Alternative Sampling Designs for Surveying Nutritional Status in Emergency Settings

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FOOD AND NUTRITION TECHNICAL ASSISTANCE

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Presentation Outline

- Alternative Sampling Designs
- Comparison of Alternative Sampling Designs with Traditional Approach
- Field experience –FSAU Somalia

Data Priorities in Emergencies

- **Statistically representative** data on the status of a situation are usually necessary - before resources can be directed to the area
- Reliable data are needed **rapidly** - to allow appropriate decisions about interventions and level and type of aid
- Often times **recurrent assessments** are mandated (quarterly, e.g.) – either by national government or donor agencies
- Data on **GAM** among children 6-59 mo is a key indicator used to measure the severity of a situation

The Traditional Approach

30x30 Cluster Survey

Clusters: **30**
Observations per Cluster: **30**
Total Sample Size: **900**

Or improved:
- Calculate sample size based on expected prevalence and required precision, e.g., 700-900, minimum 30 clusters

Indicators:
- GAM to inform on severity and magnitude of emergency
- Child and household level to indicators to inform the problem analysis and needs

The Traditional Approach

Challenge Conventional 30x30 cluster surveys are **time and resource intensive** – this poses a challenge, particularly in emergency situations, when rapid and appropriate humanitarian response is essential for effective targeting of scarce resources to communities most in need.

Alternative Sampling Designs

Objective To develop a statistically representative assessment method allowing for rapid collection and analysis of data.

Principles of LQAS

- LQAS analysis methods can be used to assess *binary outcomes*
- Allows for hypothesis testing of an indicator *against threshold prevalence levels*
- Statistical principles of the method are based on *cumulative probabilities of binomials*
- *Decision rules* are used to judge whether the threshold prevalence of an indicator has been reached
- Requires observations be independently and randomly selected (SRS)

Alternative Sampling Designs

Objective To develop a statistically representative assessment method allowing for rapid collection and analysis of data.

Result

1. 33x6 Design
2. 67x3 Design
3. Sequential Design

LQAS Hypothesis Tests for GAM

The 33x6 and 67x3 designs allow for

a. Point estimates with CI for GAM and other child level and household level indicators

AND

b. LQAS hypothesis tests of GAM prevalence because the designs approximate a SRS for assessment of GAM

- 10% and 15% prevalence levels (i.e. upper thresholds) of primary interest, 20% prevalence of secondary interest

- Useful if 95% CI overlaps with a threshold level necessary for decision making about response

Alternative Sampling Designs: 33x6 and 67x3

Completed and Forthcoming Work	Collaborators	Funded By
1. Development of Designs	FANTA, CRS, OSU	USAID/GH Andrew W. Mellon Grant
2. Ethiopia Field Test	FANTA, CRS, OSU	GH and Ethiopia Mission Andrew W. Mellon Grant
3. Sudan Field Validation	FANTA, SC-US	OFDA GH SC-US private funds
4. Simulation Validation and Post-Hoc Correction Formula	FANTA, Harvard	GH
5. **Guide for survey planning, data collection and analysis**	FANTA	OFDA GH

