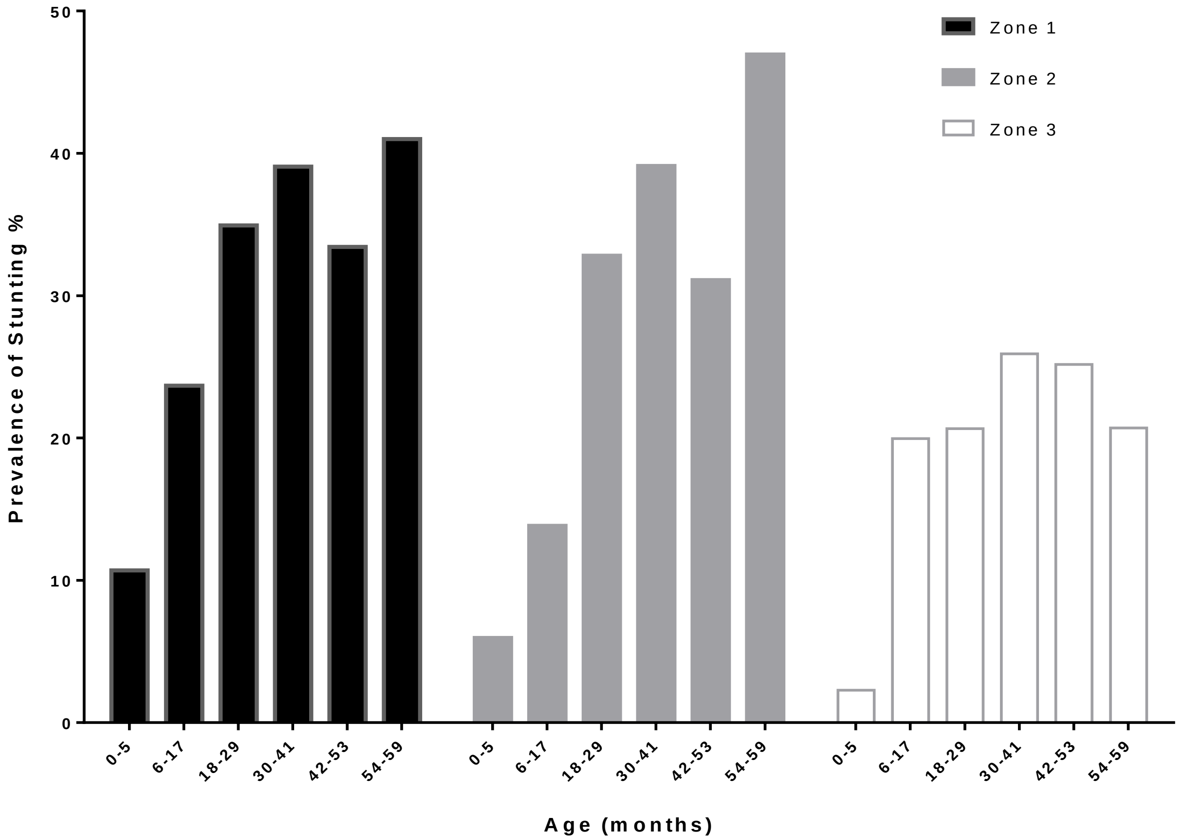

Figure 16: Prevalence of stunting by age group, by zone

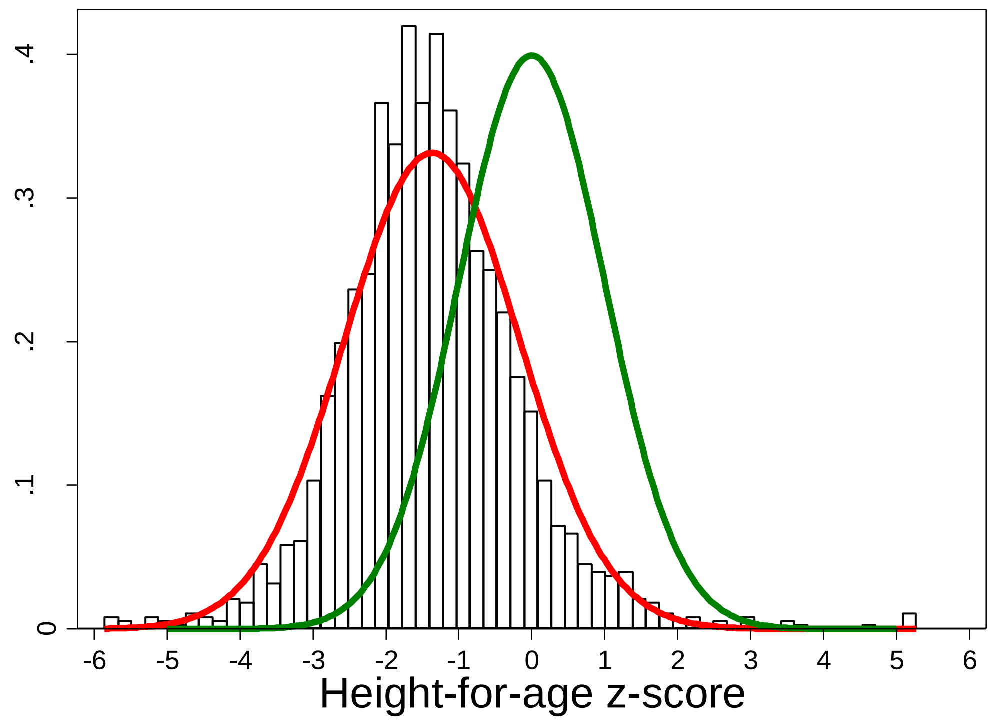

Figure 17: Dry Zone sample HAZ distribution curve (red) compared to the reference population (green)

Underweight

Mean WAZ was -1.38 (sd 1.00) and there was strong evidence that it was highest in zone 3 (p=0.002) (see table 6A). There was no significant difference in mean WAZ by sex. More than a quarter of children were underweight (27.2%), a 'high' rate according to the WHO (WHO 1995), and nearly 1/20 were severely underweight (4.7%); a similar pattern to the stunting rates (see table 7A). The same pattern of significant differences between agroecological zones was evident, with very strong evidence that the proportion of underweight was highest in zone 3 (p<0.001). The significance of difference between 1 and 3 persisted when the different categories of underweight were tested (p<0.001). There was no sex differential.

There was evidence of a significant difference in underweight by age with highest rates in the age group 18-29 months (33.1%), 42-53 months (38.9%) and 54-59 months (39.6%), a pattern which reflects the mixture of stunting and wasting this indicator captures. The trend was mostly similar across the zones.

Birth weight

Only a fifth of children were reported to have been weighed within three days of birth and had documentary evidence, and this percentage did not differ significantly by zone (see table 14A). The mean documented weight for the Dry Zone was 3.12 kg (sd 671g) and the percentage of LBW babies (<2500g) was 17.2%. In figure 18 it is shown that between zones, there was strong evidence that the mean was significantly lower in zone 1 (p<0.01) and there was strong evidence also that the percentage of LBW infants was highest in zone 1 (p<0.01), which is consistent with the patterns seen for the other nutrition indicators by zone.

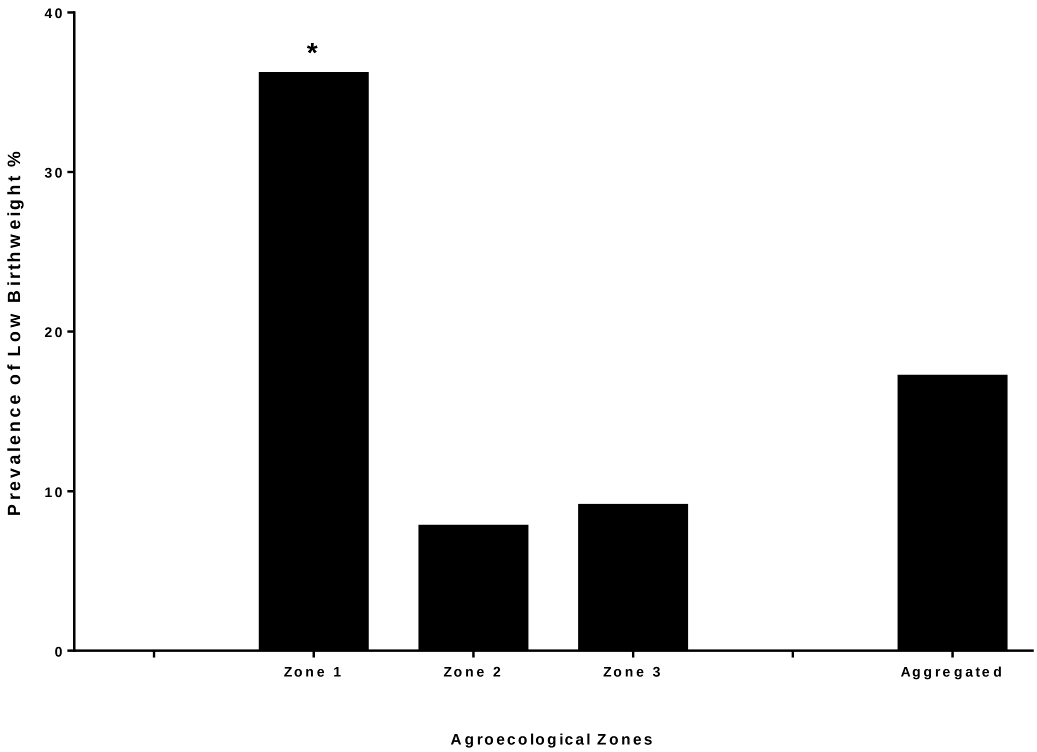

Figure 18: Prevalence of Low Birth Weight, by zone

SICKNESS AND CARE OF THE SICK CHILD

Over a quarter (28.0%) of children had been sick in the two weeks prior to the survey and there was good evidence that the rate was significantly highest in zone 2 ($p<0.05$) (see table 15A). The most common reported symptom was 'fever', among 1/10 children (9.8%) (see table 16A), which is consistent with the data from the village profile and it expected in the rainy season. There was strong evidence ($p=0.004$) that fever was significantly more common in the highland farming zone 2 than in the flood plains of zone 3. Diarrhoea was reported among 7.1% of children with strong evidence of lowest rates in zone 3 ($p<0.01$). In addition there were three unverified measles cases, one in each zone. Quite a large proportion of other sicknesses were captured, including infections, dysentery, aches, rashes, colds and flu. A large proportion of the sicknesses (113/176) were classified as 'normal fevers', which enumerators explained were raised body temperatures which did not lead the parent to take the child for medical attention. Figure 19 shows the prevalence of main sicknesses by zone.

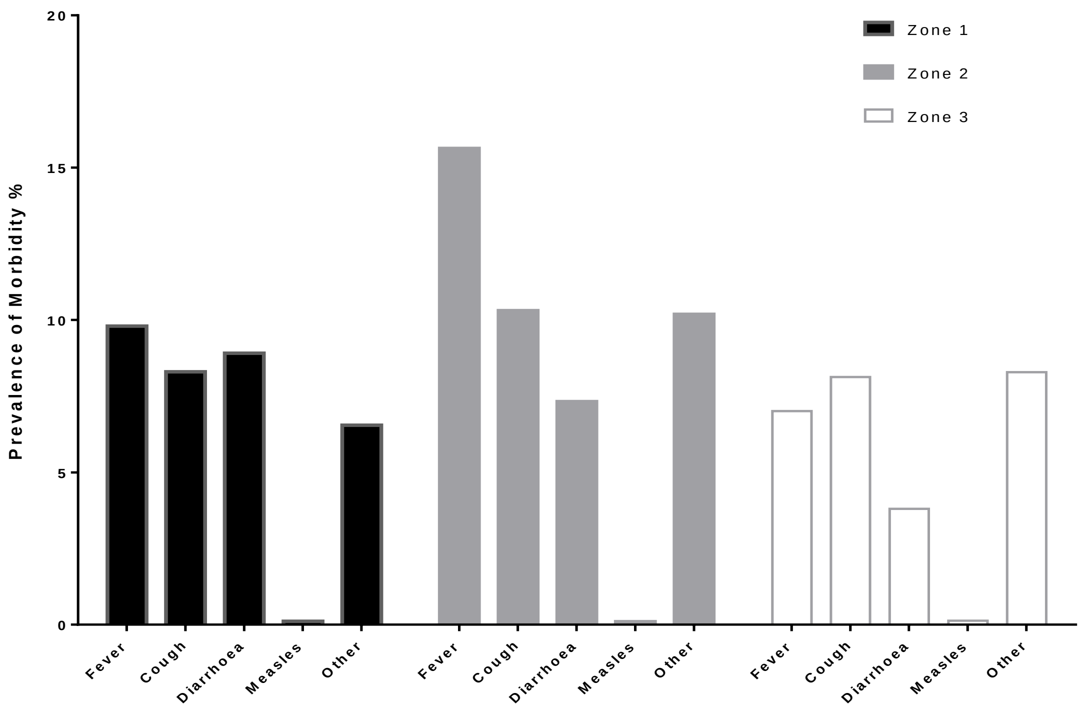

Figure 19: Prevalence of common illnesses in last two weeks, by zone

Within the Dry Zone, sickness was strongly associated with age, as expected, with highest prevalence in the age groups 6-17 and 18–29 months, which coincides with weaning and the introduction of pathogen contaminated nutritionally poor complementary foods ($p<0.001$) (see table 17A). However, figure 20 illustrates that the pattern differed by zone, with age associated with sickness only in zones 1 ($p<0.001$) and 3 ($p=0.001$). The trends of morbidity by zone by age are similar to the trends of both wasting and stunting by age, suggesting that sickness may be an important determinant of wasting in zone 2, particularly for the older age groups, and possibly in zone 1, but not very important in zone 3.

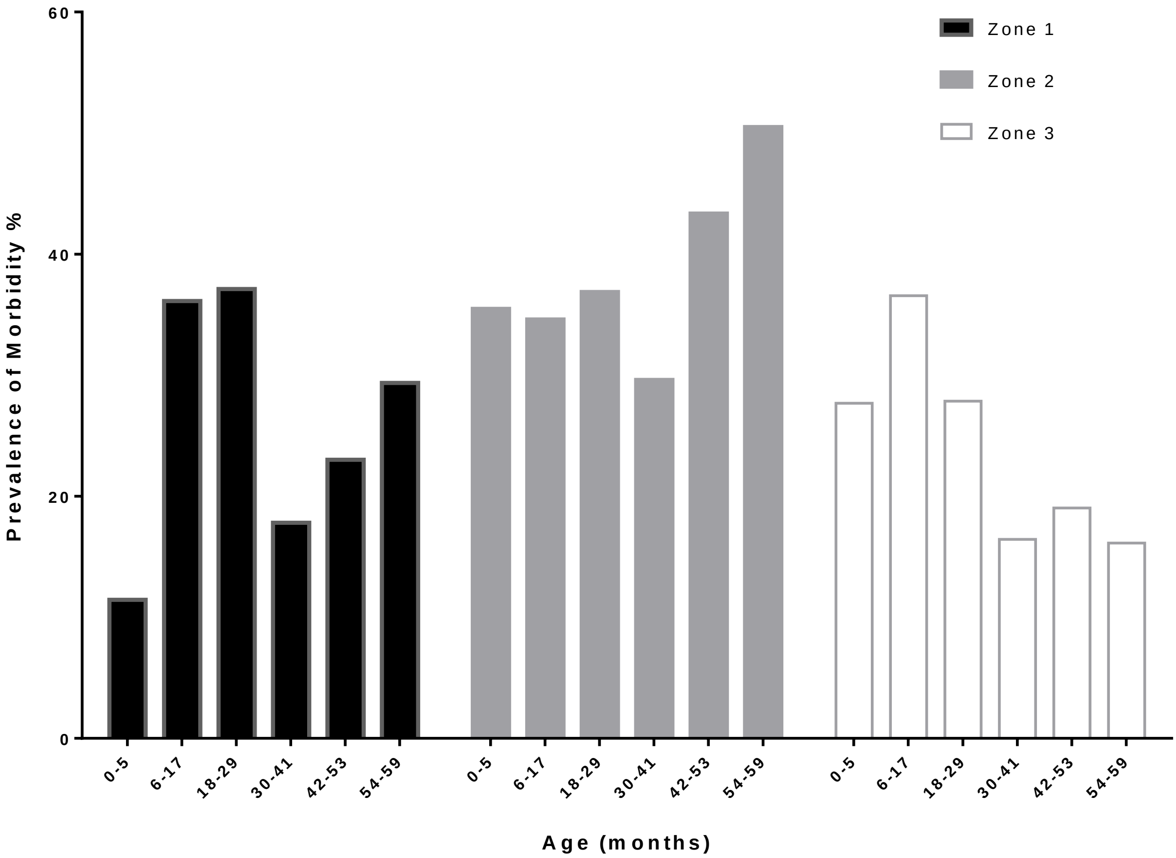

Figure 20: Two week retrospective morbidity prevalence rates by age group, by zone.

Diarrhoea prevalence was strongly associated with age (*p*<0.001) being most prevalent in the 6-17 (10.9%) and 18-29 (12.8%) month groups and this pattern was the same in each zone. Fever did not show an association with age at Dry Zone level but there was a positive association with age in zone 3 (*p*=0.014) in which prevalence peaked in the 6-17 (10.1%) and 18-29 (11.9%) month age groups also. Cough was associated with age at the Dry Zone level (*p*=0.034) and was most prevalent in the 6-17 month olds (11.8%) and the oldest children aged 54-49 months (10.1%). This pattern was also observed in zone 3 but not zones 1 and 2.

Carers who reported that their child had had diarrhoea were asked about their caring practices. Figure 21 shows that a third (67.6%) of the 146 children were given more to drink during their diarrhoea (see also table 18A). Feeding more during diarrhoea was far less common, and only 2.9% of children were given more to eat whilst sick. ORS was not commonly given (37.1%). Homemade ORS was rarely used (6.1%). Just over 1/10 children were given zinc tablets (13.5%) or zinc syrups (12.8%).

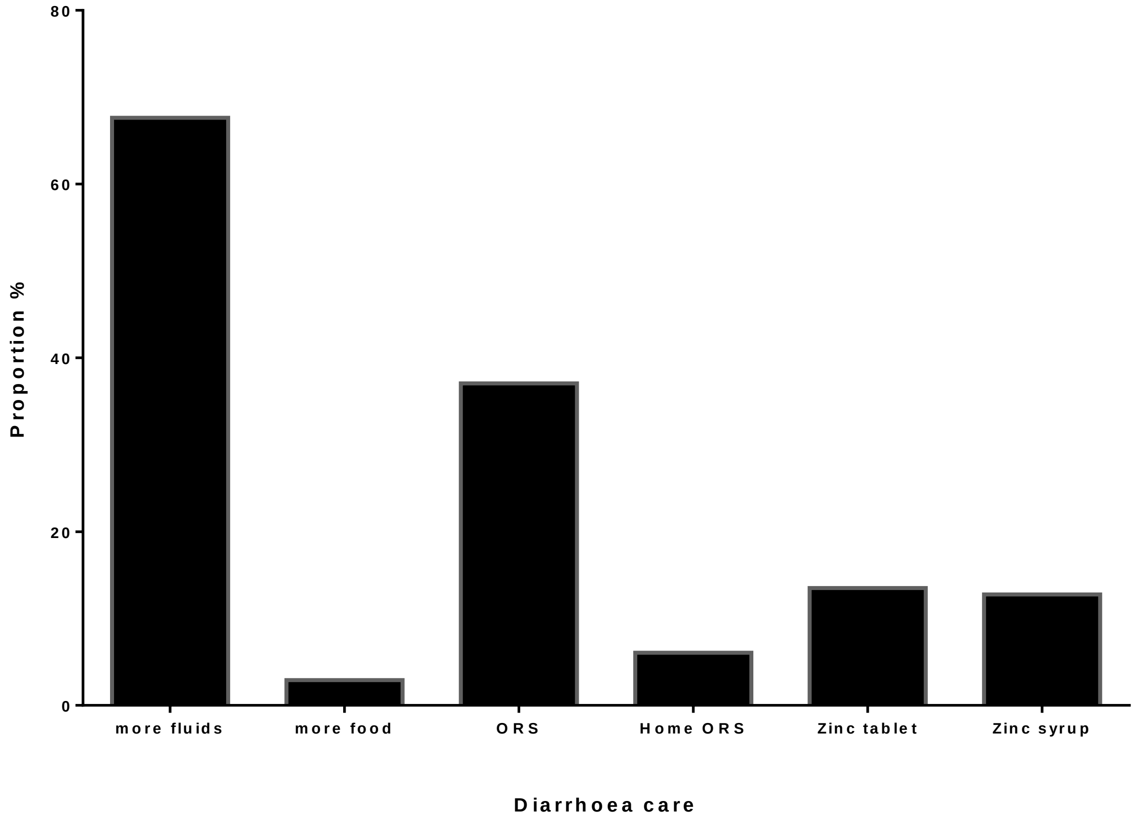

Figure 21: Care of children with diarrhoea (Dry Zone)

Carers were also asked about their hand washing practices and disposal of child faeces[10]. Figure 22 shows that a high percentage of carers reported washing their hands after assisting a child to pass a stool (83.6%) (and this did not differ between zones), although less than a third washed their hands with soap (61.5%) (see also table 19A). The disposal of faeces in a latrine was only practiced by half the respondents (48.9%) and there was evidence that this was probably least likely in zone 1 ($p<0.05$). Hand washing before preparing food for children above six months of age was nearly universal (98.0%) although the use of soap was even less common than after latrine use, at only 33.1%, with an anomalous finding of good evidence of lower soap use in zone 3 than zone 2 ($p<0.05$).

[10] Enumerators were instructed to ask these questions to the mother in relation to one child in each household, in the event that there was more than one child under five years old. Due to confusion this practice was not adhered to, therefore this analysis is of a selection of data from one child per household, noting that this does lead to oversampling of children without siblings under five.

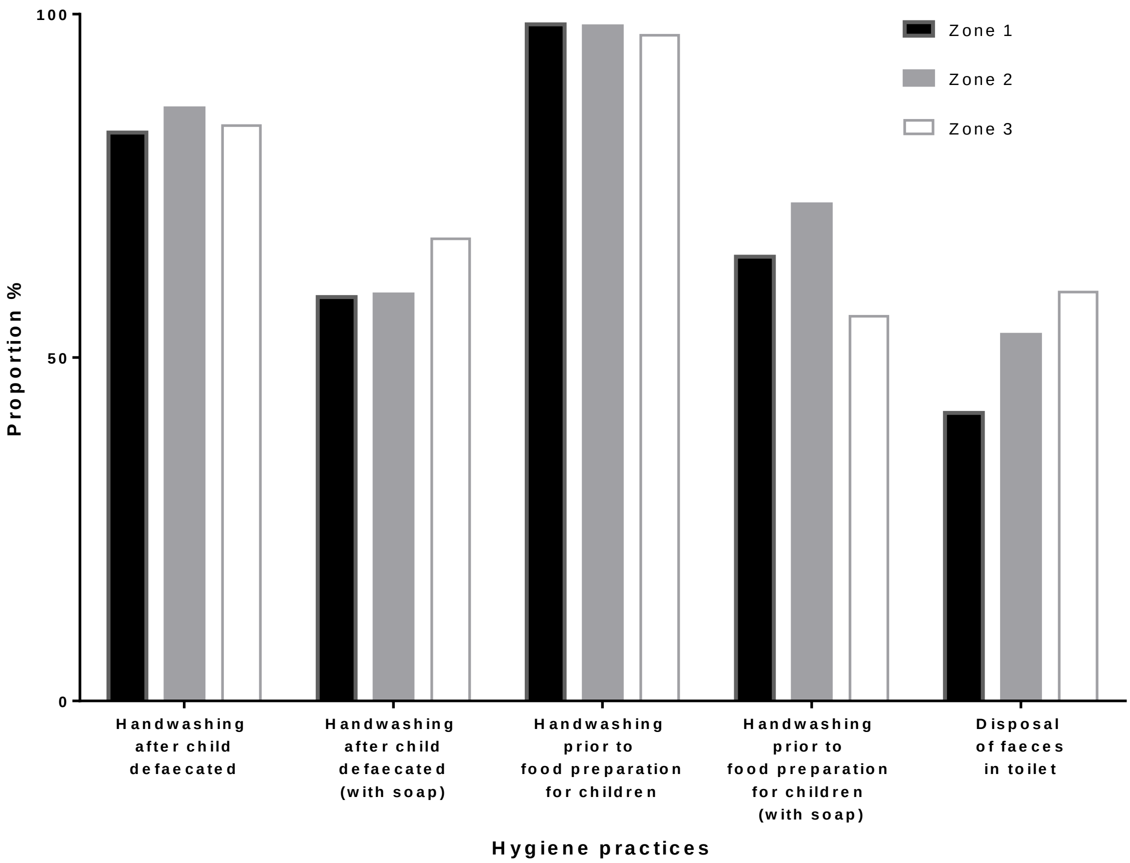

Figure 22: Hygiene practices, by zone

PREVENTATIVE HEALTH CARE

Figure 23 illustrates prevalence of key preventative health care behaviours. The majority of children (89.4%) were reported to have slept under a mosquito net the night before the survey (see also table 20A) and this was lowest in zone 1 ($p<0.05$). Among those children in the 12-24 month age group who should have been vaccinated for measles, the reported coverage exceeded the international benchmark of 90% (WHO 2012) (91.0%) with no difference between zones (see also table 21A). Among those children eligible for antihelminths (aged above 12 months), the reported rate of coverage in the six months prior to the survey was about half (46.8%), again, with no zonal difference (see also table 22A). Carers of children above six months of age were asked if their child had received a vitamin A supplement in the six months preceding the survey. The reported rate of coverage was just over two thirds (70.8%) although there was good evidence ($p=0.028$) that coverage in zone 2 was lowest and zone 3 highest (see also table 23A). All children were checked for a BCG scar. The high rate of presence of a scar (89.5%) indicates a high rate of coverage of vaccination against TB with no difference between zones (see also table 24A).

