# SMART survey report in Tonj North county, Warrap state, South Sudan **Submitted by REACH**

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## **REACH** Initiative



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## List of acronyms

Action Contre la Faim
Asset Creation Livelihood
Acute Food Insecurity
Acute Malnutrition
Bureau of Humanitarian Assistance
Centers for Disease Control and Prevention
Crude Death Rate
County Health Department
Centimeters
Community Management of Acute Malnutrition
Crude Mortality Rate
Confidence interval
Crude Mortality Rate
Comprehensive Peace Agreement
Conflict Sensitivity Resource Facility
Digital Data Gathering
Design Effect
Emergency Nutrition Assessments
Early Initiation of Breastfeeding
Exclusive Breastfeeding
Food and Agriculture Organization
Foreign, Commonwealth and Development Office
Food Consumption Score
Food For Action
Famine Early Warning System Network
Food Security and Livelihoods
Food Security and Nutrition Monitoring System
Global Acute Malnutrition
General Food Distribution
Height for Age
Height for Age Z scores
Household
Household Hunger Scale
Integrated Phase Classification
Integrated Phase Classification – Acute Malnutrition
Inter-Agency Needs Assessment

IYCF:	Infant and Young Child Feeding
KG:	Kilogram
LCS:	Livelihood Coping Strategies
MAM:	Moderate Acute Malnutrition
MAD:	Minimum Acceptable Diet
MDD:	Minimum Dietary Diversity
MM:	Millimeter
MOH:	Ministry of Health
MUAC:	Mid Upper Arm Circumference
NIWG:	Nutrition Information Working Group
ODK:	Open Data Kit
OTP:	Out-Patient Therapeutic Programme
PLW:	Pregnant and Lactating Women
PPS:	Probability Proportional to Size
RC:	Reserve Cluster
RRC:	Relief and Rehabilitation Commission
SAM:	Severe Acute Malnutrition
SD:	Standard Deviation (measure of spread around the mean)
SMART:	Standardized Monitoring and Assessment of Relief and Transitions
SSD:	South Sudan
TEM:	Technical Error of Measurement
TOB:	Temporary Operating Base
TSFP:	Targeted Supplementary Feeding Programme
U5MR:	Under Five Mortality Rate
UNHCR:	United Nations High Commissioner for Refugees
UNICEF:	United Nations International Children's Emergency Fund
UNMISS:	United Nations Mission In South Sudan
Vit A:	Vitamin A
WASH:	Water Sanitation and Hygiene
WFH:	Weight for Height
WFP:	World Food Programme
WHO:	World Health Organization
WHZ:	Weigh for Height Z Scores
WVI:	World Vision International

## **Executive Summary**

From December 02–12, 2023, a SMART survey was carried out in each of the nine Payams in Tonj North County, Warrap State, South Sudan. In this survey, a two-stage sample technique was employed: first, the villages were identified using the proportion to population size (PPS) method of cluster sampling, and second, the houses were identified using simple random sampling. In order to determine the nutritional status of 667 children aged 6-59 months, anthropometric data from 493 households in 44 clustered villages in Tonj North County were surveyed. There was no need to activate reserve clusters because the final sample size is greater than the intended sample size of 506 children.

Category	Indicator	n	Ν	(%) ( 95% CI)
Wasting -	Prevalence of global malnutrition by WHZ (<-2 z-score and/or oedema)		667	13.6 % (10.8-17.0)
	Prevalence of severe malnutrition (<-3 z-score and/or oedema)		667	3.1 % (2.0-5.0)
	Prevalence of global malnutrition by MUAC (< 125 mm and/or oedema)		683	7.2 % (5.0-10.1)
	Prevalence of severe malnutrition (< 115 mm and/or oedema)		683	1.5 % (0.8-2.8)
	Prevalence of stunting (<-2 z-score)		619	24.6 % (20.4-29.2)
Stunting	Prevalence of severe stunting (<-3 z-score)		619	8.4 % (6.2-11.3)
l la democialet	Prevalence of underweight (<-2 z-score)		666	21.2 % (17.1-25.9)
Underweight	Prevalence of severe underweight (<-3 z-score)		666	5.6 % (3.6-8.5)
Mortality	Crude Death Rate (Deaths/10,000 people/day)		493	0.45 % (0.27-0.75)
	Under-5 Death Rate (Deaths/10,000 children U5/day)		493	0.80 % (0.36-1.79)
Nutrition and	Measles card + mother confirmation		687	53.6 % (49.5-57.4)
Health Service Coverage	De-worming (children12-59 months)		628	68.6 % (64.8-72.3)
	Vitamin A Supplementation	466	706	66.0 % (62.5-69.4)