Comparison of Traditional and Alternative Sampling Designs

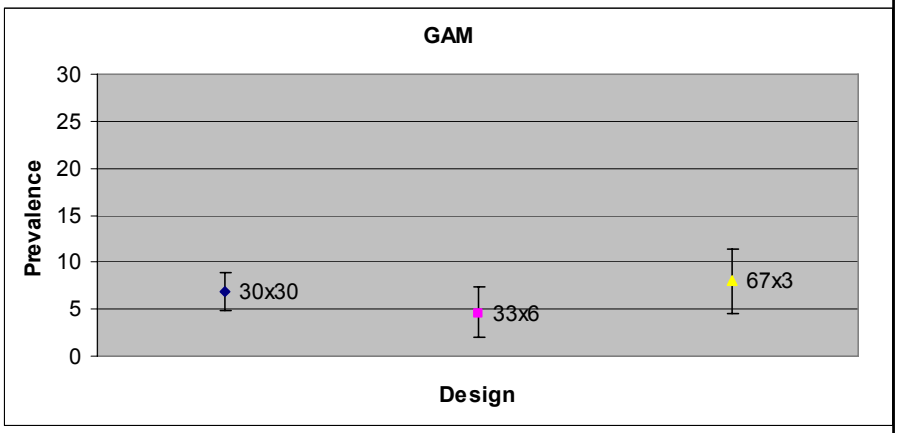
30x30 Design, 33x6 Design, 67x3 Design

Accuracy
Precision

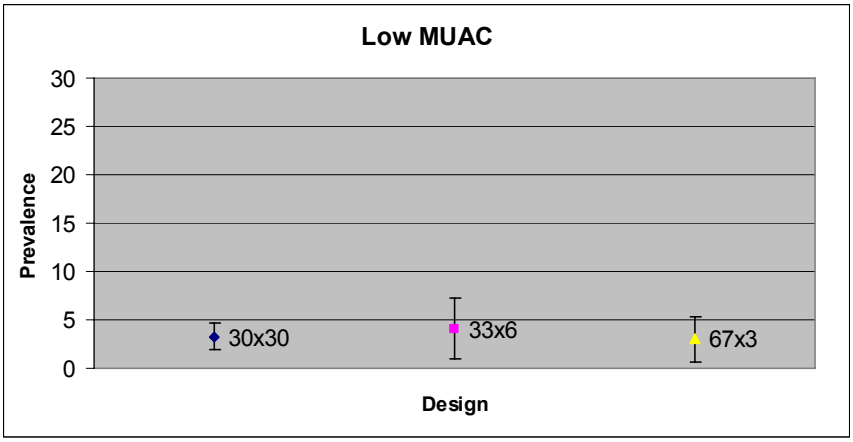
for child- and HH-level indicators

using data from a field validation in West Darfur, Sudan