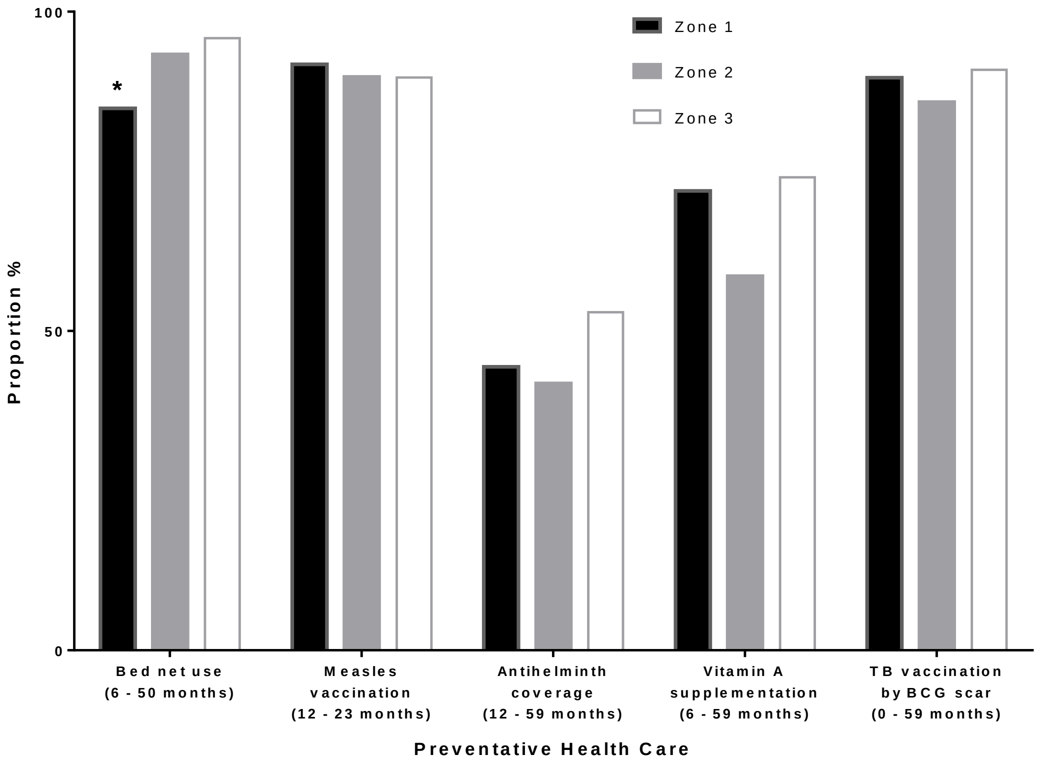

Figure 23: Preventative health care, by zone

INFANT AND YOUNG CHILD FEEDING

As shown in table four, data were collected on IYCF practices from the mothers of 822 of the 835 surveyed children under two years old for whom anthropometric and health data were also collected (see table 25A). Sometimes the data may have been reported by another primary carer if the mother was absent. Whilst the target sample size was exceeded, this sample was not powered to detect differences between agroecological zones.

Almost all children had been breastfed at some point (98.5%) (see table 25A). Figure 24 shows that the initiation of breastfeeding within an hour of delivery was only practiced in about a third of cases for the under two year olds (34.6%). Examining answers only for infants under a year (for whom recall may be easier and answers therefore more accurate) shows little difference (33.0%). Median number of hours to initiation was '0' (equating to 'immediate') but the data are skewed to the right, with a maximum delay of six days in one instance.

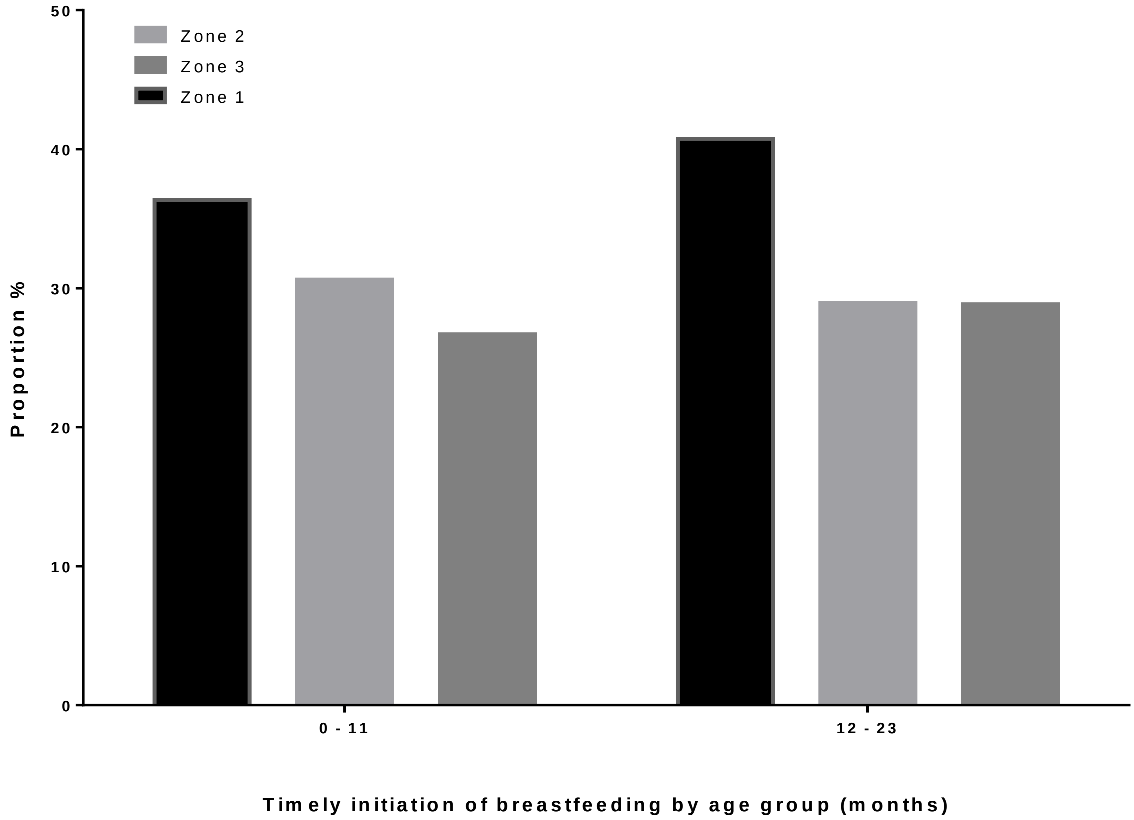

Figure 24: Timely initiation of breastfeeding by age groups, by zone

Figure 25 shows that it was very common that colostrum was reported to be given to the child (90.2%). Mothers were also asked whether they had given any other liquids to their baby in the three days after birth (see table 26A). The giving of plain water was quite common; 1/4 children were given water (24%). Sugared water was also given to 1/10 children (8%). Other liquids were rarely given. There is some indication that wet nursing of newborns by other lactating women is an acceptable practice for some mothers, although the circumstances supporting this were not explored. Given the reporting of pre-lacteal feeding among a fairly large proportion of mothers, it is not surprising that the rate of exclusive breastfeeding is quite low. The rate among infants 0-<6 months of age is 37.5%. Figure 25 shows that, as expected, this is highest among the youngest infants and declines with age, to only 10.3% of infants in the 4-<6 month age group.

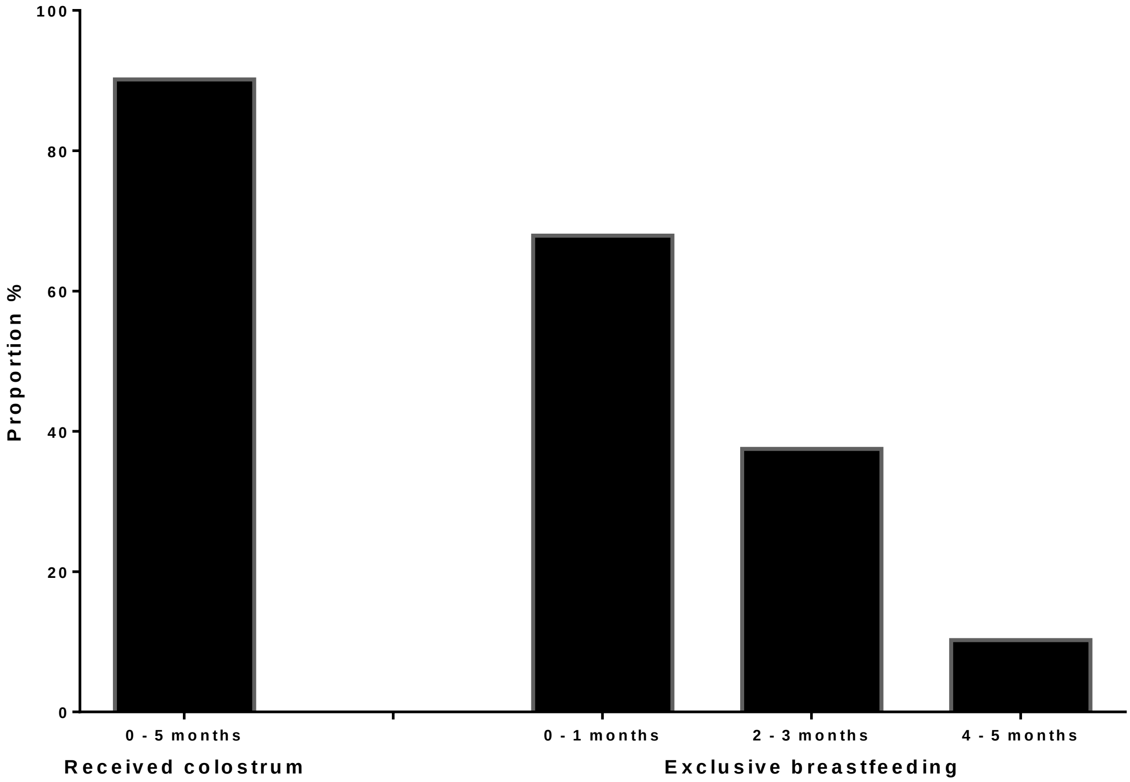

Figure 25: Colostrum feeding and exclusive breastfeeding prevalence (Dry Zone)

Figure 26 shows that timely complementary feeding[11] is almost universal (97.4%); although the low exclusive breastfeeding rate highlights that a large proportion of children are introduced to fluids and foods too early. The indicator 'timely introduction of solid, semi-solid or soft foods at 6-8 months' just focuses on food consumption. All children in this age group were reported to have eaten these foods in the 24 hour recall period. Nearly all (96.6%) of the surveyed children of 12-15 months were still breastfeeding and the rate of continued breastfeeding at two years was also extremely high (90.6%). See Table 25A for details.

According to the mother's 24 hour recall results, children's diets lack diversity. Only 1/5 (19.4%) of children 6-<24 months of age received at least 4/7 food groups in the day before the survey, the acceptable minimum, and figure 31, below, illustrates that the mean Individual Dietary Diversity Score (IDDS) was only 2.4 (sd 1.3). The most frequently consumed groups are 1. starchy staples (rice) (93.7%), 2. pulses and legumes (beans, lentils, seeds, nuts) (38.6%), 3. vitamin A rich fruits or vegetables including dark green leaves (35.3%), and 4. fish or meat, including offal (22.5%) (see table 27A).

The percentage of children 6-<24 months old consuming iron or iron rich foods was low at 27.1%, and this rate was somewhat better among the older half of this group (12-<18 months, 28.1%) than the younger half (6-<12months, 21.5%). This is consistent with low reported consumption of animal source foods (meat, organ meat, fish and seafood) and also fortified foods (5.0%) or multiple Micro-Nutrient Powder (MNP) ("Sprinkles") (1.6%). Figure 27 illustrates this data by agroecological zone (see also table 25A).

[11] Requiring children aged 6-<10 months to have eaten foods in the previous day, as well as to have received breastmilk.

Figure 26 also illustrates that minimum meal frequency[12] was only achieved among just over half of the breastfed children (56.6%) and among the very small number of children not being breastfed (no.=28), very few were being fed frequently enough (11.0%) (see table 25A). As a result, the percentage of children receiving a 'Minimum Acceptable Diet'[13] was very low: 10.5% for breastfed children and 8.4% for non-breastfed children.

Bottle feeding, whilst not common, was still prevalent among 6.4% of children under two years old (also in figure 26).

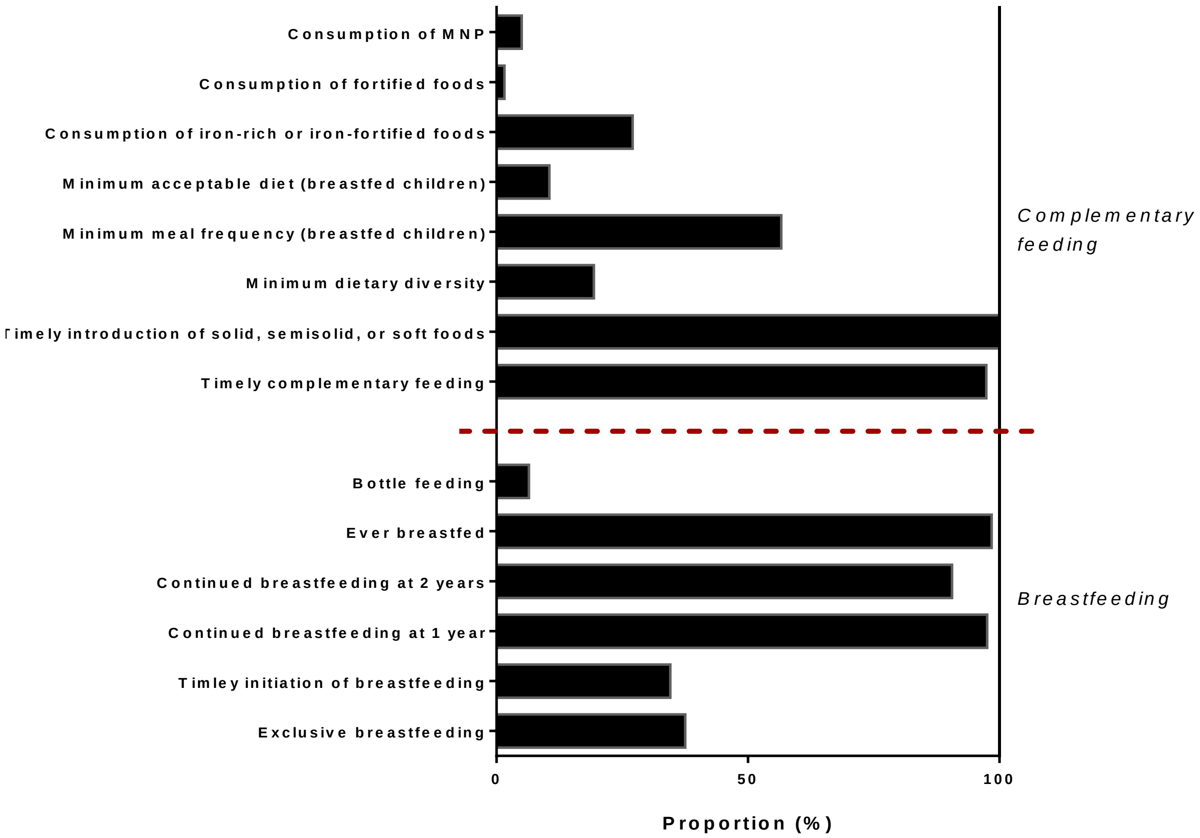

Figure 26: Breastfeeding and complementary feeding practices (Dry Zone)

[12] Defined as two times in the preceding 24 hours for breastfed infants aged 6-<9 months and three times for those 9 -<24 months, and four times for any non-breastfed infant 6-<24 months of age.
[13] Defined as achieving minimum meal frequency and dietary diversity and calculated separately for breastfed and non breastfed children, who should have also at least two milk feeds.

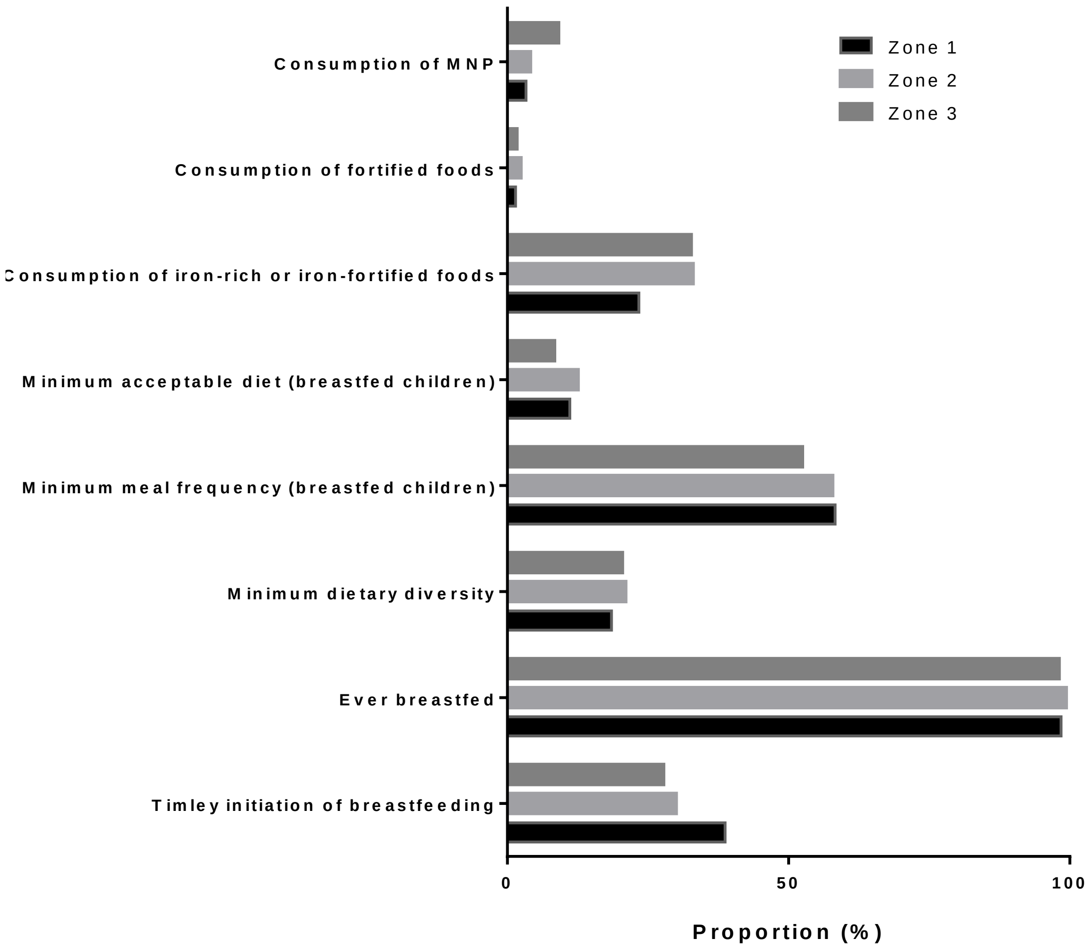

Figure 27: Breastfeeding and complementary feeding practices, by zone (where sample size is sufficient to stratify)

4.5 MOTHERS' NUTRITION AND CARE

Table four shows that 1789 mothers of the 2037 children under five were included in the survey. Twenty six mothers of surveyed children were absent.

REPRODUCTIVE STATUS, AGE AND BIRTH HISTORY

Two thirds of mothers were currently breastfeeding or pregnant (66.4%); 12 women reported to be both (see table 11). In the sample there was strong evidence that significantly more mothers were currently breastfeeding in zone 1 compared to zone 3 (p=0.006).

Table 11: Mothers' reproductive status, by zone

	Dry land farming zone (1) (n=591)	Highland farming zone (2) (n=598)	Flood plains/irrigated zone (3) (n=599)	Dry Zone total (n=1788)
% mothers breastfeeding *(95% CI)*	69.2 (61.8, 76.6) **1 and 3 p=0.006*	64.2 (56.9, 71.6)	54.9 (48.4, 61.3)	**64.1 (58.8, 69.3)**
% mothers pregnant *(95% CI)*	2.8 (1.1, 4.5)	5.0 (1.4, 8.5)	2.5 (1.2, 3.8)	**3.0 (1.8, 4.1)**

Table 12: Mothers' age and birth history, by zone

	Dry land farming zone (1)	Highland farming zone (2)	Flood plains/irrigated zone (3)	Dry Zone total
Age/years Mean *(sd)* *(95% CI)*	32.5 (5.3) (31.8, 33.1) (n=591) ***1 and 2 p=0.007*	31.1 (10.3) (30.5, 31.8) (n=597)	31.8 (6.8) (30.8, 32.7) (n=599)	**32.1 (6.7) (31.6, 32.6) (n=1787)**
# Births Mean *(sd)* *(95% CI)*	2.9 (1.5) (2.4, 3.3) (n=591) ***1 and 3 p=0.002*	2.6 (2.8) (2.4, 2.8) (n=599)	2.3 (1.6) (2.2, 2.5) (n=599)	**2.7 (1.8) (2.4, 2.9) (n=1789)**
Age at first delivery Mean *(sd)* *(n)* *(95% CI)*	23.4 (3.8) (n=591) (22.5, 24.3)	22.7 (6.7) (n=597) (22.2, 23.2) **2 and 3 p=0.014*	23.8 (5.1) (n=599) (23.1, 24.5)	**23.4 (4.8) (n=1787) (22.9, 24.0)**
# living children Mean *(sd)* *(n)* *(95% CI)*	2.5 (1.4) (n=591) (2.1, 2.9)	2.2 (2.3) (n=597) (2.0, 2.4)	2.1 (1.4) (n=599) (2.0, 2.3)	**2.3 (1.6) (n=1787) (2.1, 2.6)**
# deceased children Mean *(sd)* *(n)* *(95% CI)*	0.4 (0.6) (n=590) (0.3, 0.4) ****1 and 3 p<0.001*	0.4 (1.2) (n=595) (0.3, 0.4) ***2 and 3 p=0.001*	0.2 (0.6) (n=599) (0.1, 0.3)	**0.3 (0.7) (n=1784) (0.3, 0.4)**

Table 12 shows that the mothers' mean age was 32.1 years (sd 6.7) and there was strong evidence that mothers in zone 1 were significantly older than those in zone 2 (*p*=0.007). Age at first delivery was 23.4 years (sd 4.8) on average, with first mothers in zone 2 significantly younger than in zone 3 (*p*=0.014).

Mothers were also asked about their birth history and how many living children they had. Table 12 shows that the mean number of deliveries was 2.7 (sd 1.8) and there was strong evidence of fewer births in zone 3 than zone 1 (*p*=0.002). The average number of living children was 2.3 (sd 1.6) with no significant difference between zones, but there was strong evidence that the mean number of deceased children was significantly lower in zone 3 than in zones 1 and 2 (*p*<0.01).

MOTHERS' ANTHROPOMETRY

All mothers had their MUAC taken and all non-pregnant mothers had their height and weight taken to enable calculation of BMI for those over 19 years of age, among whom BMI is a valid measure. Mean MUAC was 26.0cm (sd 3.2cm) and there was weak evidence that mean MUAC was significantly highest in zone 3 (*p*<0.05) (see figure 28 and table 28A). Looking only at mothers who were not pregnant or lactating indicated that their mean MUAC was significantly greater than those who were pregnant or lactating (*p*<0.001) (see table 30A). The percentage of mothers with a MUAC <21.00cm (one cut off to define acute malnutrition, Sphere 2011) was only 3.6% (see figure 29) with no difference between zone (see table 28A). However, using a less conservative cut off of 23.0cm (Verves et al 2013) yields a prevalence of 19.3% (16.7, 22.0) with evidence that the rate in zone 3 was lowest (zone 1: 21.9% (18.0, 25.9), zone 2: 21.5% (17.0, 26.0), zone 3: 13.8% (9.7, 17.8), *p*<0.05).

Of the 1689 women with a valid BMI[14], mean was 21.3 (sd 3.4). As for MUAC and illustrated in figure 28, there was strong evidence (*p*<0.01) mothers in zone 3 had the highest mean BMI (see also table 28A). Figures 29 and 30 show that one fifth (19.7%) of mothers were classified as Chronically Energy Deficient, having a BMI <18.5kg/m^2. But whilst this proportion varied between zones along the same trend as the BMI score and for MUAC, the difference was not significant.

[14] The Bacon command was used in STATA (12.0) whereby the distribution of mothers' heights, weights and MUACs were used to identify 8 outliers which were removed from the analysis.