#### Table 1: Executive summary table

## Introduction

Warrap State is one of the ten states in South Sudan, and it consists of six counties: Tonj South, Tonj East, Tonj North, Gogrial East, Gogrial West and Twic, with a total area of 31,027 km2. The population of Warrap State was estimated to be 920,045 in the 2008 census and currently projected to be 1,696,671<sup>1</sup>.

In terms of access, the areas where frequent attacks occur, mainly related to cattle raiding across neighboring counties and communal (inter-clan) conflicts, have been reported to be located along the borders with Warrap and Lakes States, and include Tonj and Manyang Ngok Payams in Tonj South County; Wunlit, Makuac, Paliang and Paweng Payams in Tonj East County; Marial Lou, Akop, Alabek and Aliek Payams in Tonj North County; and Toch North and Toch East<sup>2</sup>.

According to the South Sudan Conflict Sensitivity Resource Facility (CSRF) county profiles<sup>3</sup>, Tonj North county is situated in the western floodplain's sorghum and cattle livelihoods zone<sup>4</sup>. It is the largest county in Warrap State and the landscape is characterized by flat grassland and tropical savannah. A recent study indicates that 70% of households engage in agriculture<sup>5</sup>. Planting is conducted during the rainy season and the main crops are sorghum, sesame, millet, ground nut peas, okra, and pumpkin. Fishing is also a key livelihood in the county, and dry fish is exported to markets such as Wau.

FAO and WFP reported in 2019 that ox-ploughs were used in the area, allowing for higher crop yields. However, access to such tools to maintain livelihoods may be lost during times of insecurity and displacement, and there can be cultural barriers to using cattle to pull ox-ploughs. Pastoralists throughout Tonj North – like others from Tonj South, Abyei and Lakes/Warrap States – migrate during the dry season in search of water in various parts of the northeastern and eastern Warrap State. Livelihoods can be disrupted by recurring resource and migration disputes and cattle raiding in conflict-prone payams of Tonj North that border Tonj East County (Kirik, Rualbet, Marial-Lou) and Warrap State (Akop and Alebek).

The latest Inter-Agency Needs Assessment (IRNA) in Tonj North, dated from August 2022, states that at least 54% of the population in the county (165,000 people) are affected each year by recurrent subnational violence and seasonal flood<sup>6</sup>. Information coming from this assessment also highlights that, ninety thousand people had been internally displaced in Warrap state as of 2021 as a result of subnational violence brought on by cattle raids and retaliatory attacks. Between January and June 2021, 25,000 of the displaced individuals experienced emergency and crisis situations (IPC4 and IPC5). Partners in Warrap and Wau provided humanitarian assistance, which

- <sup>4</sup> <u>FEWSNET, 2018</u>
- <sup>5</sup> FAO & WFP, 2018

<sup>&</sup>lt;sup>1</sup> South Sudan Population Projections, 2020-2040

<sup>&</sup>lt;sup>2</sup> ibid

<sup>&</sup>lt;sup>3</sup> CSRF, South Sudan

<sup>&</sup>lt;sup>6</sup> IRNA Report, August 2022

helped to alleviate some of the most pressing needs of the affected population<sup>7</sup>. Access to humanitarian assistance has been hindered due to access constraints, among others due to security incidents related to ambushes, looting of humanitarian convoys, and direct attacks to health facilities, such as Marial Luo hospital<sup>8</sup>. The security situation in the area remains fragile.