Comparison of Results: Child-Level



Comparison of Results: Child-Level



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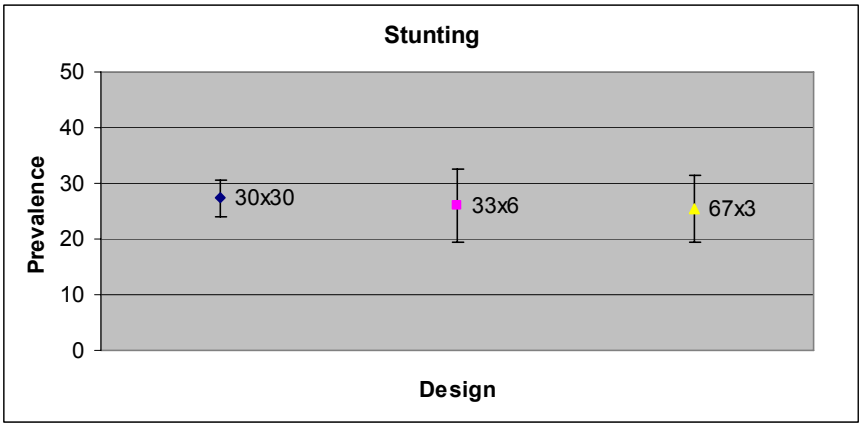
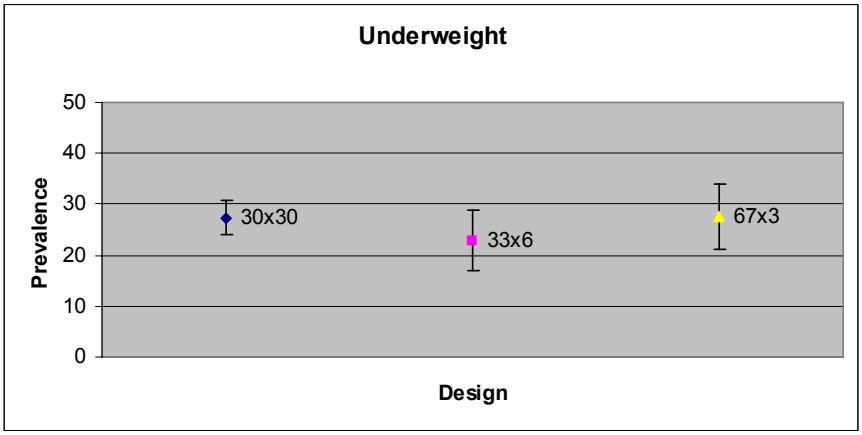
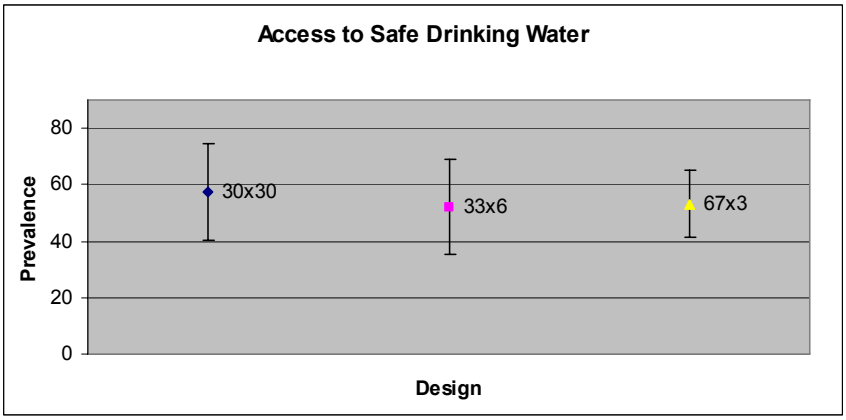