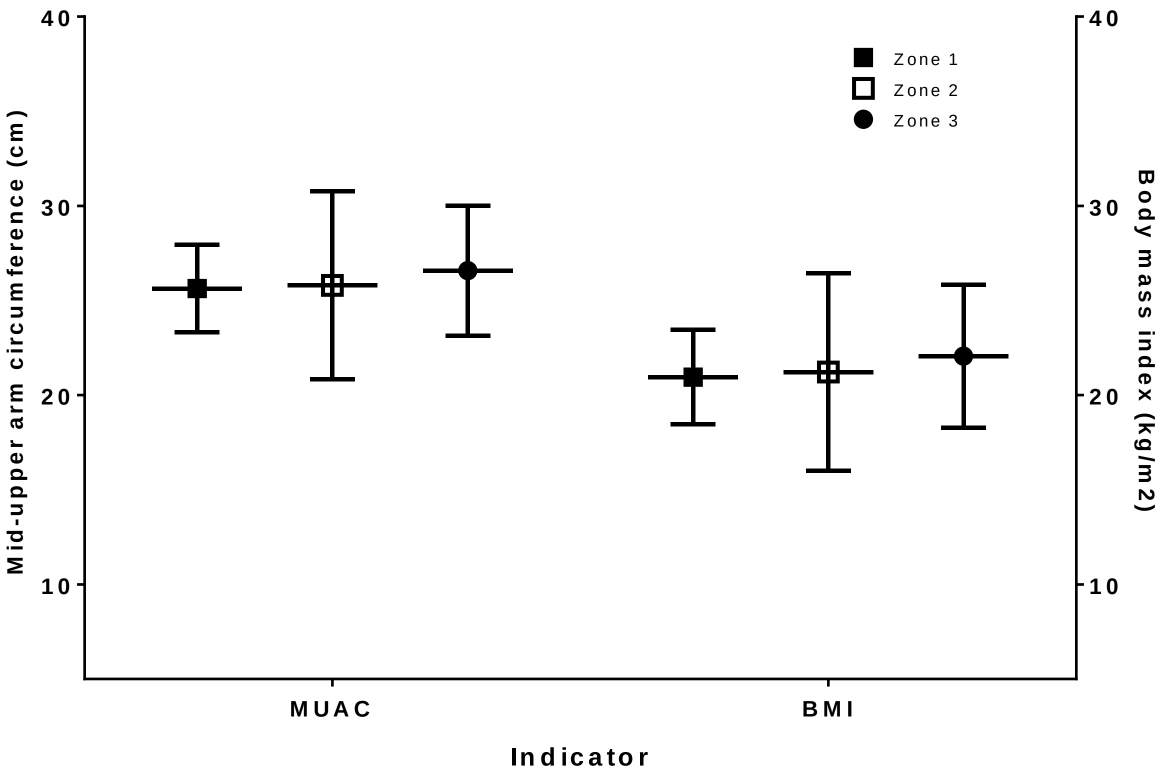

Figure 28: Mothers' mean MUAC and BMI, by zone

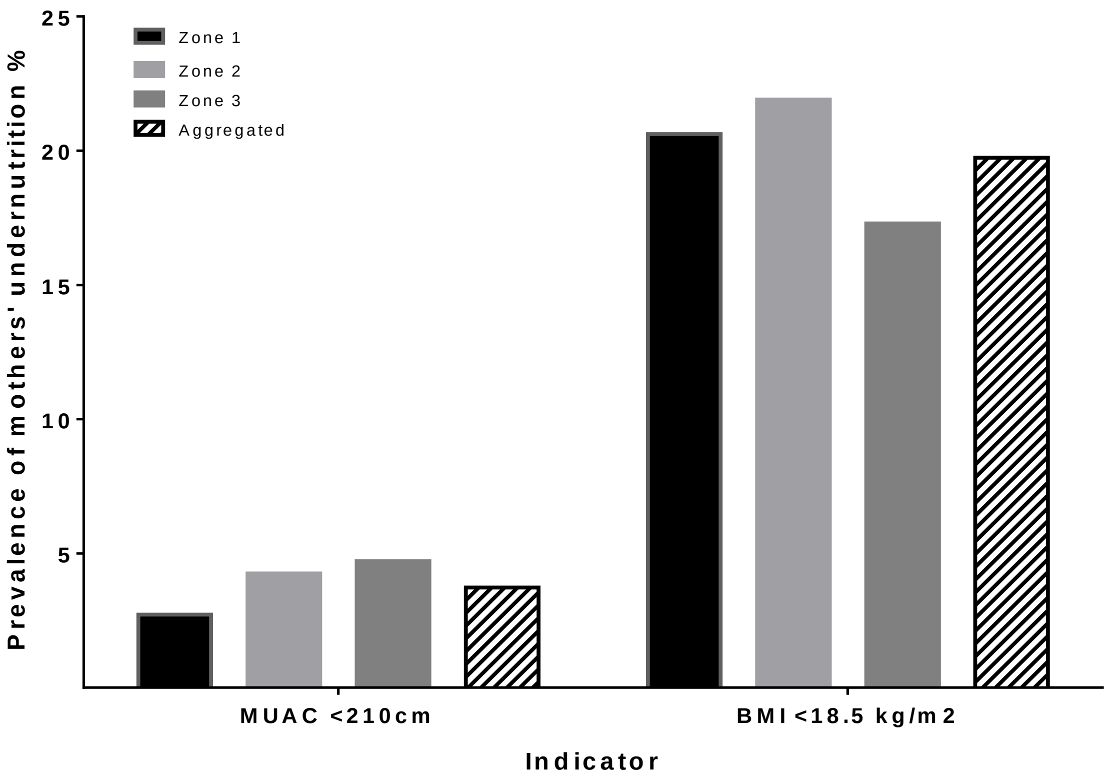

Figure 29: Prevalence of undernutrition among mothers, by zone

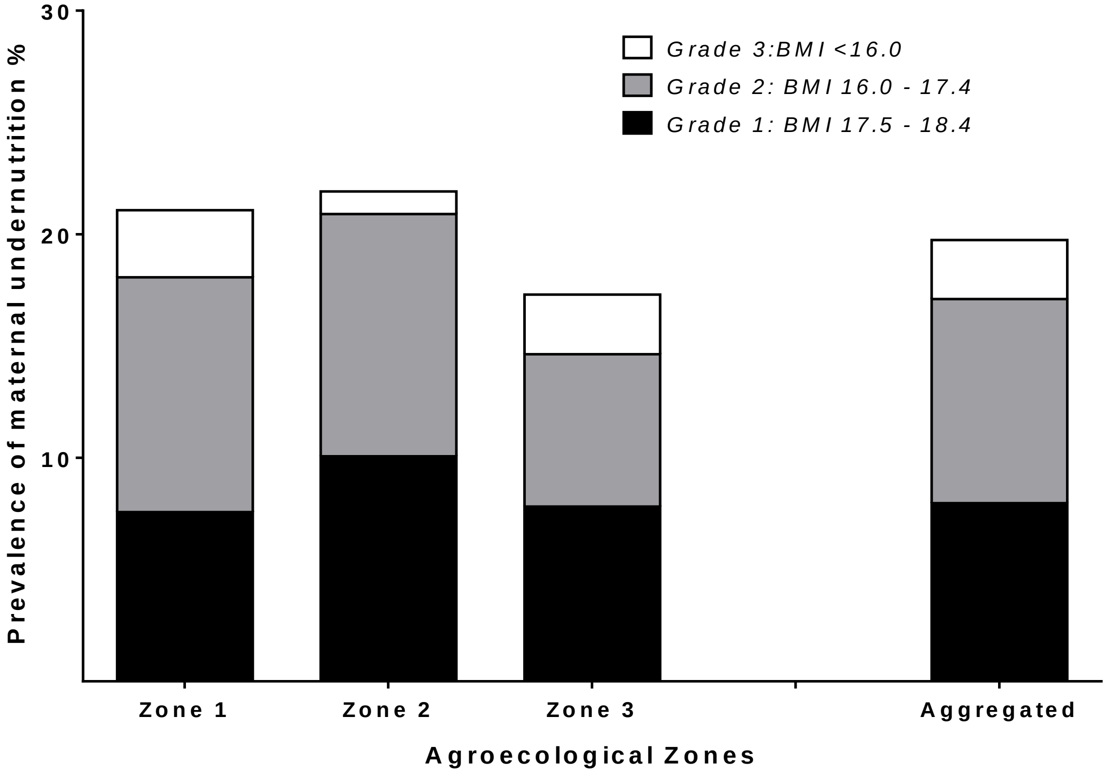

Figure 30: Prevalence of Chronic Energy Deficiency among mothers, by grade, by zone

MOTHERS' DIET

A 24 hour dietary recall was undertaken with mothers and Individual Dietary Diversity Score (IDDS) calculated after grouping responses in to nine food groups (see figure 31 and table 29A). Out of a maximum score of nine the mean IDDS was 4.3 (sd 1.2) and there was good evidence (p<0.05) that the mean was significantly lowest in zone 2. Looking at the IDDS among the non-pregnant and lactating women indicated a higher mean IDDS compared to mothers who were pregnant or lactating (p=0.013).

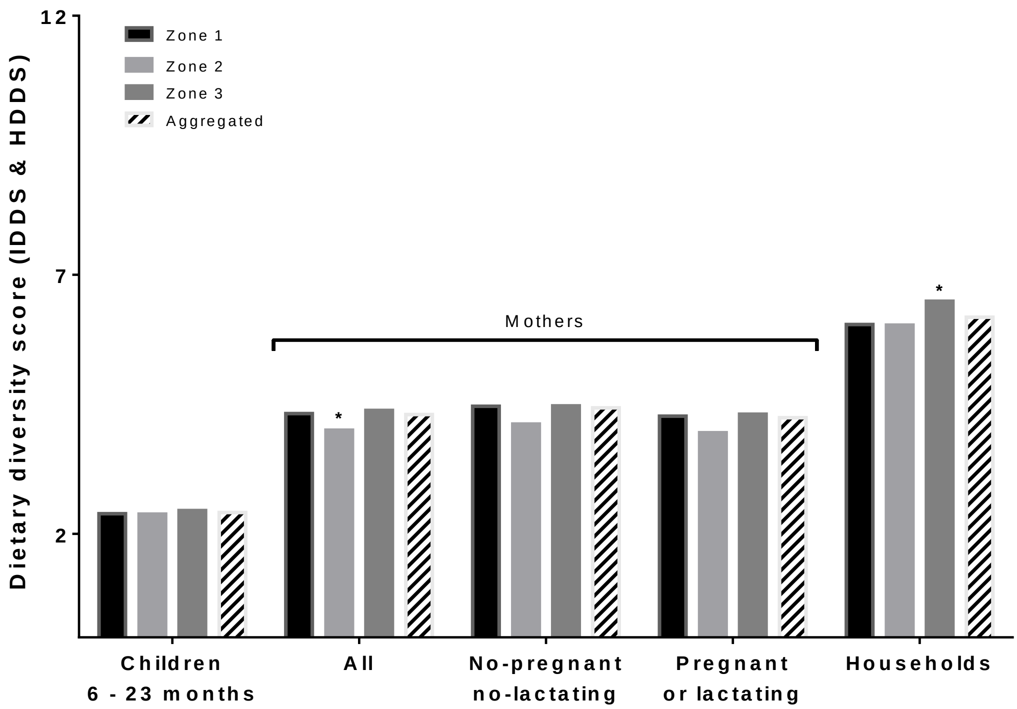

Figure 31: Mean Individual Dietary Diversity Scores for children and mothers and mean Household Dietary Diversity Scores, by zone

Figure 32 shows that the food groups most commonly contributing to the mothers' IDDS are starchy foods, vitamin A rich fruits and vegetables (not including green leafy vegetables which are counted separately), legumes and other fruits and vegetables[15]. Just over a half of women reported eating fish or meat and less than one in five eggs, with dairy produce and organ meats rarely consumed, all indicating low consumption of animal source foods and a reliance on plant proteins. A third of mothers reported eating dark green leafy vegetables. Figure 33 illustrates that there was no evidence of important variation between the zones in food groups consumed in the 24 hour recall period, with only the proportion of legumes showing any significant differences, with very strong evidence that zone 2 had the lowest prevalence (*p*<0.001) (see also table 29A). Figure 34 highlights that mothers' consumption of vitamin A rich foods is over 80%, but mostly from plant sources.

[15] Whilst almost universally consumed, fats/oils are not included in the calculation which focuses on micronutrient rich foods (dissimilarly to HDDS which aims to assess economic access to food and therefore includes all foods).

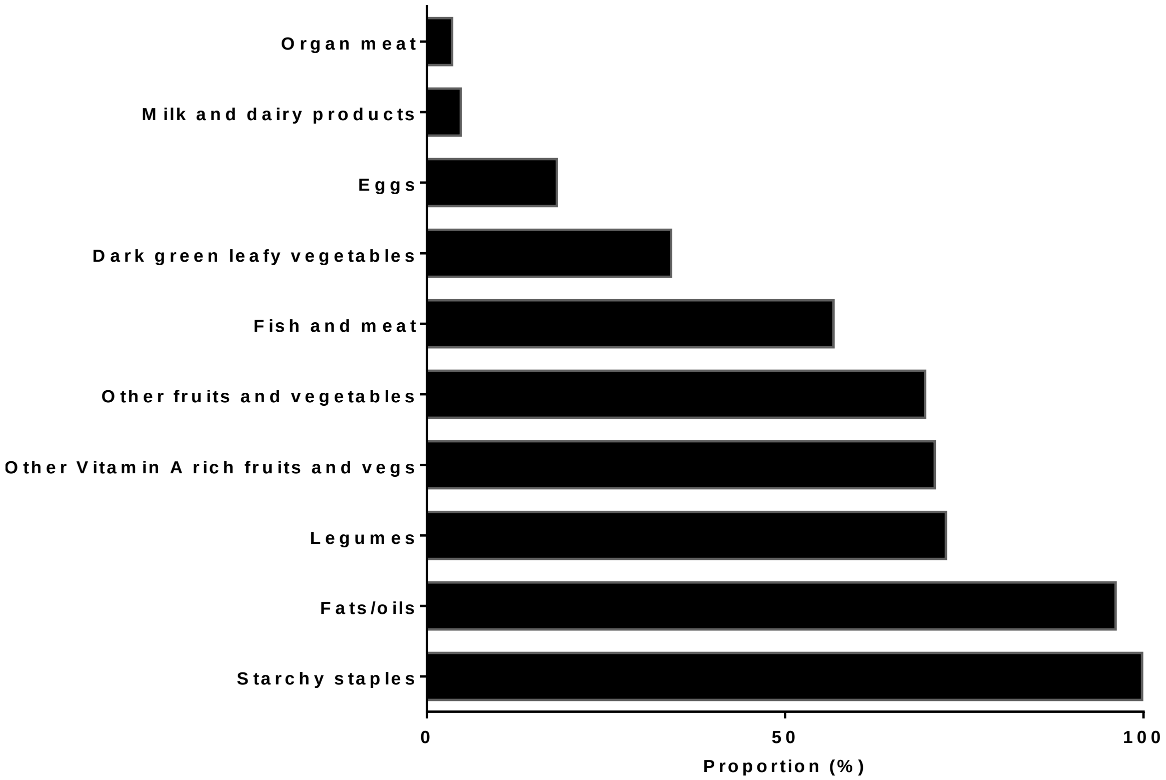

Figure 32: Mothers' diets by food group, according to 24 hour recall (Dry Zone)

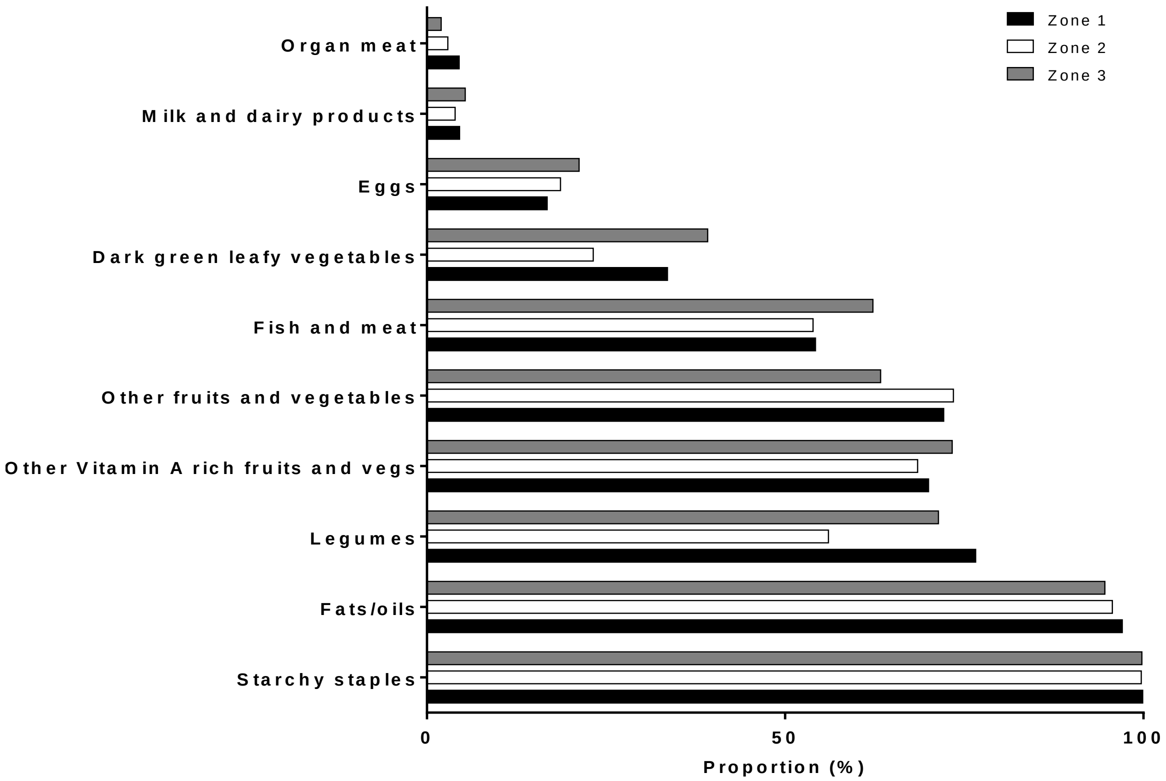

Figure 33: Mothers' diets by food group, according to 24 hour recall, by zone

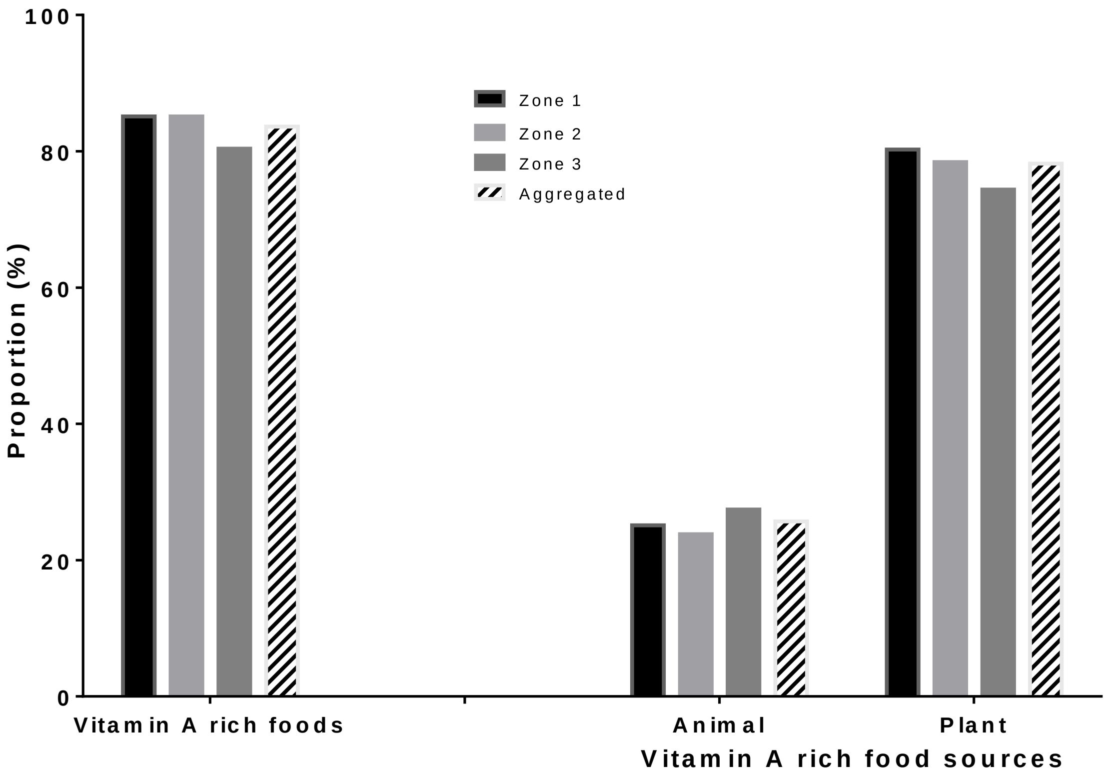

Figure 34: Mothers' consumption of vitamin A rich foods, according to 24 hour recall, by zone

MOTHERS' ANTENATAL (ANC) AND POSTNATAL (PNC) CARE

Figure 35 illustrates that the most common ANC care providers reported were midwives who supported 1/2 of the surveyed mothers (55.1%), followed by auxiliary midwives who supported 1/3 (32.8%) and then Traditional Birth Attendants (TBAs) supporting 1/10 (9.7%) (see also table 30A). One in five received care from a doctor or nurse (13.4% and 8.7% respectively). Figure 36 illustrates that there was good evidence (p<0.05) that receipt of ANC from a doctor was least likely in zone 2 (5.3%). Nurse delivered ANC was also lower in zone 2 (5.2%) and highest in than zone 3 (13.5) (p=0.029). There was strong evidence that TBA delivered ANC was more common in zone 2 (16.3%) than zone 3 (5.2%) (p=0.009) (see also table 30A).

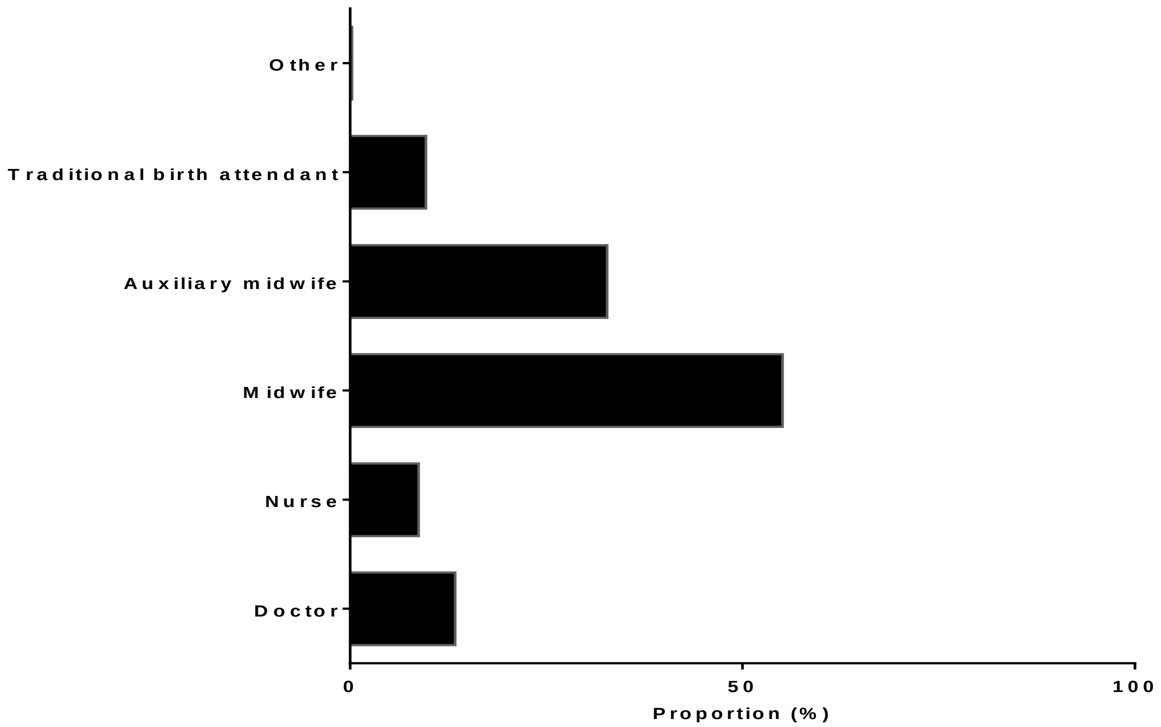

Figure 35: Prevalence of ANC receipt by provider (Dry Zone)

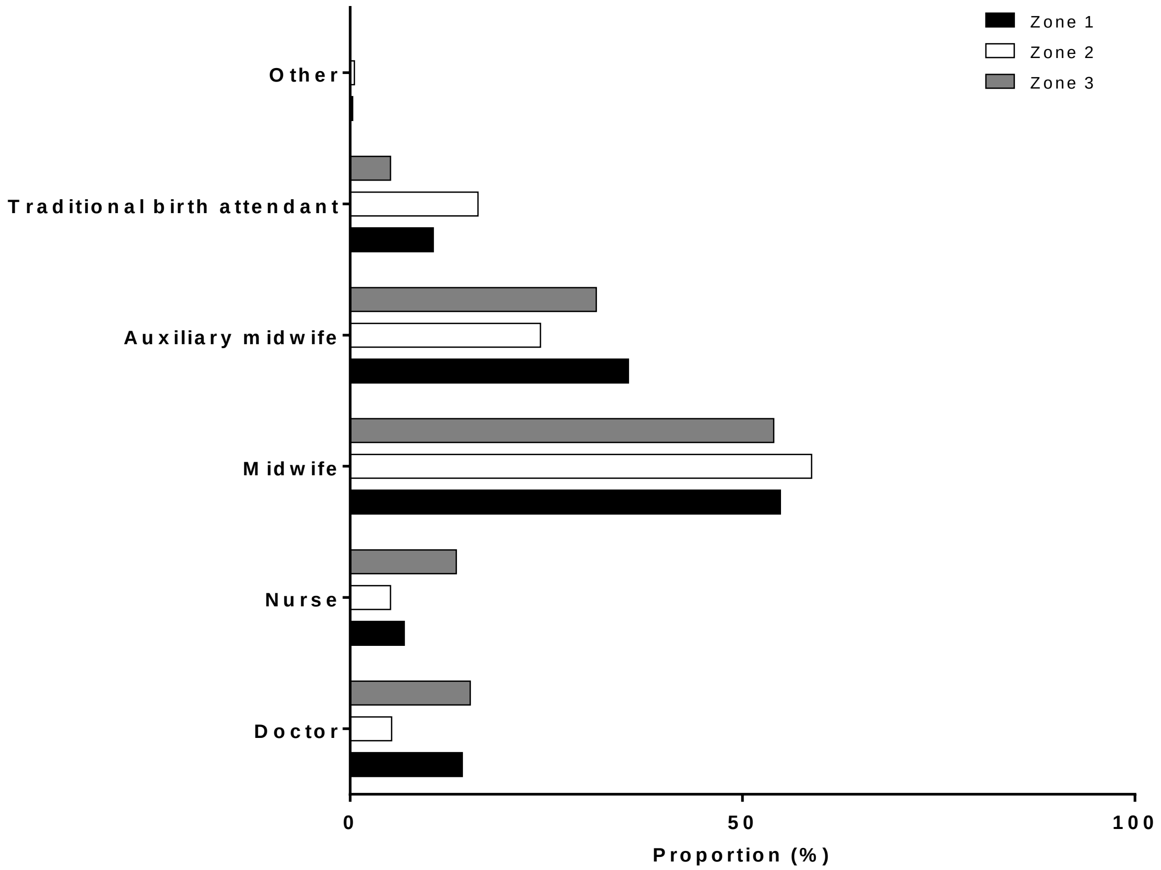

Figure 36: Prevalence of ANC receipt by provider, by zone

Only a third of mothers reported receiving a post-partum vitamin A supplement within six weeks of delivery (31.8%) (see figure 37). The proportion of mothers reporting taking a vitamin B1 supplement during pregnancy or after delivery was higher, at 1/2 (54.7%). Reported iron supplement use during pregnancy was very high at 84.7% and figure 38 shows that nearly all these women (71.1%) said that they took the iron more than five days a week (see also table 30A). There were no differences between zones.

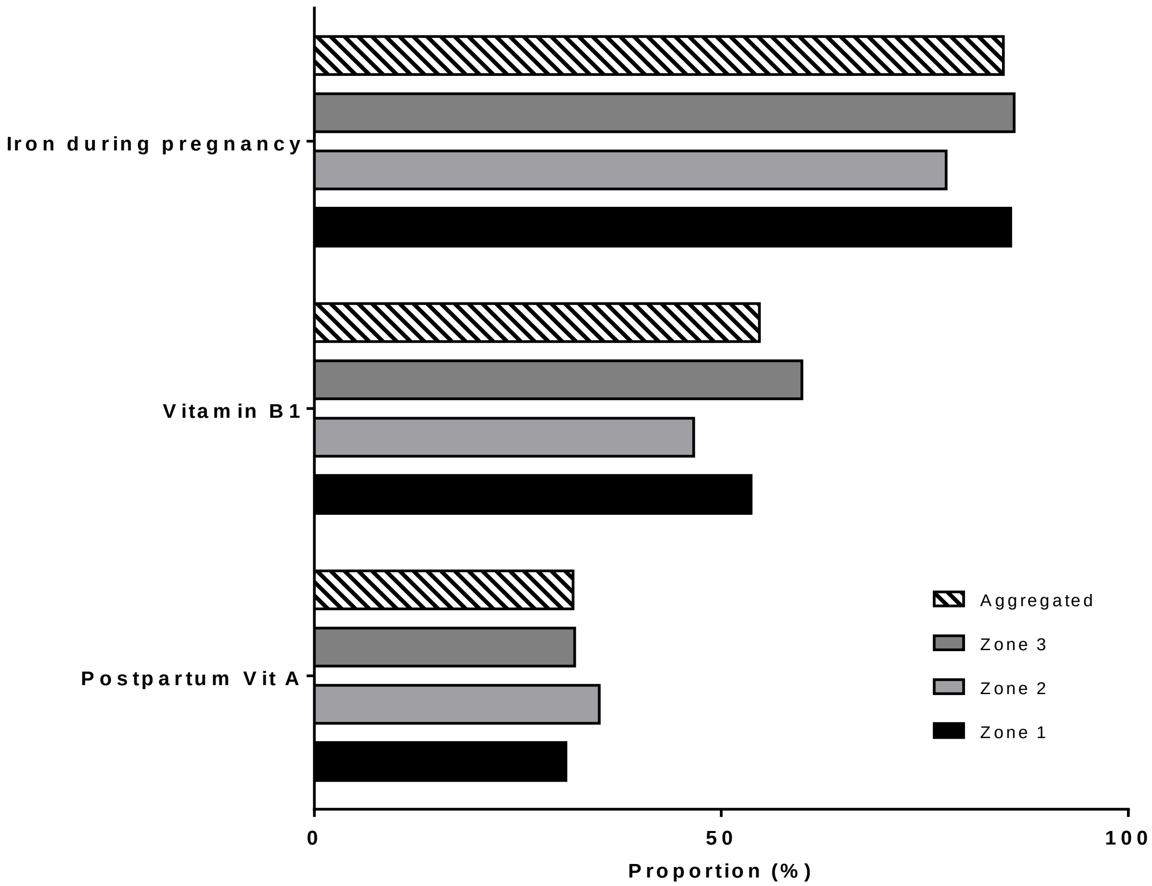

Figure 37: Mothers' reported ante natal and post natal micronutrient supplement use, by zone

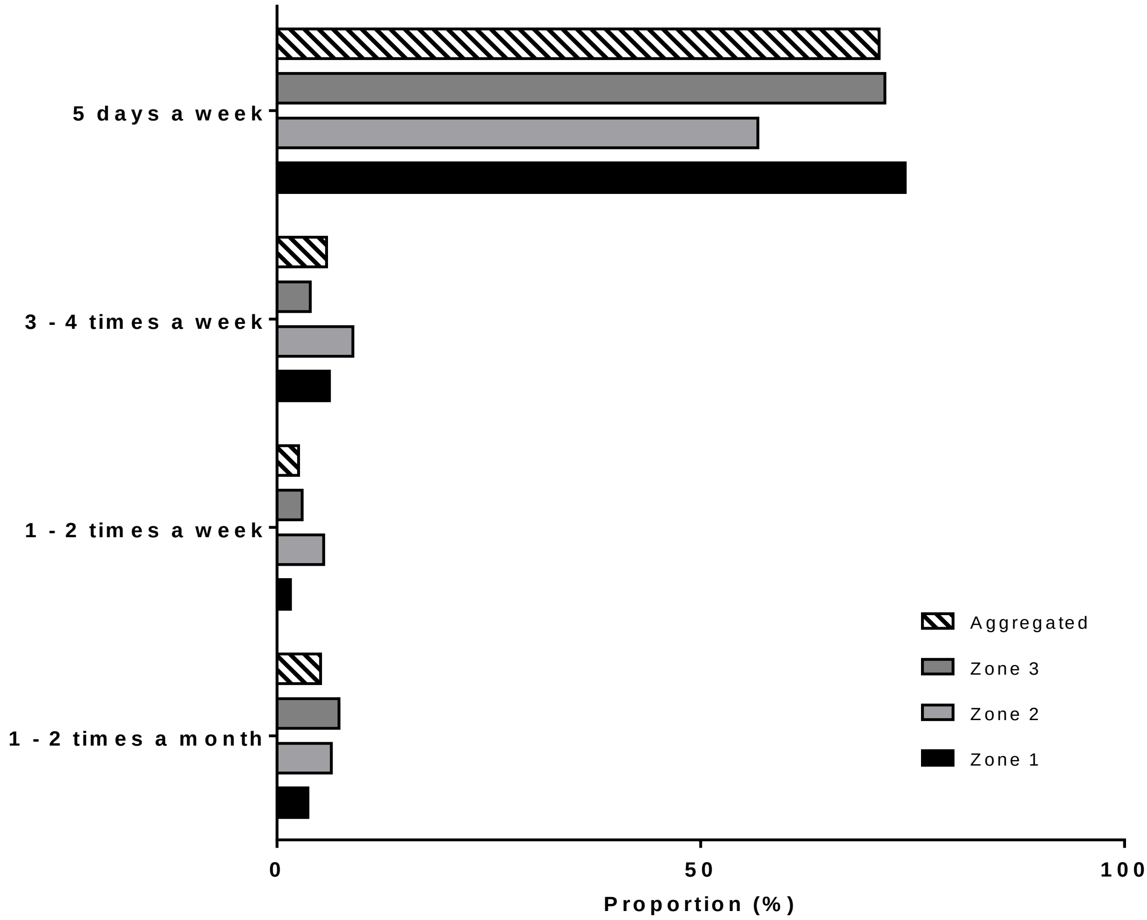

Figure 38: Mothers' reported frequency of iron supplementation use during pregnancy, by zone

4.6 HOUSEHOLD FOOD SECURITY, WEALTH/POVERTY AND WATER AND SANITATION

1803 households with or without children under five years of age participated in the food security survey. The characteristics of this sample are described in section 4.2. 573 of these households also had children under five years old, and also have data on the child and mother's nutrition status and other health, hygiene and diet data. An analysis of associations follows.

FOOD UTILISATION

The majority of both adults (greater than and equal to 15 year of age) (91.4%) and children (less than 15 years of age)[16] (93.9%) reported eating three meals a day and figure 39 shows that there was no evidence that either vary significantly by zone (see also table 31A).

[16] This indicator does not distinguish between the meal frequency of younger and older children and infants where this may exist, and is the household representative's report of the average for all children under 15 years of age.

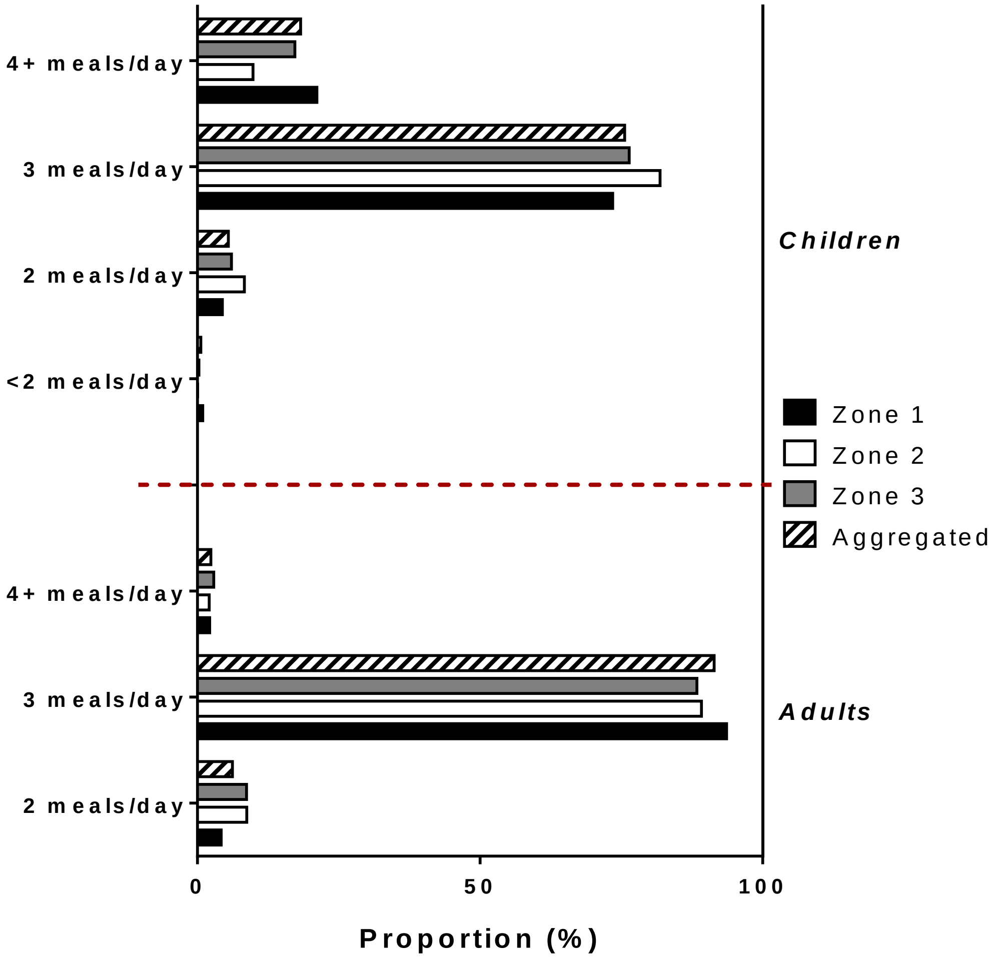

Figure 39: Reported meal frequency among household members the day before the survey, by zone

Household dietary diversity was scored out of a maximum of 12 food groups[17] consumed in the 24 hours prior to the survey (FAO 2013). Mean HDDS was 6.2 (sd 1.4), and figure 31 (see back) illustrates that there was good evidence that households in zone 3 had the highest mean at 6.5 (sd 1.6) (p<0.05) (see also table 31A). Figure 40 shows that the majority of households are classified as having an 'adequate' HDDS in relation to the FSIN suggested threshold of 4, (90.4%), with no evidence of a significant difference across zones.

[17] Cereals, roots and tubers, pulses/legumes/nuts, vegetables, fruits, meat and poultry, eggs, fish and seafood, milk/milk products, fats/oils, sugar and miscellaneous – including beverages and condiments.

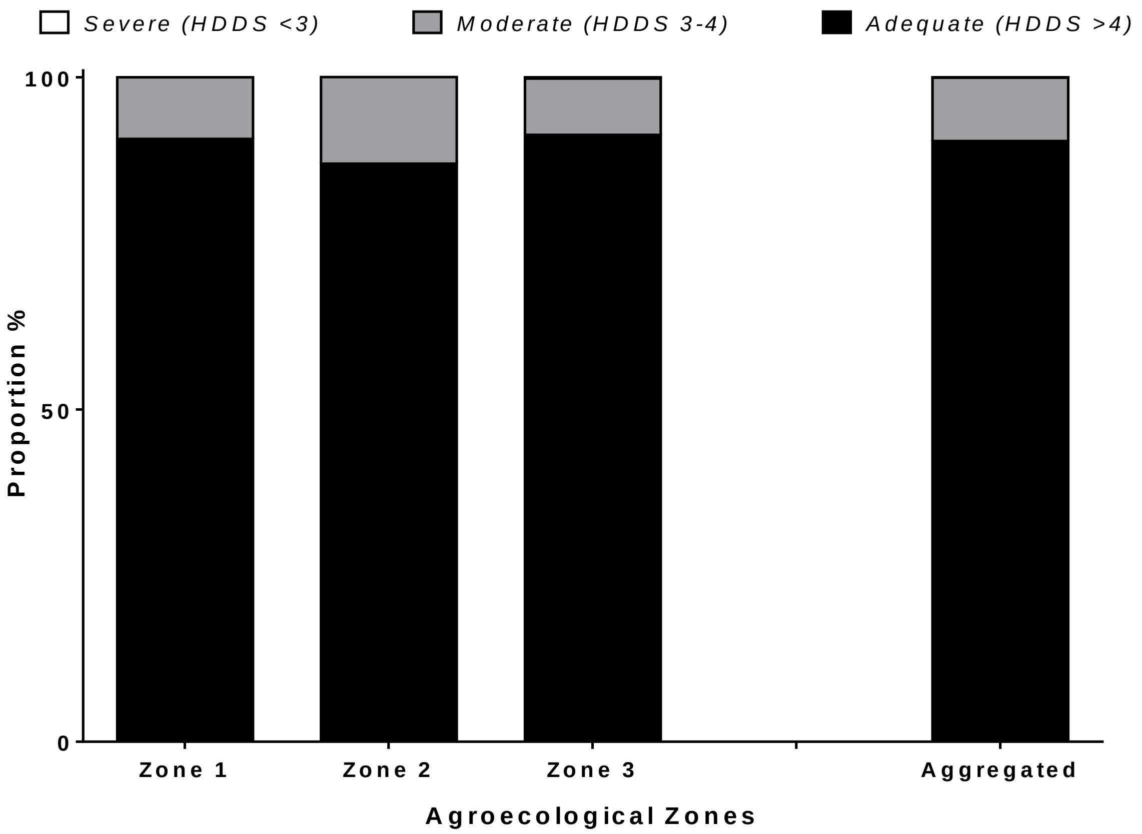

Figure 40: Household Dietary Diversity Score (HDDS) by category, by zone

There was no evidence of significant variation in the frequency of reported food groups consumed in the previous day between zones; most commonly consumed were: cereals and oil (all but one household reported eating rice and oil), condiments (99.9% of households) vegetables (94.6%), pulses/beans (61.6%) and fish 39.4%. About 30% of households also reported eating meat/poultry (34.7%), fruits (32.7%) and eggs (31.8%).

Analysis of the frequency (out of a maximum of seven days for the weekly recall period) by which the groups were consumed indicates daily consumption of rice and vegetables, consumption of beans/pulses on average three days a week and eggs, fish and fruit about two days a week and meat (including poultry) only once a fortnight. Other good groups were all eaten less than one day a week. There is evidence of a significant difference in consumption of a range of food groups between agroecological zones, favouring zone 3 as follows; cereals (other than rice or maize), fruits and eggs were more frequently consumed in zone 3 overall, dairy and vegetables more frequently in zone 3 than 2 and poultry more frequently in zone 3 than 1. Fish and beans/pulses were least frequently eaten in zone 2 but sugar was most frequently eaten there.

The differences in recalled food group consumption between the 24 hour recall and the seven day recall suggest that the seven day recall may underestimate real consumption.

A seven day Food Consumption Score (FCS) was also computed out of a maximum of eight food groups consumed daily, with differential scores to account for diet quality[18] (WFP 2008).

[18] Cereals and tubers=2, beans/pulses=3, vegetables=1, fruits=1, meat, fish and eggs=4, dairy=4, fat/oils=0.5, sugar=0.5

This composite indicator aims to assess the consumption of diverse/quality diets. Mean FCS was 54.8 (sd 15.5) and, not surprisingly given the differences observed in HDDS and frequency of consumption of certain food groups, there was strong evidence of a significant difference between the means by zone, with zone 2 the lowest (49.3, sd 23.5, $p<0.01$) (see table 31A). Figure 41 shows that the majority of households have an adequate FCS (>38.5) (82.4%) although there was strong evidence of significant differences between zones, with more households ranked as 'poor' or 'borderline' in zone 2 ($p<0.001$).

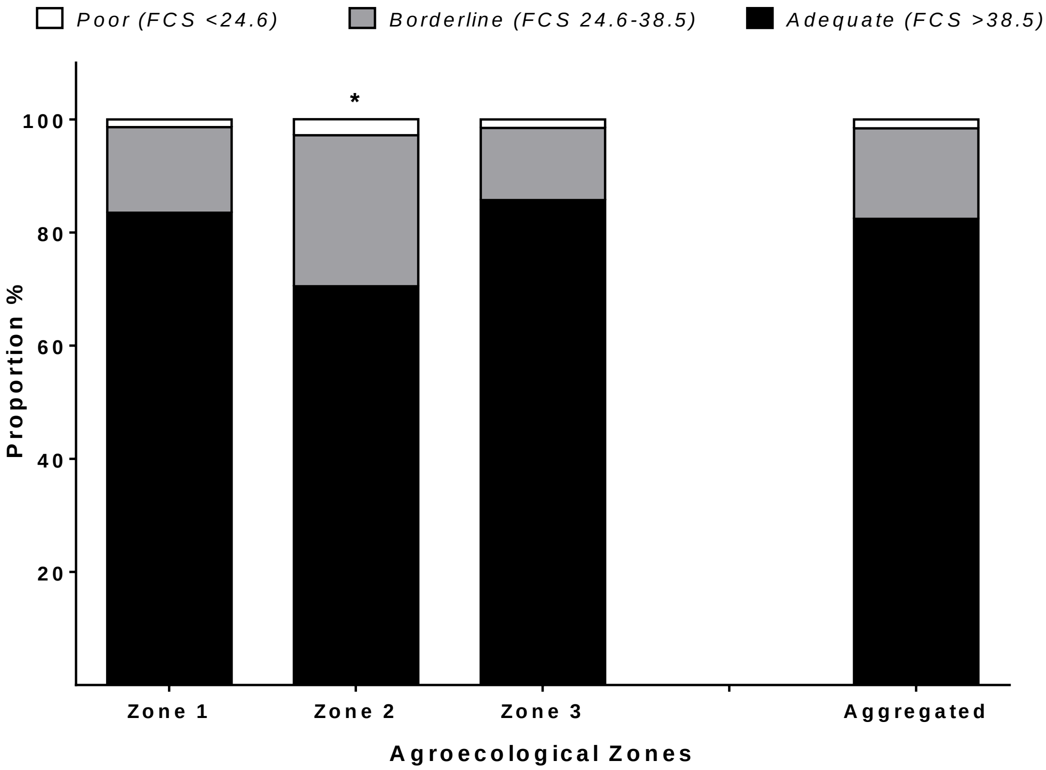

Figure 41: Household Food Consumption Score (FCS) by category, by zone

FOOD AVAILABILITY

Agriculture

Figure 42 illustrates that 60.9% of households reported undertaking agricultural production and 39.1% reported being not being able to access any land, with no evidence of significant differences between zones (see table 32A). A fifth of households had access to between two and four acres and the same proportion 5-10 acres. Less than 10% (9.3%) had access to fewer than two acres and the same proportion more than 10 acres. There was good evidence of a difference by zone, with smaller land holdings in zone 2 ($p<0.05$) (see also table 32A).

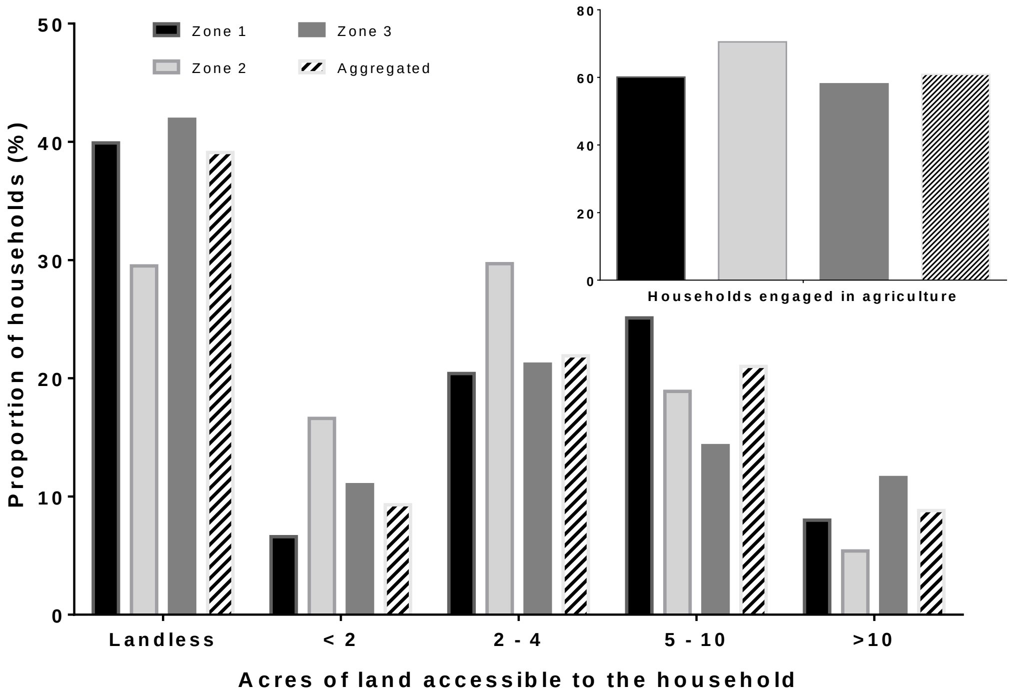

Figure 42: Proportion of households farming and by acres of land accessed

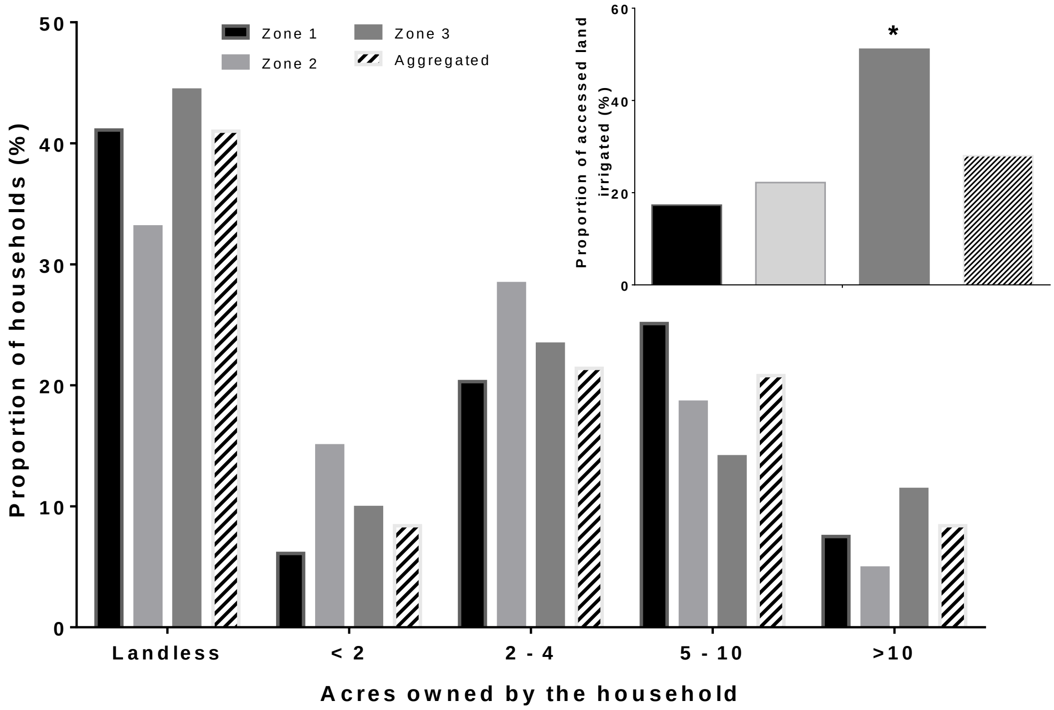

Figure 43: Proportion of households by acres of land owned and proportion of land irrigated

Patterns of land ownership did not differ greatly indicating very low rates of land rental and about a third (28.0%) of the accessed land was irrigated, with this proportion rising to a half in zone 3 (51.1%) ($p<0.01$) as would be expected given the features of the agroecological zones (see figure 43 and table 32A).