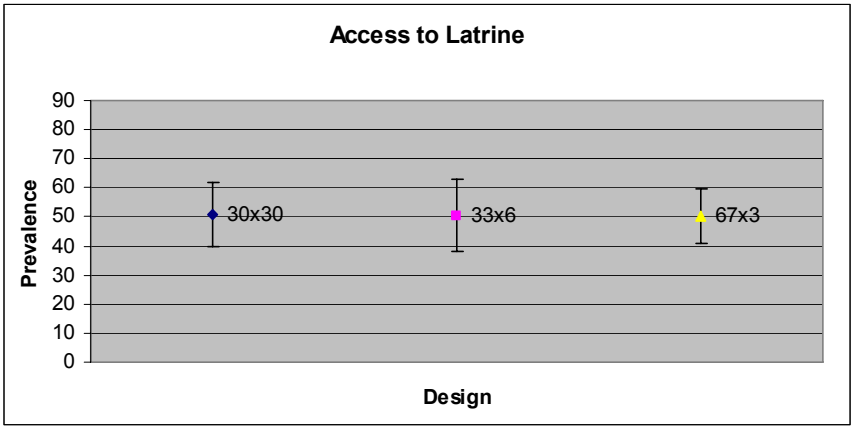
Comparison of Results: Child-Level



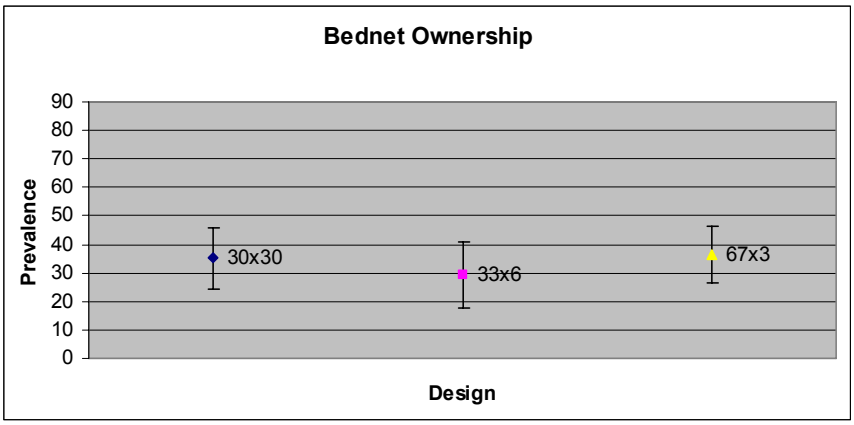
Comparison of Results: HH-Level



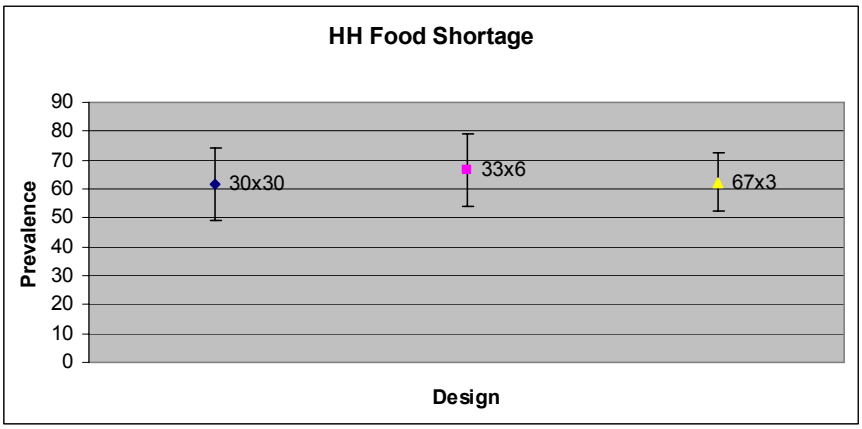
Comparison of Results: HH-Level



Comparison of Results: HH-Level



Comparison of Results: HH-Level



Why Do The LQAS Designs Work?

- Inherent to cluster sampling is the possibility for intra Cluster Correlation.
  - Intra cluster correlation (ρ) measures how similar responses are in a cluster
  - The greater ρ, the more data (clusters) must be collected to precisely capture the variability that exists across the entire assessment area
  - Design effect (DE) measures the diminished ability to precisely measure an indicator
    - DE= 1+ρ(m-1)
      with m = observations in a cluster
      →30X30, m= 30
      →67X3, m=3

Comparison of Design Effects

Indicator	30x30	33x6	67x3
GAM	1.422	0.804	0.831
Low MUAC	1.284	1.351	0.953
Stunting	1.364	1.151	0.955
Underweight	1.285	1.006	1.058

Comparison of Design Effects

Indicator	30x30	33x6	67x3
Safe Water	27.651	5.791	2.924
Latrine Access	11.402	3.271	1.955
Bed-net Ownership	12.179	3.421	2.202
HH Food Shortage	15.075	3.609	2.168

Comparison of CI Widths (in ppt)

Indicator	30x30	33x6	67x3
GAM	+/- 2.0	+/- 2.6	+/- 3.4
Low MUAC	+/- 1.4	+/- 3.1	+/- 2.3
Stunting	+/- 3.4	+/- 6.5	+/- 5.9
Underweight	+/- 3.3	+/- 5.9	+/- 6.4

Comparison of CI Widths (in ppt)

Indicator	30x30	33x6	67x3
Safe Water	+/- 17.0	+/- 16.8	+/- 11.8
Latrine Access	+/- 11.0	+/- 12.6	+/- 9.7
Bed-net Ownership	+/- 10.9	+/- 11.7	+/- 9.9
HH Food Shortage	+/- 12.3	+/- 12.4	+/- 9.9

Time and Cost Comparison

	30x30	33x6	67x3
Time	30.00 team-days	8.25 team-days	11.17 team-days
Cost	4606 US $	1232 US $	1630 US $

Summary of Main Points

- 33x6 and 67x3 designs provide **accurate** results for child- and HH-level indicators
- 33x6 and 67x3 designs provide **reasonably precise** results for child- and HH-level indicators (notable exception is mortality).

Note: the 67x3 design provides more narrow CIs than the 30x30 design for child-level indicators with high intra-cluster correlation (eg. VAC suppl., diarrhea, malaria) and for all HH-level indicators tested.

Summary of Main Points (continued)

- 33x6 and 67x3 designs allow for **LQAS hypothesis testing of GAM threshold prevalence levels** (using cumulative binomial probabilities)
- 33x6 and 67x3 designs offer substantial benefit over 30x30 cluster design in terms of **sample size, time, and cost** required for data collection
- 33x6 and 67x3 design are statistically appropriate alternatives for purpose of obtaining rapid, reliable assessment data in food insecure areas

The FSAU experience with using alternative sampling designs

Lot Quality Assurance Sampling S[illegible]ept 2007

SCN, Nutrition in Emergencies Working Group, March 2nd 2008, Hanoi, Vietnam

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FSAU

Methodology

- A 33 by 6 cross-sectional assessment was conducted in parallel with a 30*30 assessment in the protracted displaced populations in Hargeisa, Somaliland. 33 clusters selected to reduce on travel.
- A list of all settlements within each of the seven identified "camps" with their respective populations formed a sampling frame. (population ~80,000)
- Sampling of the 33 cluster from LQAS and the 30 clusters for the standard surveys were conducted separately and most of which overlapped.
- For the standard 30*30 survey – 6 teams took 5 days to complete the 30 clusters
- For LQAS - 2 teams took 8 days (~4 clusters per day).
- Quantitative data was collected through a standard household questionnaire for both assessments, including info on public health environment, dietary diversity etc

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Methodology Cont…

- For the 30*30 assessment, all children in the 30 households in each of the 30 clusters were assessed providing a sample size of 905
- For the LQAS all eligible children in a sampled household were assessed giving a total of 204 children. Since only 198 children were required for analysis, the six extra children were randomly eliminated at the analysis stage using a table of random numbers. Household and child data was entered, processed (including cleaning) and analysed using EPI6 software.
- Overlapping of households occurred in 2 cases

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Results

Wasting (WHZ)		
Indicator	**30X30**	**33X6**
Prevalence	**10.3**	**9.6**
95% CI	8.4 – 12.2	6.1 – 13.1
CI Width	± 1.9	± 3.5
SE	0.06	0.08
Design Effect	0.91	0.72

MUAC (<12.5cm)		
Indicator	**30X30**	**33X6**
Prevalence	**3.3**	**4.5**
95% CI	1.9 – 4.6	1.3 – 7.8
CI Width	± 1.4	± 3.2
SE	0.09	0.10
Design Effect	1.22	1.27

Stunting (HAZ)		
Indicator	**30X30**	**33X6**
Prevalence	19.2	19.2
95% CI	16.3 – 22.2	12.7 – 25.7
CI Width	± 3.0	± 6.5
SE	0.09	0.10
Design Effect	1.30	1.42

Underweight (WAZ)		
Indicator	**30X30**	**33X6**
Prevalence	18.0	20.7
95% CI	14.8 – 21.3	15.0 – 26.4
CI Width	± 3.3	± 5.7
SE	0.06	0.08
Design Effect	1.68	1.02

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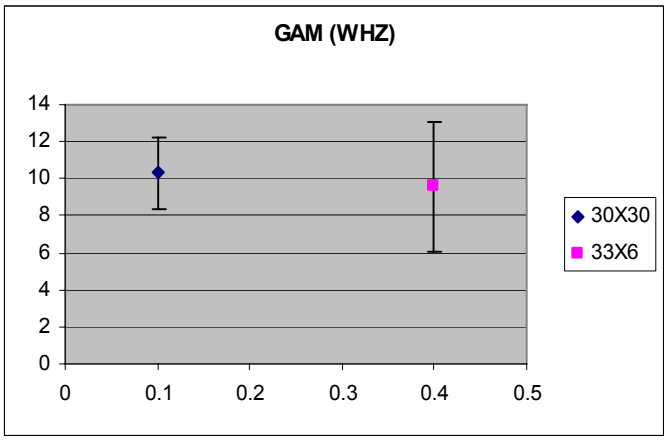
Confidence Intervals (GAM)



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Interpretation of Results

- Prevalence results between LQAS (10.3%) and 30*30 (9.6%) , although very close - cross current thresholds – alert/ serious. The same applies to the CI in both studies
- Potentially can have a significant impact on the interpretation and thus response
- When the analysis of the LQAS data was conducted using the hypothesis testing/ decision rule, results indicated that the population fall into the >10% – more in line with the 30*30 analysis
- The decision rule states >/= 13 cases of acute malnutrition for the 10% GAM threshold. In this study 16 cases were found.