Table 13: Household's with staple stocks and duration of stocks, by zone

	Dry land farming zone (1) (n=617)	Highland farming zone (2) (n=574)	Flood plains/irrigated zone (3) (n=612)	Dry Zone Total (n=1803)
% households with staple stocks *(95% CI)*	83.2 (77.6, 88.8)	83.1 (75.6, 90.4)	86.4 (80.7, 92.1)	**84.2 (80.4, 87.9)**
Staple stocks/days *Median (range)*	10 (0 - 365)	20 (0 - 365)	12 (0 - 365)	**15 (0 - 365)**

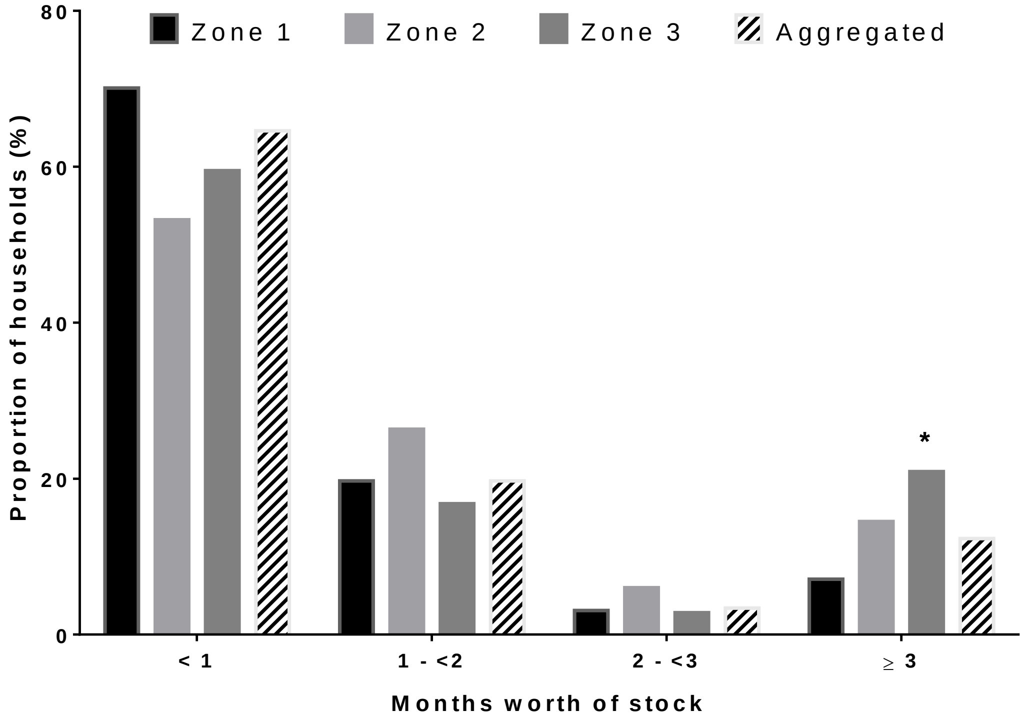

Figure 44: Proportion of households by months' worth of staple stock

Table 13 illustrates that whilst the majority of households reported having a rice/staple crop stock (84.2%), one in six households did not have any reserves. The median days of stock was only 15 for the Dry Zone, and this varied a little by zone, being longest in zone 2 (20 days) and shortest in zone 1 (10 days). Figure 44 illustrates the months' worth of stock by zone (see also table 33A) and looking at the data this way there was strong evidence that zone 1 has the smallest stocks (*p*<0.01) and weaker evidence that zone 3 stores are significantly bigger (*p*<0.05).

Table 14 shows that iodised salt was available in three quarters of households (72.9%) and there was no evidence of significant variation across zones.

Table 14: Household's with iodised salt, by zone

	Dry land farming zone (1) (n=610)	**Highland farming zone (2) (n=567)**	**Flood plains/irrigated zone (3) (n=608)**	**Dry Zone Total (n=1785)**
% households with iodised salt *% (95% CI)*	70.9 (61.5, 80.2)	75.3 (64.5, 86.1)	75.5 (67.2, 83.8)	**72.9** **(66.8, 79.0)**

FOOD ACCESS

Food sources

Household representatives reported that purchase dominated as the main source of nearly all foods in the Dry Zone for the last day and week, mostly followed by own production; e.g. 77.5% reported relying on purchase as the main source of rice, and 13.9% from own production, 77.5% and 15.5% respectively for beans, 78.2% and 17.6% respectively for poultry. There were significant differences between zones in the proportions of main sources for the following food groups: rice, main source of own production was least common in zone 1 (6.8%, *p*<0.001) where there was a greater reliance on purchase (83.6%), whereas zones 2 and 3 displayed a similar in balance of production (22/23%) and purchase (66/70%); beans (*p*=0.001), nuts (*p*<0.05) and vegetables (*p*<0.001) all with a higher proportion of main source as own production in zone 2, than in the other zones (38.3%, 47.8% and 36.6% respectively); pork (*p*<0.05), mutton (*p*<0.001), poultry (*p*<0.01) and fish (*p*<0.001) were also only reported as coming from 'own production' in zone 2 (5.5%, 29.8%, 40.6% and 7.1% respectively). i.e. the population of the Dry Zone are dependent on market purchase to access the majority of their foods, followed by own production and the scope and range of subsistence production appears greatest in zone 2.

Hunger and coping

Figure 45 illustrates that more than a third (39.4%) of households reported that there were times in the last 12 months when they had a problem to meet their food needs, and there was with no evidence of difference between zones (see also table 34A). Figure 46 shows that the most food secure months (having the least reports of problems meeting food needs) were December – February whilst the most food insecure were April – October, peaking in June and July (coinciding with the months of fieldwork). The majority of households had 12 "Months of Adequate Household Food Provisioning".

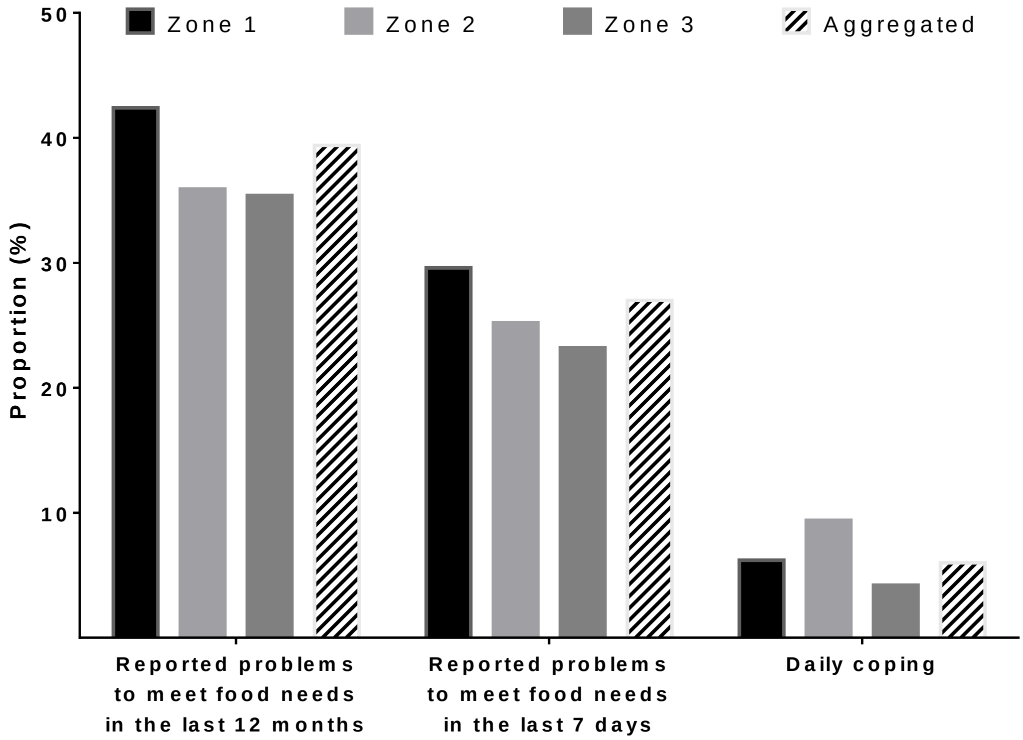

Figure 45: Proportion of households reporting problems to meet their food needs, by zone

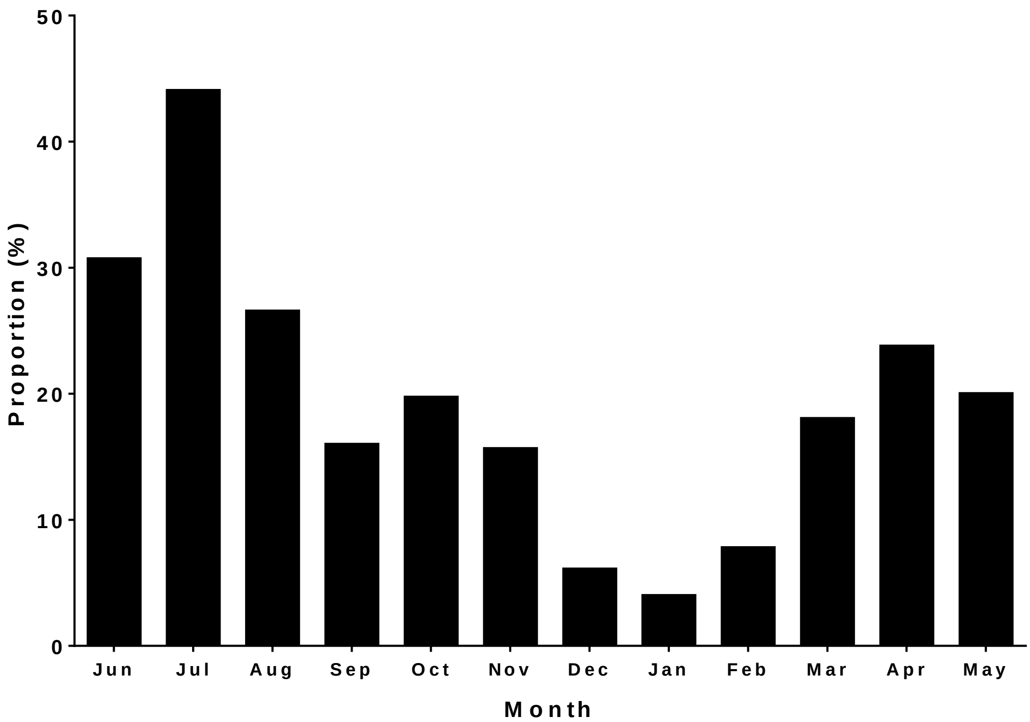

Figure 46: Proportion of households reporting a problem accessing food, by month

They were also asked if there were any times in the past week when they did not have enough food or money to buy food and if yes, a checklist of likely coping strategies was completed, recoding how many times (out of a maximum of seven days) the coping strategy had been used. Figure 45 shows that a quarter (27.0%) of households reported having a problem meeting their food needs in the last week (see also table 34A). The most frequently reported coping strategy in the previous seven days was 'reduction of rice portion size' and this was only practiced by 6.7% of those households with a problem meeting their food needs, followed by consuming a less preferred staple (3.4%) changing curry ingredients/variety/rice quality (2.9%) and eating only rice all day (2.9%).

Figure 45 also shows that a small proportion of households reported employing coping strategies on a daily basis (6.0%) and there was no evidence of a difference by zone (see also table 35A). A Coping Strategies Index (CSI) was calculated from the sum of coping strategies reported per household, with locally validated scores assigned to the coping strategies according to views on their severity[19]. Figure 47 illustrates the CSI scores. Most households ranked 'adequate' on the CSI index (79.4%) with a score less than 3, and no significant difference by zone.

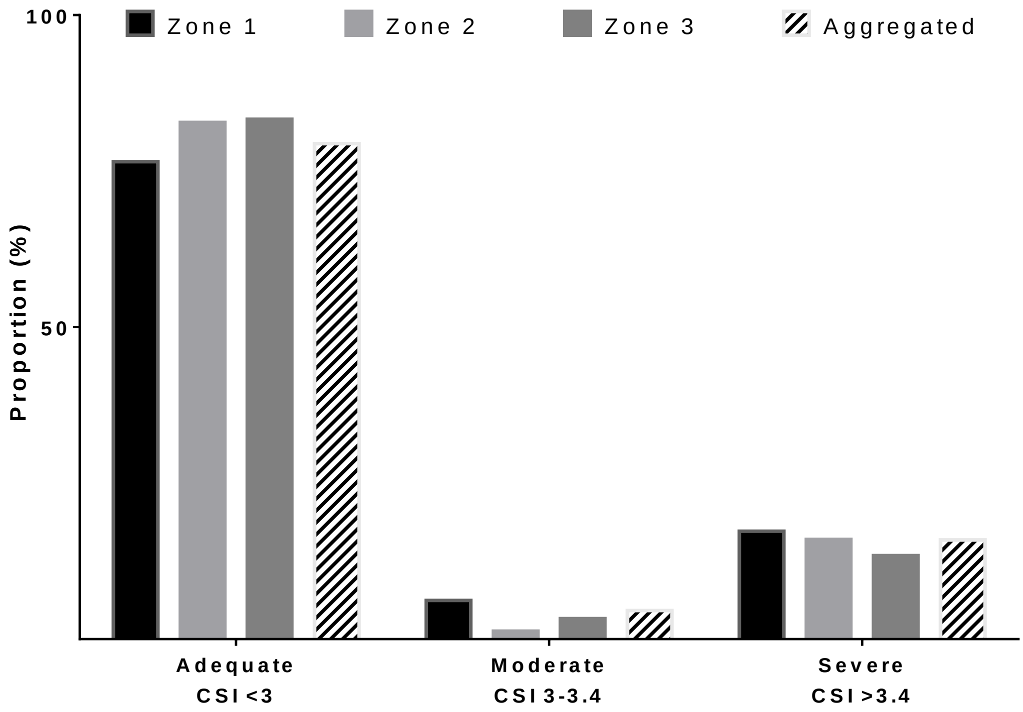

Figure 47: Proportion of households classified by coping strategies index, by zone

[19] Begging for food, eating immature crop = # days of each/7 * 4; eating rice porridge, prioritising children for food, prioritising number of daily meals, eating rice seed stock = # days of each/7 * 3; reducing rice portion size, consuming lesser preferred staple, borrowing food from neighbours/relatives, eating wild plants/animals, sending children/elderly away to eat = # days of each/7 * 2; consuming only rice at meal times, changing curry ingredients/variety or rice quality, purchasing food on credit, reducing health expenditure = # days of each/7 * 1

Household representatives were asked three standardised questions about their access to food, self-perceived hunger and whether they ever went without food for a whole day, to which they could answer never, sometimes, rarely or often. These were coded (0–3 respectively) and summed to create the Household Hunger Score (HHS) (FANTA 2011). As figure 48 illustrates, nearly all households (98.4%) across the zone were classified as having 'no hunger' (a score < 1). Households classified as 'moderately hungry' (a score 2-3) were evenly spread across the zones, and there were only 3 households who were classified as 'severely hungry' (score 4-6) (see also table 34A).

This data would suggest that the reports of recent problems meeting food needs may be overestimated to a degree, and whilst the timing of the survey places the communities in the hungriest months of the year there was no unusual stress at the time of the survey.

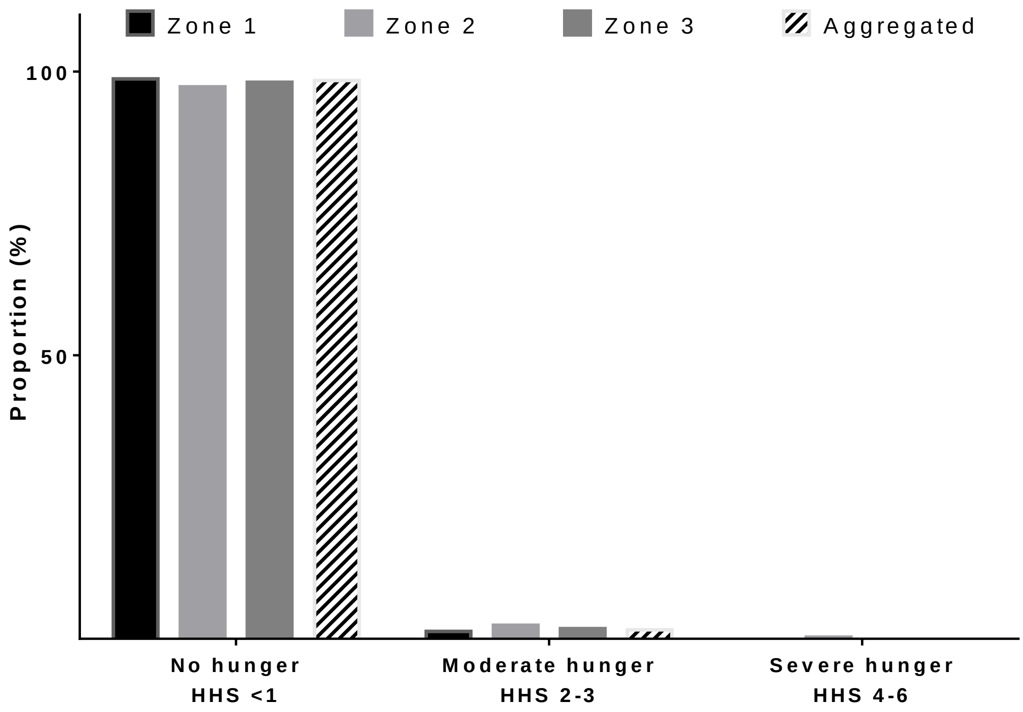

Figure 48: Proportion of households classified by different levels of hunger, by zone

WEALTH AND POVERTY

Incomes

The median number of sources of income per household year round was two across the zones, with a range from 0-9 in the Dry Zone as a whole (see table 35A). Figure 49 shows that only a handful of households reported having no income at all in the last year (0.6%); the majority of households had two different income sources (40.4%) and a further 36.8% three or more, with no difference between zones.

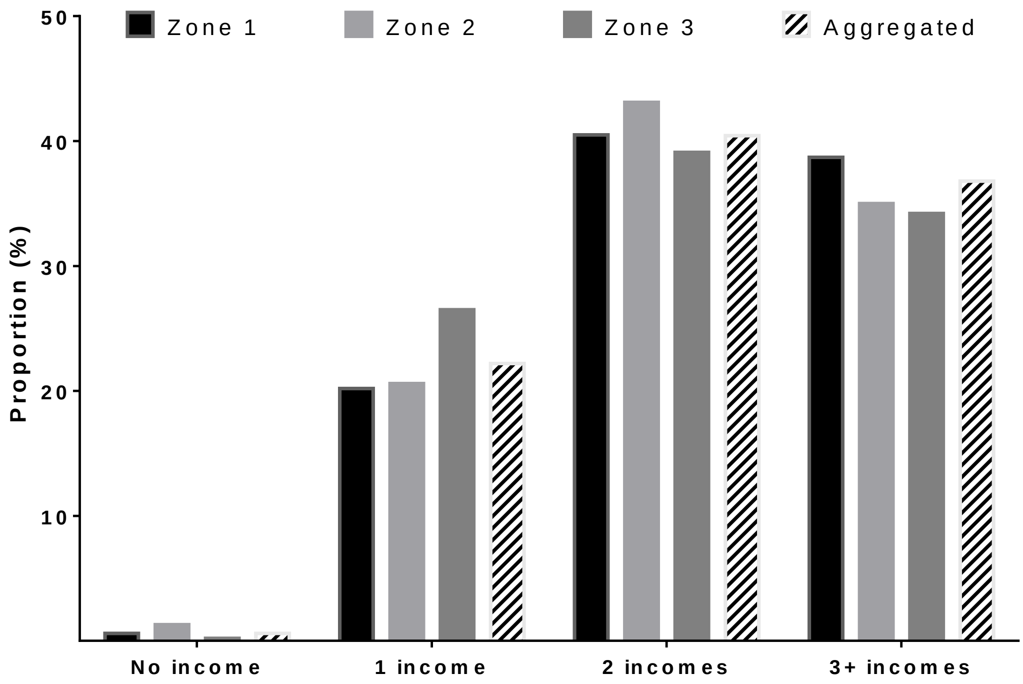

Figure 49: Proportion of households with different numbers of income sources, by zone

Household's income sources during the last year were categorised in to 30 categories. Agricultural wage labour was the most common source of income for a third of households across the dry zone (35.2%), followed by sale of pulses/beans 33.7%, sale of sesame 29.1%, non-agricultural wage labour 18.4%, sale of paddy 17.3%, remittances 12.4% and petty trading 9.2%. Sale of paddy showed significant differences by zone being lower in zone 1 at 12.0% than in zone 3 at 26.2% (p=0.017), as did remittances being highest in zone 1 at 17.0% (p<0.01)[20].

The distribution of mean income during the last month was highly skewed and the median income was 38,000 kyat (38 USD) with a very large range from nothing to 7,000,000 (0 – 7,000 USD) (see table 35A). Examining and testing for the differences in the percentage of households falling in to income categories of 25,000 kyat highlights the strong evidence of significantly higher incomes in zone 3 compared to zones 1 (p=0.007) and 2 (p=0.003) during the month preceding the survey, as illustrated in figure 50, although it is important to remember that absolute incomes are low across the Dry Zone. More households in zone 2 earned less than 25,000 kyat in the month before the survey and more households in zone 3 earned more than 100,000 kyat.

Households were asked about their main and second main income generating activity in the month before the survey. The results for the main and second main activities were very similar

[20] Other less common income sources that varied significantly by zone were: trade/commerce/shop keeper, a source of income for 3.7% of households, but highest in zone 3 (p=0.005); toddy sale, a source of income for 3.5% of households but higher in zone 1 than zone 3 (p<0.001); sale of other wooden products 2.3%, most likely in zone 2 (p=0.009); caretaker of livestock/shepherd 2.1%, higher in zone 2 than in zone 3 (p=0.047), and mining and quarrying 0.5% (p=0.015), nearly all in zone 2 and the rest in zone 3.

so only those for the top four main activities are presented in figure 51 and table 35A. The results are similar to year round reports, with wage labour and arable produce sale dominating, with some difference between zones e.g. highest paddy sale in zone 1.

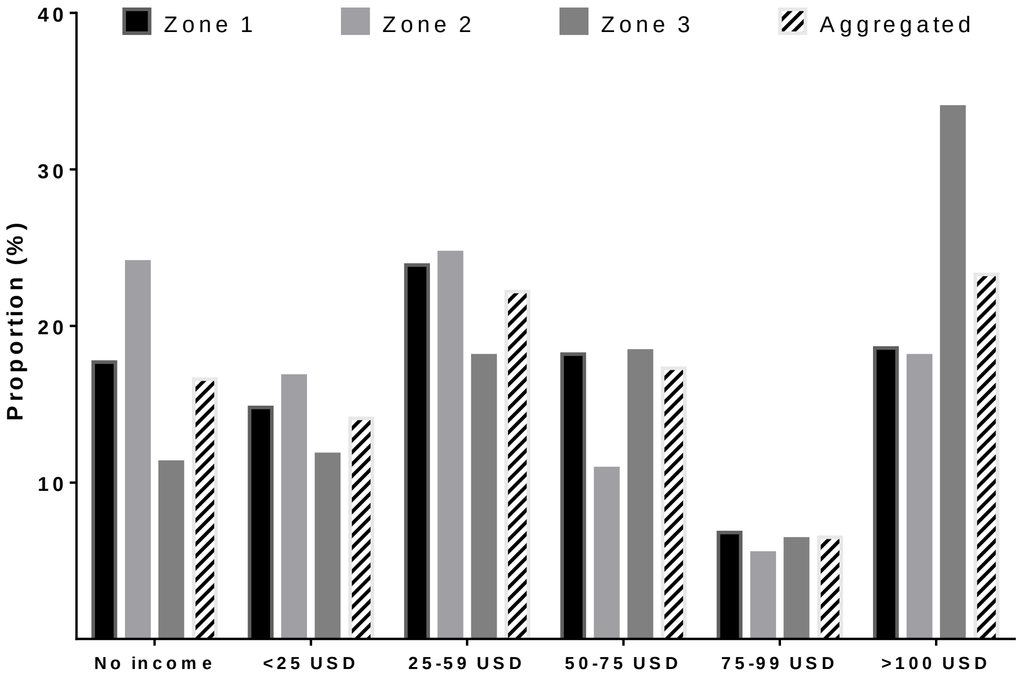

Figure 50: Proportion of households with different levels of income, by zone

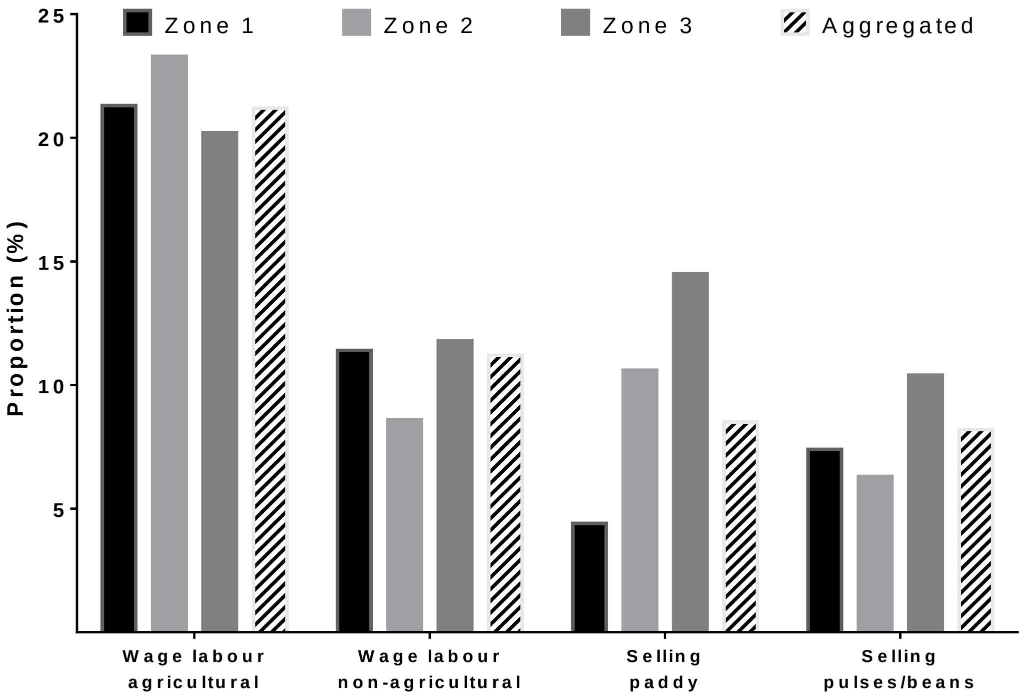

Figure 51: Proportion of households engaged in the top four income generating activities, by zone

Expenditures

Household representatives were asked how much they had spent on food and a limited number of non-food items (firewood, betel/cigarettes/alcohol and drinking water) in the last 30 days, by both cash and credit purchases. Whilst the distribution was skewed, figure 52 illustrates that the mean total expenditure for the Dry Zone was 127,000 kyat (sd 109,000 kyat) (127USD, sd 109 USD) and there was good evidence that this was highest in zone 3 ($p<0.05$)[21]. Medians showed a different pattern because of a much wider range in spend in zone 3 (see also table 15).