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Conclusion

- LQAS results appear sufficiently sensitive to inform decision making and monitor the nutrition situation – using hypothesis testing /decision rule not prevalence estimate – need further clarification on which is the more appropriate.
- Significant saving in time and resources - 14 man days saving and $5,600 versus $13,700 (**60% less**)
- Definite possibility to assess nutrition situation in an emergency prone and insecure context such as Somalia
- Further studies planned in 2008 in rural riverine and pastoral populations in South Central Somalia – linked to areas where significant nutrition data is available.
- Potential to explore its use in identifying hot spots thus link to response (collaboration with UNICEF)
- Will require significant sensitization to Governments, NGO partners, donors, etc…

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Acknowledgments

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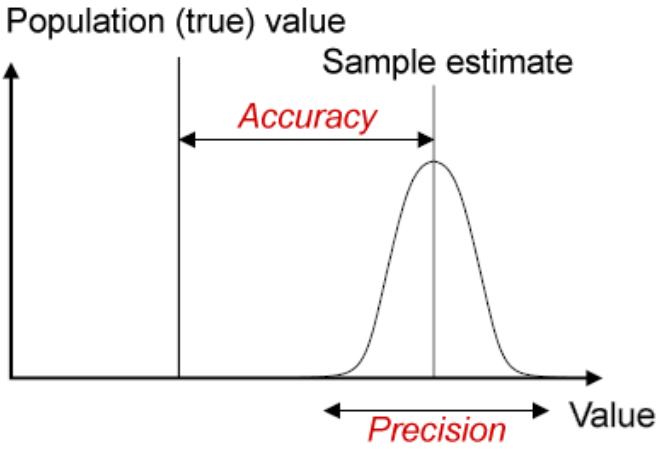
Vocabulary

- **Accuracy**
  The degree of veracity of a measurement. The closer the measurement to the true value for the whole population, the more accurate the measurement is considered to be.

- **Confidence Interval**
  A statistical quantification of the uncertainty in the measurement - usually reported as a 95% Confidence Interval (CI). It is the range of values within which we can be 95% sure that the true value for the whole population lies. The width of the 95% CI is often referred to as the **precision** of the measurement.

Vocabulary



Vocabulary

- **Intra Cluster Correlation**

  A measure of how similar the responses are within clusters for an outcome of interest. The intra cluster correlation coefficient is often referred to as rho, and is designated by *"p".*

Vocabulary

- **Design Effect**

  A measure of the extent to which a cluster design has diminished ability to precisely measure an indicator, as compared to a simple random sample of the same size.

  DE=1 + *p* (m-1), where m=# obs per cluster

LQAS: A simple, low cost random sampling methodology

- Originally developed in the 1920s to control the quality of output in industrial production processes
- Involves taking a small sample of a manufactured batch (lot) and test sampled items for quality.
- If the number of defective items in the sample exceeds a predetermined criteria (decision rule), then the lot is rejected.
- The sample size is statistically determined, based on desired production standards and on the corresponding decision rule
- The sample size is chosen so the manager has a high probability of accepting lots that meet the quality standards, and a high probability of rejecting lots that fail to meet those standards

Useful LQAS definitions

Standard LQAS theory	Public Health programs
Production standard: % of items that must "pass" before the lot is accepted	Coverage % of persons to be covered by the service (i.e. received food, or were vaccinated)
Production unit: The machine or team that produced or assembled the lot	PMAs (Supervision Areas) The CS or program responsible for delivering the service
Lot: Total number of items produced in given time by the production unit	Lot: Total number of persons in a given zone receiving service (food, vaccines, etc)