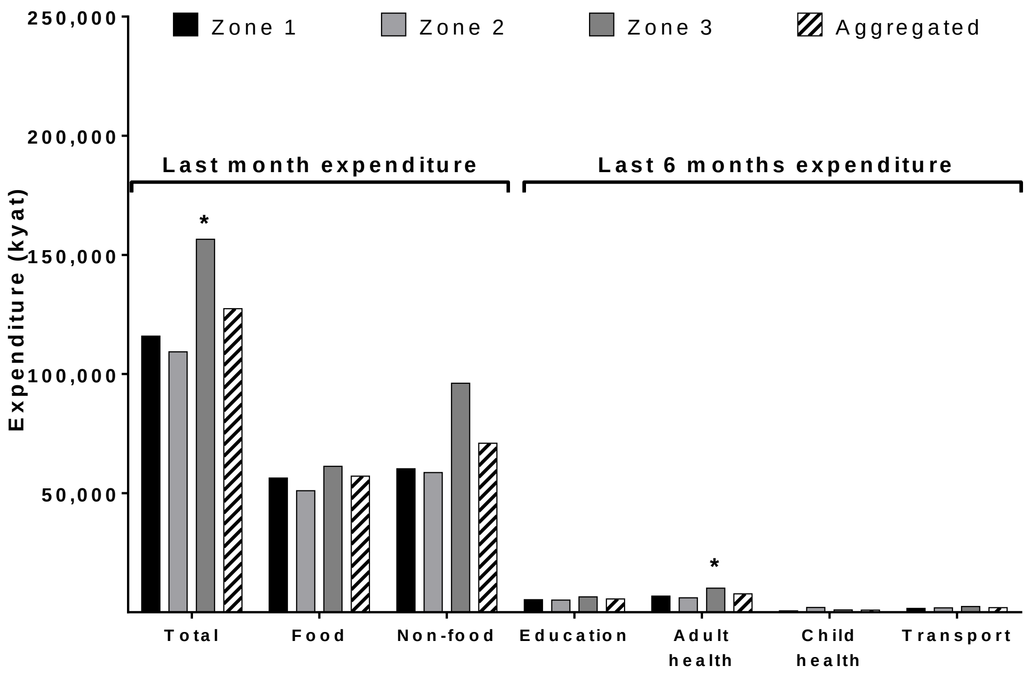

Figure 52: Household mean expenditure in kyat, by category, by zone

The mean expenditures were more in the Dry Zone as a whole and in zones 1 and 2, than mean monthly incomes, with the biggest difference in zone 1. The differences between the medians were far greater. Given that the months in which the field work was undertaken are the most food insecure in the year, a differential is rational but the absolute difference is still striking.

Looking only at expenditure on food (in figure 53), this was 55.3% of total spend at Dry Zone level. There was good evidence that the absolute mean (transformed and untransformed) for zone 3 was higher than for zone 2 ($p=0.032$) (see table 15), and figure 53 shows that there was good evidence that the proportion spent on food was lowest in zone 3 ($p<0.05$). Rice purchase accounts for a very large proportion of food expenditure, with significant differences by zone following the same pattern, with good evidence that it is lowest in zone 3 ($p<0.05$) (see also table 36A). Cooking oil and meat follow in terms of greatest absolute spend (medians 7,500

[21] Monthly expenditure was skewed but the identity distribution was similar to the square root transformation and testing differences between transformed and untransformed means gave the same results

(from 0-90,000) and 5000 (from 0 – 100,000) for the month). The medians follow a different trend in terms of differences between agroecological zones as a result of very wide ranges in zone 3. In short, about half of recent monthly expenditures were on food (and just short of half of this on rice) and this was highest in zone 3[22].

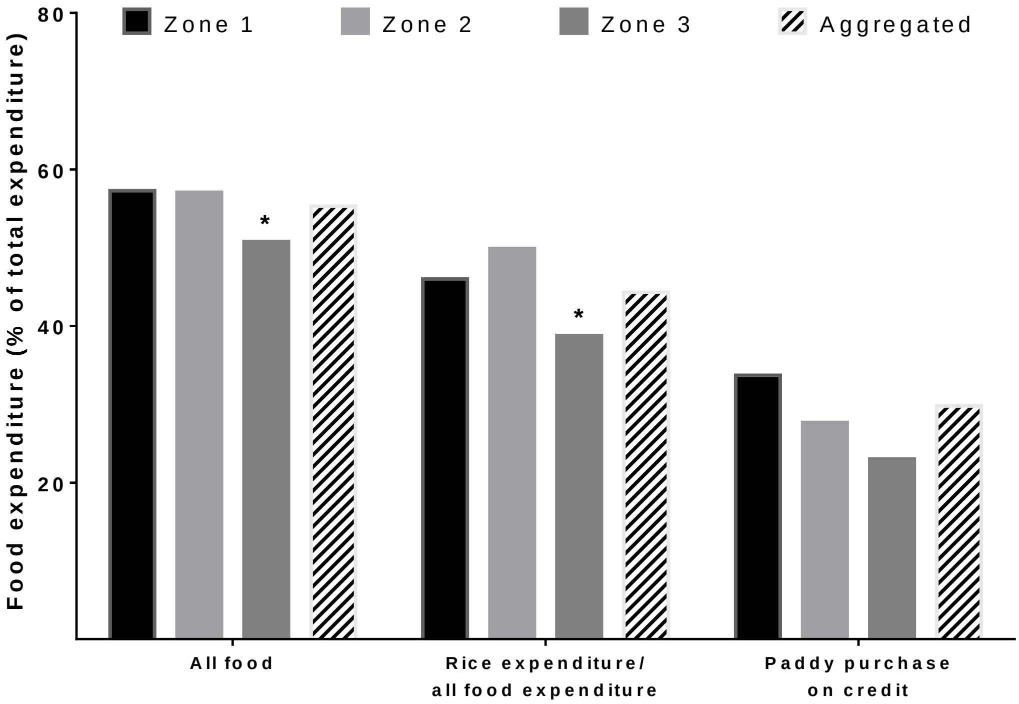

Figure 53: Household's mean food/rice expenditure as a proportion of total expenditure and percentage of paddy purchased on credit

Looking at six monthly spend on education, health and transport illustrated in figure 52 (and see tables 15 and 36A) indicates the following: very low absolute and proportional investment in education across the Dry Zone, with no evidence of zonal differences; low absolute and proportional spend on adult health costs, with absolute spend significantly more in zone 3 than 2 (p<0.05); extremely low absolute and proportional spend on child health costs with no significant zonal differences; and lastly, low absolute spend on transport, again with no evidence of significant difference by zone. The absence of evidence of significant differences in absolute spends by zone given indication of variable health needs (greatest in zone 2) and differential access challenges (greatest in zone 2) is surprising but may be explained by limited available income to meet these needs as incomes are highest in zone 3.

[22] This is an interesting finding given that the majority of households are achieving 'adequate' HDDS scores, which are meant to be an indicator of economic access to food, i.e. whilst most households are accessing enough of a range of foods to achieve adequate diversity scores, this is requiring them to spend nearly half of their small incomes. As this is a suggested threshold for Myanmar (FSIN 2012) it may be that it should be revised upward, to make it less conservative.

Table 15: Household's average absolute expenditures, by category, by zone

	Dry land farming zone (1)	Highland farming zone (2)	Flood plains/irrigated zone (3)	Dry Zone Total
Expenditures/last month				
Mean/kyat *(sd)* *(95% CI)*	115,897 (68,986) (98,202, 133,592) **1 and 3 p=0.035†*	109,290 (143,749) (97,614, 120,965) *** 2 and 3 p=0.003†*	156,580 (147,507) (128,896, 184,264)	**127,419** **(109,140)** **(112,708, 142,129)**
Median *(range)* *(n)*	99,558 (0-737,600) (n=606)	76,667 (0-1,113,900) (n=563)	96,817 (0-1,089,500) (n=594)	**91,500** **(0 – 1,113,900)** **(n=1763)**
Food expenditures/last month				
Mean/kyat *(sd)* *(95% CI)*	56,379 (23,438) (51,489, 61,269)	51,031 (42,413) (46,840, 55,221) **2 and 3 p=0.032†*	61,230 (38,279) (53,918, 68,541)	**57,151** **(31,927)** **(53,437, 60,863)**
Median *(range)* *(n)*	53,675 (0-191,500) (n=613)	44,800 (0-222,000) (n=567)	50,500 (0-241,000) (n=604)	**49,500** **(0 – 241,000)** **(n=1784)**
Non food expenditures/last month				
Mean/kyat (sd) *(95% CI)*	60,209 (55,838) (46,442, 73,976)	58,655 (123,092) (49,695, 67,614) *** 2 and 3 p=0.002†*	96,162 (128,708) (73,048, 119,277)	**70,973** **(92,589)** **(59,089, 82,856)**
Median *(range)* *(n)*	43,792 (0-6,600,000) (n=610)	26,850 (0-1,009,500) (n=570)	41,667 (0-9,765,000) (n=601)	**37,933** **(0 – 1,009,500)** **(n=1781)**
Education expenditure/last 6 months				
Mean/kyat (sd) *(95% CI)*	5,275 (11,740) (3,739, 6,812)	5,129 (27,195) (3,467, 6,792)	6,504 (21,302) (4,071, 8,937)	**5,632 (17,150)** **(4,446, 6,818)**
Median *(range)* *(n)*	417 (0-166,667) (n=616)	333 (0-158,333) (n=574)	0 (0 – 168,333) (n=607)	**167** **(0-168,333)** **(n=1797)**

	Dry land farming zone (1) (n=617)	Highland farming zone (2) (n=570)	Flood plains/irrigated zone (3) (n=612)	Dry Zone Total (n=1798)
Adult health expenditure/last 6 months				
Mean/kyat (sd)	6,800 (12,383)	6,060 (22,350)	10,089 (23,464)	**7,713 (17,987)**
(95% CI)	(5,274, 8,327) **1 and 3 p=0.0133*	(4,529, 7,592) ***2 and 3 p=0.0026*	(7,994, 12,185)	**(6,535, 8,892)**
Median	1167	1000	1500	**1167**
(range)	(0 – 166,667)	(0 – 151,367)	(0 – 166,667)	**(0 – 166,667)**
Child health expenditure/last 6 months				
Mean/kyat (sd)	620 (3,954)	2,021 (21,479)	989 (5,318)	**922 (6,977)**
(95% CI)	(244, 995)	(0, 4,496)	(443, 1,535)	**(459, 1,386)**
Median	0	0	0	**0**
(range)	(0 – 125,000)	(0 – 50,000)	(0 – 50,000)	**(0 – 133,333)**
Transport expenditure/last 6 months				
Mean/kyat (sd)	1,667 (4,214)	1,900 (14,092)	2,441 (8,908)	**1,937 (7,051)**
(95% CI)	(825, 2,509)	(680, 3,121)	(1,153, 3,728)	**(1,283, 2,590)**
Median	0	0	0	**0**
(range)	(0 - 47,500)	(0 – 93,333)	(0 – 90,000)	**(0 – 93,333)**

†comparing square root transformed means

Loans/credit

The taking of loans is extremely common and normal in the Dry Zone; table 16 shows that 79.0% of households reported taking money loans/credit in the last six months, and there was no evidence that frequency with which loans were taken varied significantly between zones. For those who did not take loans, the majority (97.6%) stated that they had no need and the rest (2.4%) that they could not access a loan.

Most common sources of loans across the Dry Zone were: money lender: 38.2% of households; family or friends: 35.1% of household and shop keepers/traders: 31.6% of households. Whilst 13.6% of households had loans from government banks, there was strong evidence that this was significantly more common in zone 3 (21.5%) than in zone 2 (5.9%) (p=0.001). And there was also a difference between zones for Village Savings Group (VSG) loans too; 11.6% of households had a VSG loan at Dry Zone level, but this was most likely in zone 1 (17.6%) (p<0.05).

Table 16: Household's loans/credit, by zone

	Dry land farming zone (1)	Highland farming zone (2)	Flood plains/irrigated zone (3)	Dry zone total
Loans/credit				
% taking loans/credit	81.5	75.3	76.0	**79.0**
(95% CI)	(76.2, 86.8)	(69.3, 81.3)	(70.0, 81.9)	**(75.3, 82.7)**
(n)	(n=617)	(n=574)	(n=612)	**(n=1803)**

Figure 54 shows that the majority of households (50.2%) reported having loans of between 200,000 and 300,000 kyat (200 – 300USD), although a third (30.8%) had borrowed less than 100,000 kyat (see also table 37A). There was no evidence of a difference in loan amount by zone. Households were asked how this compared to their debts in the previous year, to assess typicality. A fifth of households (20.4%) reported the amounts to be similar, a fifth (19.3%) that they were less and a further third (36.7%) that they were more, with no evidence of a difference between zones; indicating that the current reported situation may not be very different from any other year and it is typical for households to have very large absolute and relative debts. This assessment is supported by the absence of hunger and damaging coping reported.

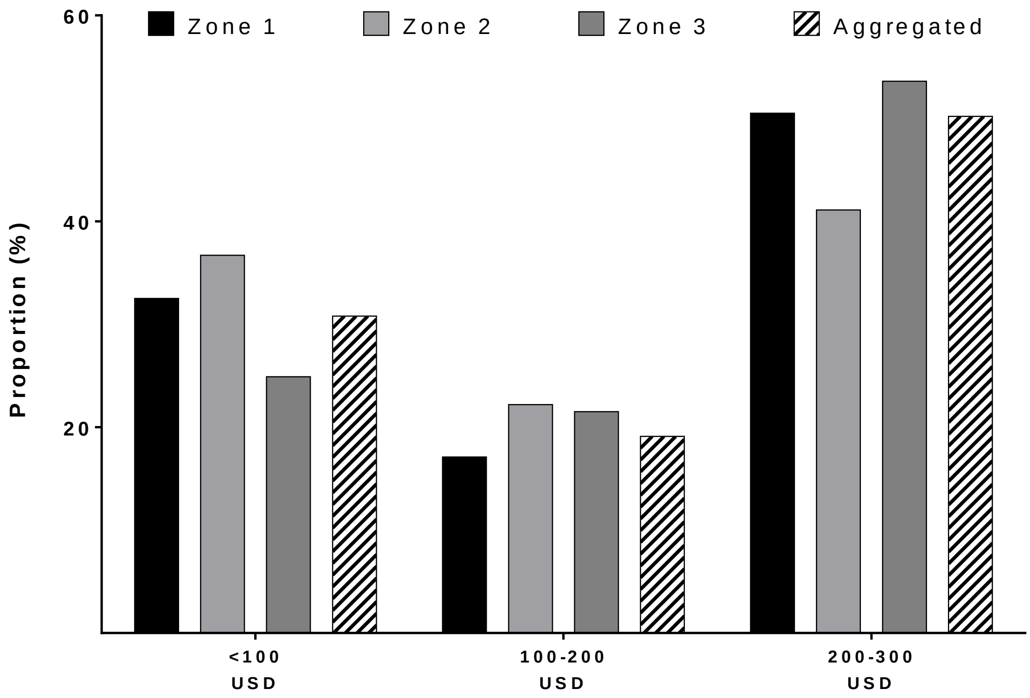

Figure 54: Proportion of households with a loan, by amount and by zone

Household representatives were asked the main use of the loans they had taken. The majority had borrowed to purchase food (58.9%), a third to purchase agricultural inputs or rent land (31.1%) and a fifth to pay for health expenditures (22.4%). Aside from borrowing to pay for travel abroad which was rare (0.8% of households) but most common in zone 2 (3.0%), there was no evidence of significant zonal differences in the use of loans.

Looking at the proportion of 30 day spend taken on credit just for paddy rice, cooking oil and meat (which command the largest absolute spends out of a range of food items, across the dry zone) highlights the commonality of use of credit; a third of rice spend was on credit (29.8%) and this was lower in zone 3 than zone 1 (p=0.028) (see table 36A); 10.4% (sd 27.2, 95% CI 7.9, 12.8) 10% of spend on meat was on credit and 16.9% (sd 33.1, 95% CI 10.8, 23.0) on oil, with no evidence of zonal differences.

Livestock assets

Table 17 shows that the majority of households owned livestock (71.5%) but this varied significantly by zone, with the lowest ownership in zone 3 (59.9%) (p<0.01). The commonly livestock owned were: chickens (36.3%); male cattle (28.2%); calves (18.6%); a female pig (15.1%) followed by a pair of cattle (14.0%). Patterns of ownership varied significantly by zone with highest ownership of female pigs and piglets in zone 2 (p<0.001) and most chickens in zone 2 and least in zone 3 (p<0.01). Whilst buffalo ownership was <1% almost all were in zone 2 (p<0.001) and the same was the case for the 4.6% of households owning goats (p<0.001).

Table 17: Households with livestock, by zone

	Dry land farming zone (1) (n=617)	**Highland farming zone (2) (n=574)**	**Flood plains/irrigated zone (3) (n=612)**	**Dry Zone total (n=1803)**
% households with livestock *(95% CI)*	75.3 (68.8, 81.7) ***1 and 3 p=0.002*	82.3 (77.8, 86.7) **** 2 and 3 p<0.001*	59.9 (53.4, 66.3)	**71.5 (67.2, 75.7)**

Poverty score

A poverty score was calculated using a Myanmar validated tool which focuses on living conditions and permits calculation of the likelihood that a household's consumption is below a given poverty line (Shreiner 2012)[23],[24] . The data were normally distributed and comparison of the means revealed good evidence (p<0.05) of a significant difference between zones, with zone 3 having the highest mean score (see table 38A). This finding is consistent with the pattern of significant differences in the other livelihoods related data presented above. Examining the differences between zones in the components of the score indicates that there are four influencing factors where there is evidence that the situation in 3 is better than 1:

[23] It includes the following variables: number of household members, woman's education, number of rooms in the house, its floor and roof materials and source of lighting, access to a stove, store cupboard, TV, transport assets and other assets and livelihoods category (landless agricultural, non-agricultural, agricultural with draught animals and agricultural without draught animals)

[24] It should be noted that the poverty lines are based on the estimations using the Integrated Household Living Conditions Assessment database from 2009/2010, which could create a limitation in the temporal comparability of the data if significant changes in these conditions are judged to have occurred over this time period.

floor materials (*p*=0.012), store cupboard access (*p*=0.000), TV access (*p*=0.002) and asset ownership (*p*=0.003) and lighting (*p*=0.003). A score between 35-39 in the Dry Zone and all zones indicates an overall likelihood that 3.2% of the population are below the food poverty line, 23.3% below the national poverty line and that 27.2% are below the international poverty line of $1.25 a day[25]. Figure 55 illustrates the Dry Zone poverty likelihoods. Looking at the mean household level likelihoods indicates more precisely that 26.1% of households are likely to be below the national poverty line, and there is good evidence (*p*<0.05) that zone 3 has the lowest likelihood proportion; although at 23.2% this is little meaningful difference (see table 38A). The median is slightly lower at 23.3 with a range of 0 – 83.4 and this was identical across zones. Looking at the mean household level likelihoods indicates more precisely that 4.4% of households are likely to be below the food poverty line, and there is good evidence (*p*<0.05) that zone 3 has the lowest likelihood proportion at 3.6% (see table 38A).

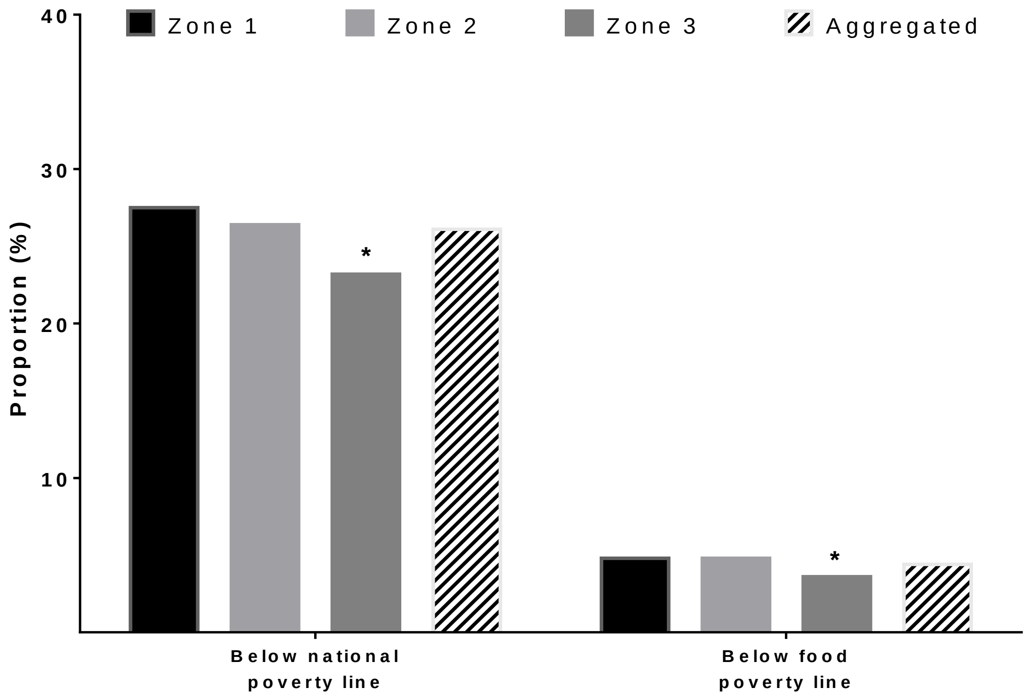

Figure 55: Proportion of households with likelihood probability of falling below poverty lines by zone

WATER, SANITATION AND HYGIENE

Water sources

Nearly all households had year round access to a water source (94.6%), although table 18 shows that in only two thirds of households (64.5%) was this protected, with no evidence of a significant difference by zone. Looking at variation over seasons, there was surprisingly little difference: rains 71.9%, winter 66.9%, and summer 69.9%, and no evidence of any difference between the zones in any season, i.e. about a third of households in the Dry Zone use unprotected water sources (likely springs) at some point during the year. In terms of specific

[25] 1.25 dollar per day (PPP 2005), Shreiner 2012

sources there was a consistent pattern through the seasons of majority accessing tube wells/boreholes (46.3%, 48.1% and 51.5% rains, winter, summer respectively), followed by protected hand dug wells (14.8%, 15.1% and 15.5%) and unprotected springs (11.7%, 15.3% and 16.5%). Whilst ponds were the fourth most important source in the rains (10.7%) and winter (8.3%), streams and rivers were more important than ponds (4.1%) in the summer season (7.6%). This is more or less consistent with the results of the village profile. There was weak evidence ($p<0.05$) that tube well/borehole use was significantly higher in zone 3 than 2 and 1 in the rainy and winter seasons.

Table 18: Household's access to protected water, year round, by zone

	Dry land farming zone (1) (n=617)	**Highland farming zone (2) (n=573)**	**Flood plains/irrigated zone (3) (n=612)**	**Dry Zone Total (n=1802)**
Households with access to protected water year round* *% (95% CI)*	58.0 (39.9, 76.1)	61.5 (47.0, 76.1)	77.5 (66.5, 88.5)	**64.5 (53.1, 75.9)**

Water treatment

As illustrated in figure 56, for treatment of drinking water, most reported household representatives reported using cloth filtration (79.6%), 17.4% reported boiling it and a small number (4.8%) letting it settle (see also table 39A). But 15.0% of households reported not filtering water. There was no evidence of a difference by zone.

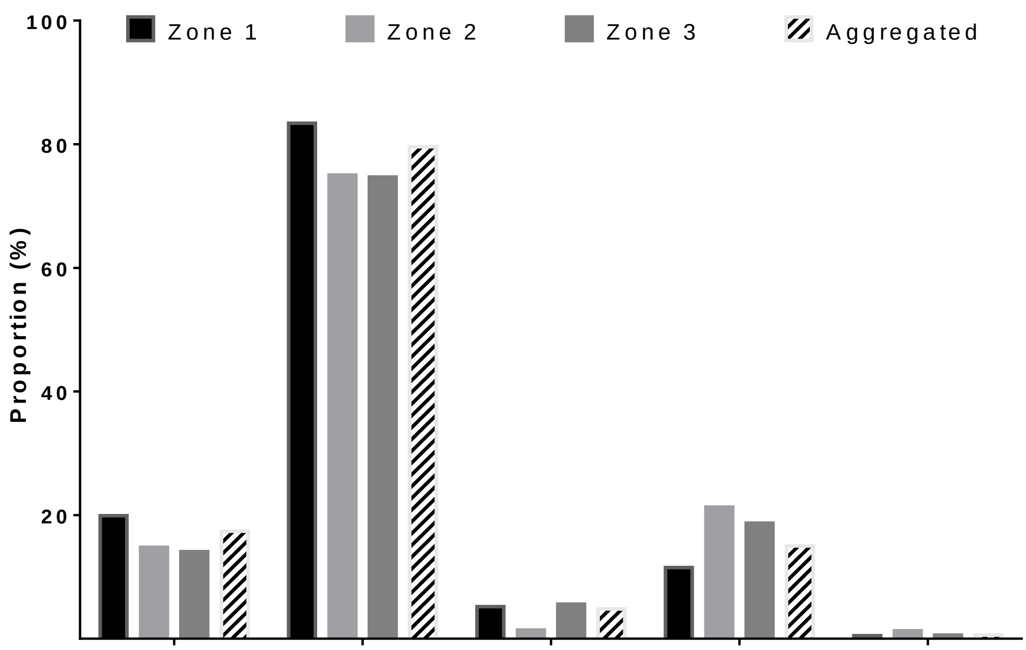

Figure 56: Proportion of households practicing water treatment, by zone

Latrine access

As illustrated in figure 57, half of households (47.4%) reported using a Ventilated Improved Pit (VIP) latrine, and a further 12.1% a flush or pit latrine with a slab (see also table 39A). However a quarter (25.1%) of households did not have access to a latrine and may therefore be forced to practice open defaecation. Again, there was no evidence of a difference by zone.

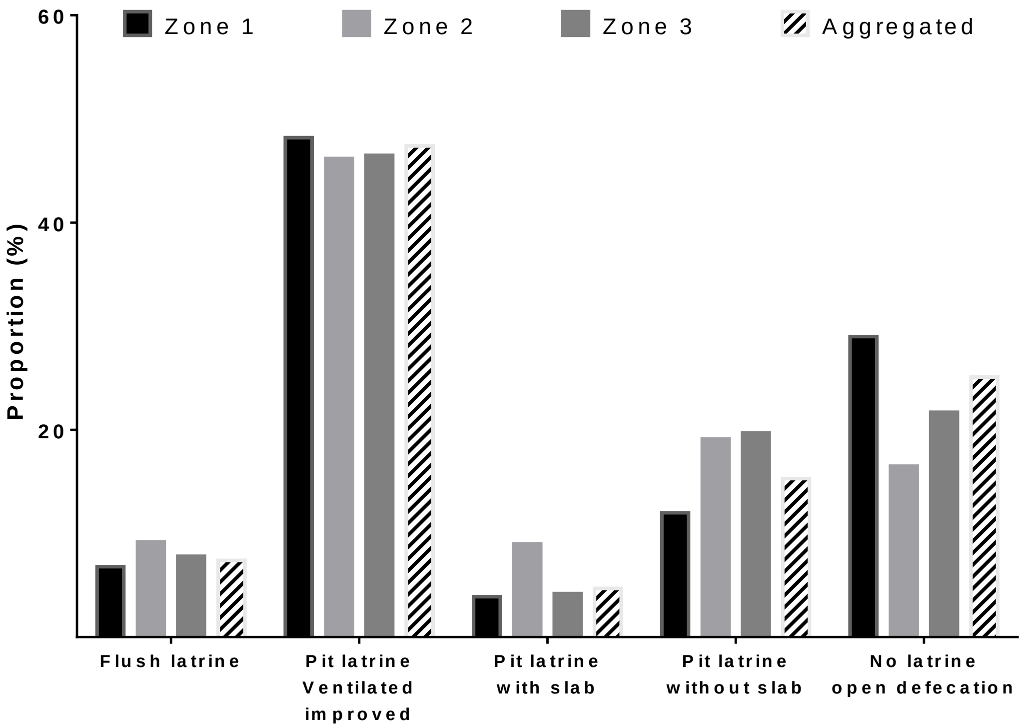

Figure 57: Proportion of household's access to latrine, by type, by zone

4.7 ANALYSIS OF ASSOCIATIONS

Annex five contains a summary of the results of the descriptive analysis including evidence of differences between agroecological zones (which are also summarised in narrative form in the discussion section below). The results of the linear and logistic regressions add to this analysis to support achievement of the survey objectives. The linear regressions explore some of the factors likely to be associated with child and mother's nutrition status at a population level in the Dry Zone as a whole. The logistic regressions explore risk factors for stunting, wasting and maternal underweight (i.e. focusing on associations at the left side of the population distribution only), in the Dry Zone as a whole. Outcomes were children's WHZ score and HAZ score, child wasting and stunting and mother's BMI. The explanatory variables listed in figure 58 were selected on the basis of the pre assessment causal analysis framework (figure 3) and the results of the descriptive analysis (annex five)[26]. Further examination of associations

[26] Clarifying the approach, every indicator at the level of immediate and underlying causes of undernutrition was systematically tested against each nutrition outcome indicator. Where the explanatory variable was continuous, a linear regression was conducted with the continuous nutrition indicators (e.g. child IDDS as the explanatory variable and HAZ as the outcome variable) and also with

between indicators of the underlying causes of malnutrition were also undertaken to unpack plausible causal pathways. Only significant results are tabulated and discussed[27].

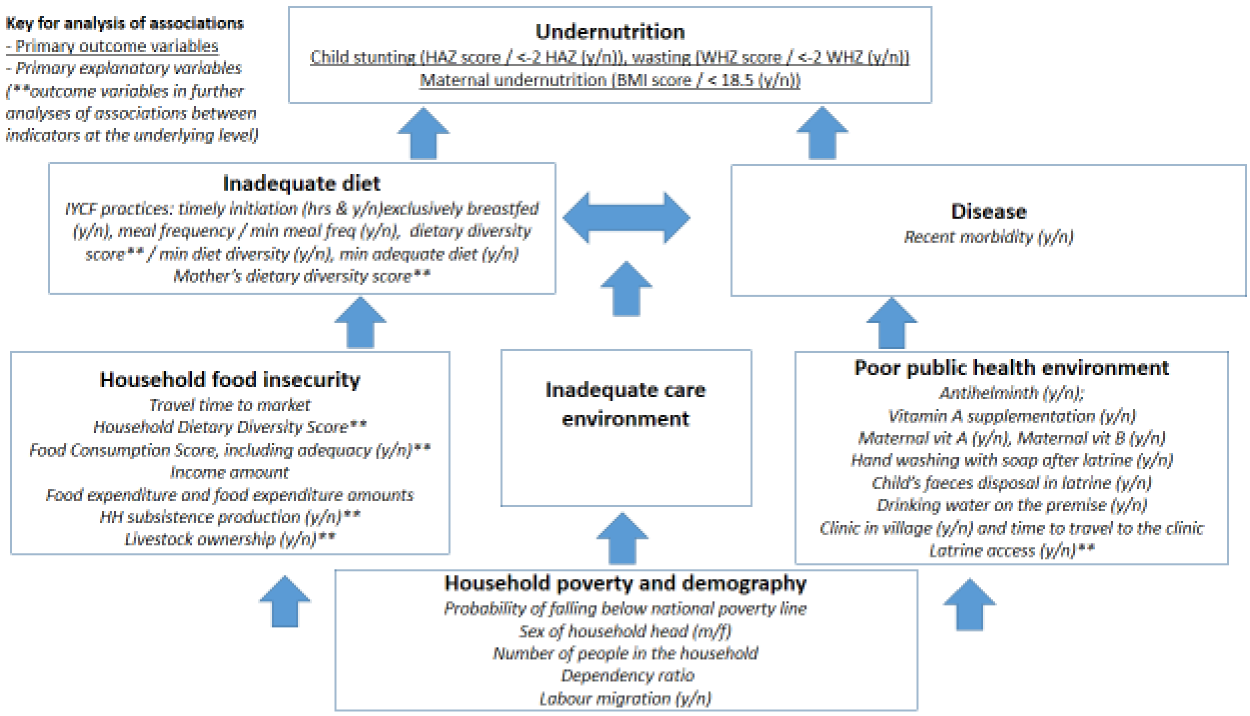

Figure 58: Indicators used in analysis of associations

Nutrition outcomes

Factors significantly associated with child nutrition outcomes at the population level

Table 19 shows that there was a strong association between weight at birth and HAZ score, with a coefficient of determination of 13.1 (meaning birth weight explains statistically 13% of the variation in HAZ of under 5 year old children in the Dry Zone; the coefficient of variation of 0.28 means that for every 1kg increase in birth weight HAZ increases by 0.28). The same relationship was evident for WHZ, although it was weaker. Mother's BMI determines 1.4% of children's WHZ variation but there was no association with HAZ, perhaps because BMI is

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the binary form of the nutrition indicator as well (e.g. explanatory variable child IDDS and outcome variable HAZ<-2). The continuous explanatory variable was also formed in to a binary variable and logistic regression undertaken (e.g. adequate IDDS as the explanatory variable and HAZ<-2 as the outcome variable). Many explanatory variables are categorical or binary, in which case only logistic regressions were undertaken (e.g. latrine access as the explanatory variable and HAZ <-2 as the outcome variable).

[27] No attempt was made either to control for confounding factors or to build a multivariable model, largely because the additional insights this would yield were judged to be limited by the cross sectional nature of the data and the relatively similar situations observed between agroecological zones.

better at capturing mother's acute nutrition status than the chronic situation. There was minimal association between children's WHZ and their HAZ and vice versa.

Sickness was associated with HAZ and specifically diarrhoea (which may be because recent sickness is a good indicator of repeated or recurrent sickness), although they only make small contributions to the HAZ variance. The absence of evidence for an association between sickness and WHZ at the Dry Zone level is not surprising given the descriptive results which show significant variations between zones. Hand washing with soap after assisting a child to pass a stool and disposal of child faeces in a latrine both made small but significant contributions to WHZ, but not HAZ; as expected given the relationships found between these hygiene practices and recent sickness, reported below.

At a household level, achievement of adequate levels of household food access and consumption (HDDS and FCS) were also found to be associated with children's HAZ (but not WHZ), but each made contributions of only about 2% to HAZ variance.

Table 19: Significant linear regressions among children

Outcome Variable	Explanatory variable	(n)	*P*	Coefficient of variation	95% CI	Coefficient of determin-ation (R squared) %
Nutrition indicators						
HAZ	Birth weight	120	<0.001***	0.28	(0.14, 0.43)	13.06
WHZ	Birth weight	120	0.005**	0.20	(0.06, 0.34)	7.79
HAZ	WHZ	2030	<0.001***	0.12	(0.06, 0.18)	0.95
WHZ	HAZ	2030	<0.001***	0.08	(0.04, 0.12)	0.95
WHZ	Mother's BMI	1690	0.001**	0.03	(0.01, 0.05)	1.35
Disease and the public health environment						
HAZ	Sickness	2029	0.012*	-0.2	(-0.35, -0.04)	0.57
HAZ	Diarrhoea	2030	0.001**	-0.38	(-0.62, -0.15)	0.69
WHZ	Hand-washing with soap after latrine	1486	0.012*	0.17	(0.04, 0.31)	0.76
WHZ	Disposal of child faeces in latrine	1805	0.002**	-0.18	(-0.29, -0.06)	0.82
Household food insecurity						
HAZ	Adequate HDDS	572	0.027*	0.6	(0.07, 1.13)	2.15
HAZ	Adequate FCS	572	0.016*	0.39	(0.07, 0.71)	1.77

Significant risk factors for child undernutrition

Table 20 shows that the child's birth weight (among children for whom this was available) was a striking risk factor for later stunting; a low birth weight baby has ten times greater odds of becoming stunted than a baby born over 2500g. The same association was not evident for wasting. And, as may be expected given their shared determinants, wasting was found to be a risk factor for stunting and vice versa, with odds of 1.68. Mother's BMI is also positively associated with child's acute nutrition status, whereby the odds of a child being wasted are 7% less for every one unit increase in mother's BMI.

Among children 6-23 months old, weak evidence of associations were also detected between stunting and 'Minimum Meal Frequency' and wasting and 'Minimum Acceptable Diet', suggesting that a child not meeting minimum meal frequency has 73% greater odds of being stunted than one achieving this standard and a child not meeting the minimum adequate diet has 3 times the odds of being wasted than one who does. The absence of associations for other diet indicators in this age group is curious but can likely at least partly be explained by low variance in the population (meaning that there is not a range of both very good and very bad practices to compare). Together with the presence of an association between stunting and adequate HDDS (children in households achieving adequate HDDS have a 57% reduced odds of being stunted than those in households who do not achieve this standard), and the associations between the child and household level diet indicators explained above, this data suggests that the range of dietary behaviours at the household and child level are likely important determinants of undernutrition in the Dry Zone. The findings of analysis of associations among mothers strengthens this conclusion, see below.

Table 20: Significant logistic regressions among children

Outcome Variable	Explanatory variable	(n)	*P*	Odds Ratio	95% CI
Nutrition indicators					
Stunting	Wasting	2030	0.006**	1.68	(1.16, 2.42)
Stunting	Low Birth Weight	120	0.002**	10.66	(2.47, 45.98)
Wasting	Mother's BMI	1690	0.014*	0.93	(0.87, 0.98)
Inadequate diets					
Stunting	Minimum Meal Frequency†	548	0.025*	1.73	(1.07, 2.8)
Wasting	Minimum Adequate Diet†	546	0.039*	3.24	(1.06, 9.9)
Stunting	Adequate HDDS	572	0.047*	0.43	(0.18, 0.99)

† breastfed children only

Perhaps because of the large skew in the household economic data, there was no evidence of associations or risk between indicators of wealth/poverty (income, expenditure, poverty score) and child nutrition outcomes. For this reason and to better understand the relevance of wealth/poverty, mean WHZ and HAZ scores were calculated by quartile for household income, expenditure and food expenditure in the last 30 days and are presented in table 21. Children in the lowest quartiles had the lowest mean WHZ, as may be expected, particularly given that both are recent measures. However, there was no similar pattern with HAZ and no clear trend between rising incomes/expenditure and rising WHZ or HAZ. This may be because nutrition status is not affected by household income/expenditure beyond a given threshold, i.e. poverty is too widespread to see clear, expected trends between household wealth and child nutrition status, and/or because these indicators on their own are too crude to categorise households by wealth or because a focus only on the recent situation is inappropriate.

Table 21: Mean WHZ and HAZ score by (30 day) income/expenditure quartile

	Quartile	Mean HAZ	Mean WHZ
Total Expenditure *(mean, 95% CIs)*	1-Richest (n=140)	-1.12 (-1.31, -0.92)	-0.95 (-1.16, -0.73)
	2 (n=141)	-1.60 (-1.86, -1.33)	-0.75 (-1.05, -0.46)
	3 (n=139)	-1.52 (-1.79, -1.24)	-0.96 (-0.96, -0.77)
	4-Poorest (n=141)	-1.22 (-1.83, -0.61)	-1.07 (-1.29, -0.83)
Food Expenditure *(mean, 95% CIs)*	1-Richest (n=141)	-1.27 (-1.51, -1.03)	-0.89 (-1.14, -0.65)
	2 (n=140)	-1.31 (-1.58, -1.04)	-0.96 (-1.32, -0.60)
	3 (n=141)	-1.20 (-1.73, -0.67)	-0.86 (-1.11, -0.61)
	4-Poorest (n=141)	-1.67 (-1.93, -1.40)	-1.03 (-1.21, -0.84)
Income *(mean, 95% CIs)*	1-Richest (n=140)	-1.32 (-1.53, -1.12)	-0.91 (-1.14, -0.68)
	2 (n=144)	-1.42 (-1.96, -0.88)	-0.94 (-1.26, -0.62)
	3 (n=136)	-1.40 (-1.59, -1.20)	-0.80 (-1.00, -0.61)
	4-Poorest (n=152)	-1.23 (-1.53, -0.93)	-1.67 (-1.07, -1.24)

Factors significantly associated with mother's nutrition outcomes at the population level

Table 22 shows that there were a few significant association between mother's BMI and some explanatory variables, but their contribution to variance were all very low. Nevertheless, those that do exist highlight the likely importance of diet related factors in determining nutritional status of mothers in the population, and maybe the nutrition status of other women too.

Logistic regressions did not reveal any significant associations between any of the explanatory variables explored and mothers' undernutrition as classified using BMI <18.5 kg/m^2.

Table 22: Significant linear regressions among mothers

Outcome Variable	Explanatory variable	(n)	*p*	Coefficient of variation	95% CI	Coefficient of determ-ination (R squared) %
Poor public health environment						
Mother's BMI	No latrine access	467	<0.001***	-1.46	(-0.66, 0.03)	3.4
Household food insecurity						
Mother's BMI	HH livestock ownership	467	0.046*	-1.21	(-0.02, 0.02)	2.32
Mother's BMI	HH subsistence production	467	0.016*	0.98	(1.77, 0.02)	1.88
Mother's BMI	Mother's IDDS	1658	0.001**	0.12	(0.51, 0.01)	1.26

As for child nutrition outcomes, trends in mean BMI by quartile of household income, expenditure and food expenditure in the last 30 days were also examined. Table 23 shows that whilst there were no trends between mean BMI and income or food expenditure, there was a dose response with total expenditure suggesting, as one would expect, that expenditure could be a determinant of mother's nutritional status. Whilst there is no similar trend with food spend, which would be an obvious mechanism, the low sample size could be obscuring the expected trend.

Table 23: Mothers mean BMI by (30 day) income/expenditure quartile

	Quartile	Mother's mean BMI
Total Expenditure *(mean, 95% CIs)*	1-Richest (n=116)	21.8 (20.9, 22.7)
	2 (n=112)	21.0 (20.1, 21.9)
	3 (n=117)	20.6 (19.9, 21.3)
	4-Poorest (n=111)	20.0 (19.1, 20.8)
Food Expenditure *(mean, 95% CIs)*	1-Richest (n=118)	21.7 (20.7, 22.8)
	2 (n=118)	21.3 (20.4, 22.1)
	3 (n=112)	19.8 (19.1, 20.6)
	4-Poorest (n=110)	20.7 (19.9, 21.4)
Income *(mean, 95% CIs)*	1-Richest (n=119)	21.5 (20.5, 22.4)
	2 (n=117)	21.3 (20.2, 22.4)
	3 (n=109)	19.9 (19.3, 20.5)
	4-Poorest (n=122)	21.2 (20.4, 21.9)

ASSOCIATIONS BETWEEN INDICATORS IN THE CAUSAL FRAMEWORK

For those variables that were found to be associated with nutrition outcomes (tabulated above) further analysis of associations and risk were undertaken among the underlying causes of undernutrition (see figure 58).

Table 24 shows that as expected, a range of dietary indicators at child, mother and household level are associated.

Table 24: Significant linear regressions on causal pathways

Outcome Variable	Explanatory variable	**(n)**	***P***	**Coefficient of variation**	**95% CI**	**Coefficient of determ-ination (R square) %**
Child's IDDS						
IDDS	Mother's IDDS	618	<0.001***	0.29	(0.19, 0.39)	7.80
IDDS	FCS	183	0.025*	0.02	(0, 0.03)	4.12
Mother's IDDS						
Mother's IDDS	FCS	484	<0.001***	0.02	(0.02, 0.03)	11.38
Mother's IDDS	HDDS	484	<0.001***	0.22	(0.11, 0.33)	7.42
Mother's IDDS	Adequate FCS	484	<0.001***	0.66	(0.35, 0.97)	5.33
Mother's IDDS	Adequate HDDS	484	0.002**	0.54	(0.21, 0.87)	1.99
HDDS						
HDDS	FCS	1803	<0.001***	0.06	(0.05, 0.06)	36.06

Table 25 shows that there are fewer significant associations when looking at risk factors for not achieving adequate HDDS or FCS. One determines the other, and other than that only household's subsistence production is a clear benefit to achieving adequate food consumption/access; a household undertaking subsistence production has a 76% and 89% greater odds of achieving adequate HDDS and FCS, respectively, than one that does not.

In the public health environment, evidence was found suggesting an increased risk of sickness in households were water is not treated, a protective effect of both hand washing (regardless of whether with soap of not) and disposal of child faeces in a latrine, with risk of diarrhoea. These support the coherent assumption that improper sanitation and hygiene practices increase risk of ill health. For key health interventions, children who receive a vitamin A supplement have two times lower odds of getting diarrhoea than those who do not, as would be expected given the importance of vitamin A for healthy immune response.

Table 25: Significant logistic regressions on causal pathways

Outcome Variable	Explanatory variable	(n)	*p*	Odds Ratio	95% CI
Sickness	No HH water treatment	573	0.037*	1.87	(1.04, 3.35)
Diarrhoea	Vitamin A	1662	0.017*	2.01	(1.13, 3.55)
Diarrhoea	Hand washing before food preparation	1681	0.002**	0.25	(0.11, 0.60)
Diarrhoea	Disposal of child faeces in latrine	1805	0.003**	0.56	(0.33, 0.95)
Adequate HDDS	Adequate FCS	1803	<0.001***	8.77	(5.99, 12.85)
Adequate HDDS	HH subsistence production	1803	0.002**	1.76	(1.23, 2.52)
Adequate FCS	HH subsistence production	1803	0.001**	1.89	(1.33, 2.71)

Table 26: Mean HDDS and mothers IDDS by (30 day) income/expenditure quartile

	Quartile	Mean HDDS	Mean mothers IDDS
Total Expenditure *(mean, 95% CIs)*	1-Richest	6.72 (n=440) (6.46, 6.98)	4.53 (n=120) (4.24, 4.82)
	2	6.16 (n=439) (5.92, 6.41)	4.04 (n=115) (3.78, 4.30)
	3	5.87 (n=443) (5.71, 6.02)	4.21 (n=121) (3.90, 4.53)
	4-Poorest	5.78 (n=441) (5.59, 5.96)	4.14 (n=117) (3.93, 4.35)
Food Expenditure *(mean, 95% CIs)*	1-Richest	6.65 (n=441) (6.39, 6.91)	4.55 (n=120) (4.25, 4.85)
	2	6.14 (n=441) (6.39, 6.91)	4.05 (n=119) (3.81, 4.29)
	3	5.84 (n=447) (5.66,6.03)	4.39 (n=120) (4.12, 4.67)
	4-Poorest	5.95 (n=448) (5.75,6.14)	4.00 (n=116) (3.64, 4.16)
Income *(mean, 95% CIs)*	1-Richest	6.64 (n=421) (6.33, 6.96)	4.60 (n=123) (4.29, 4.92)
	2	5.96 (n=480) (5.74, 6.18)	4.20 (n=121) (4.00, 4.40)
	3	5.91 (n=444) (5.72, 6.09)	4.11 (n=114) (3.81, 4.41)
	4-Poorest	6.10 (n=458) (5.92, 6.46)	4.08 (n=126) (3.87, 4.30)

Lastly, as shown in table 26, trends in mean HDDS and mothers mean IDDS by quartile of household income, expenditure and food expenditure in the last 30 days were examined to better understand the relationships between these explanatory variables and nutrition outcomes. A dose response was observed with mean HDDS rising as mean total expenditure increased, and mean mothers IDDS rising as mean income increased. Whilst not consistent, these trends suggest, as expected, that expenditure/income is a determinant of dietary diversity. The absence of clearer trends may be because everyone is poor.

5. DISCUSSION

DEMOGRAPHY

The survey data confirm that households in the Dry Zone are small (mean 4.5 individuals) with three dependents for every productive adult and only a small proportion of under-fives (6.8%). Most are male headed; more so among households with children under five years of age. Migration is common (31.2% of households, mean 1.6 people) and more likely in dry land farming zone 1. The mothers reported giving birth for the first time, on average, in their early twenties and having between 2 and 3 children, slightly more in zone 1 than zone 3 where mothers least often reported enduring the loss of a child. As the demographic factors are mostly favourable and further analyses did not yield any significant associations or indications of risk, they seem unlikely to be important drivers of undernutrition at the Dry Zone level.

NUTRITION OUTCOMES

The various indicators collected suggest that the nutrition situation in the Dry Zone is concerning, both for children and their mothers. In children it is characterised by low mean birth weights and high rates of low birth weight (higher than Divisional reports in the MICS) and of high acute malnutrition and stunting rates across the age range from birth to five years of age. These negative nutrition outcomes are all linked to higher risks of morbidity and mortality (Black et al 2008). Global Acute Malnutrition prevalence is higher than most secondary data sources, which can be accounted for at least in part the by the seasonal timing of the survey (and the low birth rate incidence may also be affected, Rayco-Solon et al 2005). Conversely, and positively, the stunting prevalence is lower than most secondary sources. Nevertheless, according to the WHO classification of the public health significance of undernutrition prevalence, the rate of acute malnutrition is 'high' (WHO 2000) and the rate of stunting is 'medium' (WHO 1995). As may be expected, children's WHZ and HAZ are associated and the odds of a child being wasted are increased if they are already stunted, and vice versa, highlighting the shared determinants of acute and chronic malnutrition and the importance of addressing both conditions.

Among mothers there are high rates of undernutrition and mean MUAC is lower among the pregnant and lactating mothers compared to those who are not. Given the higher requirements for energy, protein and micronutrients during pregnancy and lactation (WHO 2013a) and the risk that maternal undernutrition poses for adverse birth outcomes (Chan & Lao 2009, Sheiner et al 2005) and lower birth weights (Black et al 2013), this novel finding warrants further investigation and action.

The analysis of associations confirms for this context what is already known globally: a baby's weight at birth is a powerful determinant of their later nutrition (both their chronic and acute conditions), and the child's (acute) nutrition status is also associated with their mother's nutrition status. These associations support the logical assumption that children and mothers experience shared determinants of undernutrition. They also highlight the importance of taking a life cycle approach to improve and protect nutrition status in the short and longer term, particularly through focusing on the 1000 day window of opportunity.

Between zones, there is strong evidence that stunting rates are higher in dry land farming zone 1 compared to irrigated/flood plain zone 3, and vice versa. The evidence is weaker for wasting but still suggests that the situation is worse in zone 1 than 3. A similar and mostly strong pattern is evident for birth weight and the acute and chronic nutrition status of mothers[28]. In summary, whilst the acute and chronic nutrition situation in the Dry Zone as a whole is a concern, this situation is significantly better in the irrigated/flood plains of zone 3 and probably most concerning in zone 1 but there are few significant differences between dry land and highland zones 1 and 2.

IMMEDIATE CAUSES OF UNDERNUTRITION

Inadequate diet

The survey also confirms that breastfeeding practices are mixed, but mostly poor. Most babies are breastfed from within a few hours of birth to two years, but not from the first hour and not exclusively during the first six months. The diversity of diets during the complementary feeding period from six months to two years, and among mothers (particularly those who are pregnant and/or lactating) is very poor, with diversity score means far below the adequate threshold for children and low compared to the maximum possible for mothers (where no adequacy threshold has been defined). There is a heavy reliance on daily diets of rice and plant source foods; vegetables and pulses or legumes. The current season may play a role in driving the poor indicators observed. Half of children 6-23 months are not fed often enough and only a fifth met minimum levels of dietary diversity, giving a very low rates of acceptable diets. Poor quality complementary diets are likely a key driver of the rising rates of wasting and stunting in the younger age groups. Sub optimal IYCF practices are associated with increased risk of morbidity and mortality (Black et al 2003; Black et al 2008). The data on mothers' diets is new and, as for the anthropometric data for these women, worrying.

The additional analyses of associations highlight that an important key to improve the nutritional status of mothers is likely to be to improve the diversity of their diets, and similarly and expected, risk factors for wasting and stunting include inadequate diets among children 6-23 months of age. One key to improve children's IDDS is to improve mother's IDDS. The association between these variables across the Dry Zone regardless of socioeconomic status is striking and could suggest that increasing knowledge and changing attitudes may be important means of improving diets, but also that poverty is a crucial barrier to improvement across the population.

[28] The much higher rate of low birth weight in zone 1 is hard to reconcile and is unlikely to be due to greater health service access (see below). This requires further investigation.

The survey was not powered to detect significant differences in IYCF practices across the zones, but there is weak evidence that women's diets may be worst in highland farming zone 2, a pattern which is not inconsistent with the nutrition indicators and logical given the expected (if limited) differences in food security between agroecological zones, which are discussed more below. The data support an assumption that diet is an important determinant of nutrition status, and insufficiencies may be particularly important in the Dry Zone.

Disease

Sickness is one driver of undernutrition and rates of recent sickness were quite high, with more than a quarter of children reported to have an illness; fever, cough and diarrhoea all manifest in about one in 10 children, particularly in the under two year olds. This may be partly explained by the timing of the survey during the rainy season, although each season has different disease challenges. The relationship between children's current health status and acute or chronic anthropometric status was not found to be straightforward and it is likely that morbidity is driving undernutrition in dry land and highland zones 1 and 2, particularly among older children.

In terms of differences between zones, there was weak evidence that highland farming zone 2 had the highest rates of sickness (prevalent across all ages), particularly fever, and there was strong evidence that diarrhoea rates were lowest in the irrigated/flood plains of zone 3. These differences are likely to be due to topographic differences which define both the food security but also the disease environment as well as affecting infrastructure, hence the longer journey times to clinics in zone 2 which might be hindering access to and uptake of health services.

Overall, the analyses suggest what is logical, that one means to improve the nutrition status of children in the longer term (including children 2-5 years of age) is to tackle sickness, particularly diarrhoea, through improving hygiene practices and the coverage of vitamin A supplementation, discussed next.

UNDERLYING CAUSES OF UNDERNUTRITION

Poor public health environment

Health services

The survey results confirm much of the positive secondary data but also shed lights on some key insufficiencies that need to be addressed. A quarter of villages have a health centre, otherwise round trip travel time takes about an hour. There was a very high coverage of childhood vaccinations for TB and measles (positively, somewhat higher than the secondary data estimates) and for bed net use, but mixed and sometimes low coverage of vitamin A supplementation (among children and recently delivered mothers), use of therapeutic zinc for diarrhoea and antihelminths. Care of children with diarrhoea was also largely suboptimal. It is logical that these poor practices will exacerbate undernutrition risk.

Among pregnant mothers, reported iron supplement use was very high and encouragingly frequent, but vitamin B1 use mediocre and postpartum vitamin A receipt very low, which is a concern for their health and the health of their newborn baby. In particular maternal vitamin A deficiency is associated with increased LBW and infant mortality (Black et al 2013). Only about 1/2 women reported receiving ANC from a midwife and less for an auxiliary midwife so there may be a need to examine coverage of skilled care during pregnancy (particularly in highland zone 2).

At Dry Zone level there were no associations found between child anthropometric status and access to a clinic, vitamin A or antihelminth receipt. It could be that worm infestation is not a prevalent problem, whilst vitamin A receipt was found to be associated with reduced odds of recent diarrhoea, which would be expected and highlights its relevance in preventing childhood disease, regardless of absence of evidence for a direct association with nutrition status.

Whilst there were few direct associations confirmed from this dataset, there were a few important differences between agroecological zones which support the assumption that health service deficiencies are partly (indirectly) driving the high undernutrition rates. Journey times to the clinic were found to be significantly longer in highland zone 2, which is more remote and suffers greatest infrastructure challenges. Given that RHC access per head of population is far better in Magway than in Mandalay and Saigaing (see figure 3), and 64% of villages in the irrigated/flood plains of zone 3 are in Magway region (see table 1, n=983/1545), this could also be having some impact on the sickness trends seen by zone explained above, whereby zone 2 has highest rates and zone 3 may be the best off. Vitamin A supplementation was lowest in zone 2, bed net use lowest in zone 1 and rates of nurse or doctor provision of ANC were lower in zone 2 than zone 3 where TBA ANC provision was higher. The patterns suggest that zone 2 may have the greatest health service deficiencies and zone 3 is probably best off, highlighting how these deficiencies are likely to be influencing the public health and nutrition situations.

Water, sanitation and hygiene

Whilst the survey results revealed relatively good access to water across the Dry Zone with surprisingly little seasonal variation, the data suggest that a third of households use an unprotected source at some point during the year. Access to water on the premises is lower than the MICS Divisional estimates but travel times to water sources are generally short. Reports suggest that hygiene behaviours need to be improved, with inconsistent use of soap for hand washing at critical times, less than universal water treatment practices, unsanitary disposal of child faeces and lack of access to a latrine for a quarter of households. Village level reports of high rates of eye infections in the summer months are another indication that hygiene practices could be improved. Poor hygiene practices have not been documented at scale in previous surveys, and poor latrine coverage was not documented in the MICS.

Significant direct associations were found between child nutrition status and two key hygiene practice indicators; hand washing with soap after assisting a child to pass a stool and disposal of child faeces in a latrine. There was also a small but positive association between household access to a latrine and mothers' BMI. Together with the associations revealed between sickness/diarrhoea and child nutrition status, and the evidence of risk of sickness/diarrhoea with poor hygiene practices, these confirm the importance of ensuring adequate hygiene facilities to protect and improve nutrition status.

At a zone level, the WASH indicators are somewhat more consistent across the Dry Zone but a few differences are coherent with the health situation described above (i.e. lowest rate of appropriate child faeces disposal in zone; access to drinking water is consistently easiest in zone 3), adding to the suggestion that zone 3 probably enjoys the most favourable nutrition environment, in part because of better public health indicators and that the weaknesses in the public health environment are important drivers of undernutrition.

FOOD INSECURITY

An explicit objective of the survey was to explore the food security determinants of undernutrition. The following section summarises these determinants, but these findings need to be seen in context; food insecurity and poverty are only two underlying drivers of undernutrition and whilst deficiencies in these sectors need to be addressed to improve the nutrition situation, the gaps and inequalities in the public health environment outlined above also need attention.

Utilisation

The communities of the Dry Zone typically ate three meals a day at the time of the survey. Whilst the diets are based on rice and vegetables with beans/pulses on average three days a week and eggs, fish and fruits on average two days a week, nearly all households had 'adequate' dietary diversity according to the FSIN suggested Myanmar threshold of 4 on the HDDS (where HDDS is an indicator of economic access to food and less specifically of diet quality). The 'Food Consumption Score' analysis indicates that most households in the Dry Zone are probably consuming 'adequate' diets in terms of recent frequency of consumption of a diverse range of nutritious foods. These results are encouraging given the seasonal timing of the data collection, but neither indicators capture the amount being eaten. However, the nutrition outcome indicators suggest quantities consumed may not be enough at an individual level (or sickness, poor food processing and/or preparation may be affecting nutrient intakes), and that certain groups (including young children and mothers, particularly those who are pregnant and lactating) are not necessarily meeting their nutrient requirements.

As expected, both child and maternal dietary diversity scores are associated with household food access and consumption (particularly diversity) and to improve diets as a means of improving nutrition status there is a logical need to focus on improving household level food access and consumption[29]. The associations found between FCS and HDDS and household subsistence production indicates how household food access might be improved, and the small but direct association between mothers' BMI and land and livestock access also supports the logical suggestion of the importance of household subsistence production to nutritional status[30].

There was weak evidence that the mean HDDS is probably best in the irrigated/flood plains of zone 3 and strong evidence that fewer households have 'adequate' diets in highland zone 2 (from the Food Consumption Score); which is consistent with the differences between zones captured above.

Availability

As known already, the survey highlights that the main crops grown in the Dry Zone are paddy, sesame and groundnut. The other data is also consistent with the results of the localised HEA

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[29] The direct association between child HAZ and HDDS suggests that this pathway is plausible, but both indicators could be associated with another 'causal' factor which has not be revealed by this analysis.
[30] Although again, another pathway could be in play, related, for example to income generation.

studies summarised in the pre assessment causal framework (see figure three). Three quarters of households own some livestock (mostly chickens and cattle). Nearly two thirds had access to a small plot of land (at least two acres; nearly all owned rather than rented, and a fifth of which was irrigated), and as highlighted above, there is a direct association between mother's BMI and land/livestock access at the Dry Zone level. However, forty percent of households are landless, nearly everyone keeps very small food stocks and for those with land, these plots are small and therefore limited in terms of own production. Consequently food availability is largely dependent on market availability and access, and therefore on household's physical access to the market, their income and purchasing power.

There are expected zonal differences: paddy dominates in zones 2 and 3 and sesame in zone 1 and zone 3 has the greatest variety of crops (fitting well with the differences observed in diet diversity indicators) and livestock holdings are smaller where the land is better suited to arable farming, i.e. highland zone 3, and larger where the opposite is true, i.e. dry land faring zone 2.

Access

Indicators of accessibility appear positive overall but also highlight household vulnerability to food insecurity. The survey confirmed that the communities of the Dry Zone are largely reliant on market purchase supplemented by subsistence farming. Median round trip travel time to the nearest market was 1.5 hours (1.75 hours in the rainy season); although there was no evidence that variation in market access was associated with nutrition outcomes at the Dry Zone level. A third of households reported experiencing a month or more during the year when they had had a problem to meet their food needs, typically between June and July (a bit later than the secondary data suggests). But whilst the timing of the survey therefore placed it during the hungriest time of the year, there was little evidence of hunger[31] or the use of harmful coping strategies. It is a concern then, that the rates of undernutrition are high and possibly typical for this time in a 'normal' year.

There are differences between zones in market access, for which there is mostly very strong evidence that journeys are far longer in all seasons in the more remote highlands of zone 2. The communities of dry land farming zone 1 are more likely to purchase their rice, whilst those in zone 2 generally produce more 'other' main crops and livestock products than the other zones.

Analysis of the food security indicators are more or less consistent in highlighting that the situation in zone 3 is probably best, and zone 2 may be worst, but a number of indicators are inadequate across the Dry Zone and the population are vulnerable to food insecurity. This is mostly consistent with the pattern seen for the nutrition indicators, confirming the importance of the food security determinants of undernutrition.

WEALTH/ POVERTY

Considering absolute incomes and proportionate expenditures on food, it can be judged that income poverty is prevalent across the Dry Zone. Most households in the Dry Zone have two

[31] Reconciling the 98.4% of households classified as "little to no hunger in the household" on the Household Hunger Scale and the 17.6% of households with "poor or borderline consumption" on the Food Consumption Scale may require that the FSIN suggested thresholds for FCS are revised, or, more concerning, that communities are used to very poor consumption patterns characterised by limited diversity without equating them with hunger.

or more sources of income, most commonly agricultural wage labour followed by sale of pulses/beans/sesame and non-agricultural labour, consistent with the findings from localised HEAs. Average (median) incomes in the month before the survey were low but widely variable and more than half of recent monthly expenditure was on food; a large proportion of this is on rice, leaving little for investment in education, health or other basic needs like transport. Mean income/expenditure balances are very negative, highlighting the reliance on large loans across the zone, for most, probably on poor terms as the source is a money lender or trader. This pattern will be affected by the timing of the survey in the middle of the hunger gap. The main reasons for taking loans were to finance food purchase (evident also in recent reported purchase of main foods on credit), to buy agricultural inputs or rent land and to cover health costs. However, absolute and proportional expenditure on health needs are low across the Dry Zone.

This survey enabled a Myanmar validated poverty score to be calculated for the first time (Shreiner 2012), revealing that a quarter of Dry Zone households are likely below the national poverty line but only five percent of households fall below a food poverty line. Given that the lines use data from 2009/2010 and in light of the other concerning wealth/poverty data, it could be that these likelihoods are conservative.

At the Dry Zone level no clear associations were found between indicators of household wealth and poverty and child nutrition status but there was for total recent expenditure and maternal nutritional status, possibly mediated through improved dietary diversity which was found to increase in a dose response fashion with household income. Because it is expected that rising incomes may enable better nutrition (e.g. through higher spending on more nutritious foods, or on health care) the lack of a clear set of associations between household economic data, child and maternal nutrition outcomes and dietary mediators may be because the majority of the population are, in absolute terms, very poor; 50% of households had an income less than 36USD in the month before the survey to use to purchase food and pay for other costs for a family averaging 4.5 individuals.

In terms of differences between the zones, there was strong evidence that incomes were significantly highest in the irrigated/flood plains of zone 3 (where sale of paddy contributed most as a main income source,) and so therefore were expenditures. The proportion of spend on food was also significantly lower in zone 3 than zone 2 (and less was on credit, at least for rice purchase). Absolute and proportional expenditures on education, adult and child health and transport were low in the Dry Zone, and weak evidence of slightly more spent on adult health in zone 3 than zone 2, probably because of higher 'disposable' incomes. Absence of meaningful zonal differences in spending on health and transport where there are differential needs suggests that incomes are insufficient to meet basic needs, suggesting that the poverty score results could be conservative. There was no evidence of a significant difference in loan taking by zone, but there was very strong new evidence that government bank loans are more common in irrigated/flood plains of zone 3 than highland zone 2. There was weak evidence when looking at likelihoods of falling below both national poverty and food poverty lines that the communities of zone 3 are probably slightly better off. To conclude, there was a pattern in wealth/poverty indicators between zones favouring irrigated/flood plain zone 3 over highland farming zone 2, and therefore consistent with the patterns seen for the nutrition outcomes, suggesting, as expected that income poverty is one important cause of undernutrition.

6. CONCLUSIONS

The survey was conducted during the hunger gap, a time of annual food insecurity in the rural Dry Zone and also the rainy season. The seasonal timing is undoubtedly affecting indicators of acute malnutrition as well as the high rates of morbidity and poor individual dietary diversity scores; the survey may be judged as a worst case scenario in terms of typical annual fluctuations. Nevertheless, the situation is characterised by high rates of low birth weight, wasting and stunting in children and high rates of undernutrition in mothers; with an indication that the nutritional status of mothers who are pregnant or lactating is worse than those who are not. The rate of wasting is of 'high' public health concern (WHO 2000) and the rate of stunting is of 'medium' public health concern (WHO 1995). Given the political stability, the absence of extreme weather conditions in the Dry Zone at the time of the assessment and the seasonally typical food security indicators, including indicators of adequate household food access and consumption, these nutrition indicators are concerning.

The pattern of nutrition, health, food security and poverty indicators and their significant differences between zones all suggest that the flood plains/irrigated of zone 3 is the best off between the three agroecological zones. There are some indications that highland farming zone 2 may be the worst; particularly in relation to some health and diet indicators. This information may be useful for programming decisions in terms of geographic targeting. However, certain indicators are poor regardless of the agroecological zone; including most IYCF indicators (highlighting the importance of optimal breastfeeding and complementary feeding to protect and promote child nutrition status) and diet indicators at the individual level, for children and mothers (again, particularly pregnant and lactating mothers), and wealth indicators too (highlighting entrenched poverty). In nutrition situation is far from acceptable in the rural Dry Zone as a whole.

The similar pattern of differences between zones for nutrition and food security and poverty indicators suggest that these are key drivers of undernutrition, as expected. However, the same features of the agroecological zones that create differences in food security, are also likely to be driving differences in health and nutrition through affecting the disease environment and differences in infrastructure and service access.

There is an absence of evidence of many significant associations between nutrition outcomes and indicators of food security and poverty revealed in further analyses at the Dry Zone level. Two main reasons are likely: firstly, widespread inadequacy of many indicators across the Dry Zone e.g. low incomes and high indebtedness; and secondly, other (confounding) causal factors are also driving undernutrition risk, e.g. differences in topography between zones will affect food security but also service access and infrastructure as well as disease risk. Key deficiencies in the public health environment, particularly water, sanitation and hygiene, are also likely to be important drivers of undernutrition.

The survey reveals positive nutrition-relevant practices in the rural Dry Zone, such as: almost universal breastfeeding of children to two years of age; a range of good preventative and curative health practices; small family sizes and average age of first delivery after the adolescent period; and adequate meal frequency for older children and adults and some indicators of adequate food access.

However, there are, as expected, a wide range of likely causes of undernutrition which need addressing. Significant associations were found between indicators of children's nutrition status, highlighting the shared determinants of acute and chronic malnutrition and the need to tackle one to tackle the other. Significant associations were also found between the nutrition status of children and their mother's and between a child's birth weight and their later nutrition status, reminding us of the need to take a life cycle approach to improve and protect nutrition status in the short and longer term, particularly through focusing on the 1000 day window of opportunity. It is striking that pregnant and lactating mothers were found to have worse anthropometric data and diets given that a mother's nutrition status is such an important determinant of her child's. Dietary factors and their determinants seem particularly important drivers of undernutrition among children and mothers in this context.

Nevertheless, analysis of associations revealed only small contributions of any specific explanatory variable to the variance of any of the nutrition outcomes (and this includes indicators of food security and poverty), which together with analysis of risk factors reinforces that there is not just two or three important causes of undernutrition in the Dry Zone. Rather, this reminds us that a multi-sector approach is required for malnutrition prevention and nutrition status improvement, bolstering delivery of direct nutrition interventions whilst strengthening the likely nutrition impacts of other sectoral responses.

7. INDICATIVE RECOMMENDATIONS

Adopt an appropriate multi-sector strategy:

- The determinants of undernutrition in the Dry Zone include food insecurity but also income poverty, poor water, sanitation and hygiene, disease and poor breastfeeding and complementary feeding practices. Strategies to reduce child undernutrition should adopt an appropriate multisector strategy, bolstering both direct nutrition interventions as well as improving the nutrition sensitivity of indirect interventions.

Continue to promote and support joint ministry planning around nutrition outcomes:

- Using the Scaling Up Nutrition platform to facilitate this top down approach to improve policy influence of practice.

Promote and support use of a shared results framework:

- Actors from different sectors implementing interventions where reduction of undernutrition is a shared goal should strive to share a results framework which includes intermediate indicators on the undernutrition causal framework such as dietary diversity, as well as nutrition outcomes.

Take a life cycle approach to reducing undernutrition:

- All project, programmes or policies specifically aiming to address undernutrition in the short or longer term, should take a life cycle approach. There is a need to focus on women of reproductive age, pregnant and lactating mothers and infants to cover the 1000 day window of opportunity, but also children from 2 to 5 years of age (see Bhutta et al 2013 for a full list of interventions to tackle maternal undernutrition).

Acknowledge and address the high rates of acute malnutrition:

- Stunting and wasting are associated, and to tackle one, the other must also be addressed. To reduce the high rates of child wasting given the poor dietary indicators, low incomes and high proportions spent on food, a food based approach (e.g. blanket supplementary feeding using an improved fortified blended food) could be considered in the hot spots with highest rates. Consideration should be given to including all pregnant and lactating mothers with an infant under 6 months. An alternative or complementary approach could be a cash based intervention, if usual conditions for such an intervention were fulfilled.
- Including child anthropometry in the ongoing monthly surveillance would be useful to better understand seasonal variation in acute malnutrition prevalence, and to determine whether the intervention should be undertaken year round or seasonally. In the meantime it could be sensible to focus on the hunger gap, refining which months are most appropriate by location on the basis of knowledge from the existing surveillance system.

Improve the diets of children and women:

- Whilst the under twos and pregnant and lactating mothers are priority groups for intervention, all children under five years and women of reproductive age should be included whether or not they already have children.
- Qualitative research is required to understand the reasons for suboptimal IYCF practices. Improved understanding of levels of and content of knowledge, specific attitudes and beliefs should be used to adapt available Behaviour Change Communication (BCC) materials for use in a Dry Zone wide campaign.
- The same efforts should be made to understand what knowledge gaps, attitudes and beliefs might be causing mother's diets to lack diversity, with a particular focus on pregnancy and lactation. BCC messages should also focus on the nutritional requirements of pregnant and lactating mothers and how to improve dietary diversity.
- BCC activities could capitalise on the relatively high coverage of midwives and auxiliary midwives to access mothers and their children but community-based personnel delivering food security/livelihoods interventions should also be included.
- Coverage of micronutrient supplementation programmes should be improved where needed (see below).
- A micronutrient survey should be considered to understand the full impacts of the poor diets captured in the survey and to inform a longer term plan that may need to include new food fortification programmes.

Prevent and treat common childhood illnesses

- To prevent diarrhoea and other faecal-oral diseases and to promote healthy growth and prevent undernutrition, health and hygiene promotion activities should address poor hand washing practices and low prevalence of soap use, inappropriate disposal of child faeces and low rates of appropriate treatment of drinking water.
- The low use of ORS and very low rates of continued feeding for children with diarrhoea should also be addressed along with a focus on promoting the use of therapeutic zinc.

Improve the coverage of evidence-based cost-effective direct nutrition interventions through the health service:

- Future vitamin A campaigns should focus on improving coverage throughout the Dry Zone, but particularly in Zone 2.
- Reasons for low coverage of vitamin B1 supplementation use, receipt of post- partum vitamin A supplementation and use of therapeutic zinc should be investigated and addressed.
- The appropriateness of multiple micronutrient powders for infants, young children and PLW could be investigated in the medium term to complement diet focused BCC interventions.
- The prevalence of worm infestation could be investigated to establish whether efforts to improve antihelmith treatment coverage are required.

Ensure appropriate access to health care:

- The higher rates of sickness and the long and variable travel times to the clinic in highland zone 2 ought to be acknowledged and addressed.
- Approaches should tackle physical inaccessibility e.g. though running mobile clinics an/or improving transport infrastructure as well as likely economic inaccessibility e.g. through setting up village level revolving health funds.
- Adequate staffing should be ensured to improve BCC and deliver the basic package of nutrition interventions as well as ANC; particularly in highland zone 2 and particularly during the rainy season (see also township health reports which highlight greatest needs in Sagaing and Mandalay regions).

Enhance access to potable water and latrines:

- Reasons for and locations of use of unprotected water sources should be investigated and options for the provision of an alternative protected water source considered.
- Latrine construction should be considered, e.g. through ongoing or future food/cash for work programmes.

Improve food security/support livelihoods *(see also WFP report):*

Utilisation

- Typical intrahousehold allocation norms could be investigated through qualitative research. Any harmful practices which deny young children and pregnant and lactating women access to enough nutritious food should be a focus of BCC activities.
- Also investigate and address low use of abundant locally available nutritious foods such as beans, nuts and lentils.

Availability

- Projects/programmes/policies should prioritise targeting landless households
- Where feasible, livestock provision/breeding interventions could be positive for improving access to food and diets for household members as well as enabling income generation.
- Input and technical support to homestead/kitchen gardening for households with access to land could be considered, particularly as a means to promote the cultivation and consumption of micronutrient rich foods as well as their potential sale.

Access

- The reasons that most households keep no or very small rice/cereal stores should be investigated and addressed if possible, to reduce vulnerability to hunger in the event of a bad season. Community grain banks or strategic reserves managed by the government (if these do not already exist) could be considered.

Reduce poverty *(see also WFP report):*

- Household's means of income generation are limited to one or two sources and these are mostly based on agricultural wage labour and sale of produce which increases vulnerability to climatic events and economic shocks that affect the market. This stresses the value of income diversification and generation schemes. Recent/existing IGS/IGA that have been found to be effective could be prolonged and/or expanded, particularly for households lacking access to land and/or livestock. Seasonal productive works schemes may be one appropriate option (e.g. food/cash for work focusing on WASH infrastructure), and other social protection mechanisms should be considered.
- There may be benefits in improving access to credit on favourable terms, for example through Village Savings Groups and/or the improved coverage of government banks.
- Given the high rates of reported borrowing for health needs, village level revolving health funds could be one means of reducing household debt.

Protect the care environment:

- Food security/livelihoods interventions should take a 'do no harm' approach to engaging mothers, recognising and mitigating the potential negative effects of increased labour on their nutritional status and the time this leaves them to feed and care for young children

Encourage co-location of health and food security/livelihoods interventions:

- Potentially forming a demonstration site for showcasing, from the bottom up, the feasibility of 'integrated' programming as well as for generating new robust evidence of impact to fill clearly specified gaps

Ensure surveillance of the nutrition and food security situation and be prepared in the event of an emergency:

- Introduce child anthropometric measurements into the surveillance system, and analyse data separately for the agroecological zones.
- Because protection of assets in the event of any seasonal, economic or political crisis is important in this context (where debts are already high, incomes low and the population nutrition status poor) emergency contingency plans and stocks should be in place ready to be mobilised in a coordinated and timely manner to mitigate the effect of any future disaster.
- Emergency contingency plans should include general food distributions of balanced rations and supplementary feeding programmes for children under 5 and pregnant and lactating women

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ANNEXES

Annex 1: Pre assessment analysis of the likely causes of undernutrition in the Dry Zone

Annex 2: Further detail on methods

Annex 3: Questionnaires

Annex 4: Results tables

Annex 5: A summary of the results of the descriptive analysis