The last SMART survey in Tonj North was conducted by Action Against Hunger (ACF) in March 2021, and showed the Global Acute Malnutrition (GAM) rate was 18.4% (14.2 – 23.7 95% C.I) which is above the emergency threshold (15%) of the World Health Organization (WHO). Furthermore, the recent Integrated Food Security Phase Classification for Acute Malnutrition (IPC-AMN) report published in October 2023 classified Tonj North in the serious phase for the current analysis period (July - September 2023) and critical for both the first (October 2023 - March 2024) and second (April - June 2024) projections periods of IPC-AMN analysis. Similarly, IPC Acute Food Insecurity (AFI) will remain in phase 3 for both projections, with 30% of the population in phase 3 and 10% of the population in phase 4, and 35% of the population in phase 3 and 15% of the population in phase 4, for both periods, respectively. For the current analysis period (September – November 2023), AFI was classified in phase 3 with 30% of the population in phase 3 and 5% of the population in phase 4.

The nutrition situation in Tonj North County remains an information gap for implementing partners as well as for the IPC AMN, therefore Tonj North has been flagged as one of the twenty-two priority counties where SMART surveys should be conducted in 2023, according to the Nutrition Information Working Group (NIWG) classification of counties with information gaps. With the intention to close the information gap related to the nutrition situation in Tonj North County, REACH Initiative conducted a SMART survey from November 22<sup>nd</sup> to December 12<sup>th</sup> 2023 (including field level preparation, enumerator selection, training and actual data collection), collecting anthropometric and mortality data, as well as key multi-sectoral indicators - Food Security and Livelihoods (FSL), Water, Sanitation and Hygiene (WASH), and Health - to better understand the status of AMN in Tonj North County as well as its key drivers.

This report will present the survey objectives and methodology used to conduct the SMART survey in Tonj North County, including details on the sampling procedure, as well as the process undertook for training the survey teams and conducting the data collection exercise. Results of the survey are presented in different sections, corresponding to the main indicators collected across all thematic sectors. To finalize, a set of conclusions, recommendations and priorities have been drafted with the aim to better inform stakeholders working in the context.

<sup>7</sup> ibid

<sup>&</sup>lt;sup>8</sup> ibid

<sup>9</sup> South Sudan IPC Findings 2023/2024

Figure 1: Tonj North county reference map



## **Survey Objectives**

The general objective of this assessment was to assess the nutrition situation among children (boys and girls) aged 6-59 months and retrospective mortality rates amongst the population in Tonj North County. In addition, the assessment also aimed to analyse the possible factors contributing to acute malnutrition in Tonj North, county, Warrap state, South Sudan to inform humanitarian actors and contribute to a more effective planning and implementation of nutrition services.

Specifically, the objectives of this assessment in Tonj North county break down into the following points:

- To estimate the prevalence of acute malnutrition, stunting and underweight among children (boys and girls) aged 6 59 months
- To estimate retrospective (using a 94 days recall period) Crude Mortality Rate (CMR) and Under 5 Mortality Rate (U5MR)
- To estimate the proxy coverage of acutely malnourished children 6-59 months in any nutrition program
- To estimate the coverage of various immunizations including:

- Vitamin A supplementation (for children aged 6-59 months)
- Deworming (for children 12-59 months old)
- Measles vaccination coverage among children 9-59 months.
- To assess childhood morbidity and health seeking behaviors among children aged 6-59 months
- To assess the nutritional status of pregnant and lactating women (PLW)
- To assess IYCF practices such us breastfeeding and complementary feeding among mothers who have children under the age of two years
- To understand the WASH situation in relation to access and quality of services available,
- To determine the food security and livelihoods situation based on FSL outcome indicators and information on main livelihood sources available in the area.

## Methodology

This is a quantitative survey, following SMART surveys protocol, that is representative of the entire population of Tonj North county. The detailed sampling is presented below. All villages/clusters in Tonj North county were included and its respective population size was considered in order to provide each sampling unit with equal chances of being selected.

## Sampling strategy

For this survey, a representative sampling was achieved following a two-stage cluster sampling strategy, which gives a fair chance for each village/cluster to be selected based on its population size, as per the SMART survey guidelines. This strategy consists of two steps: firstly, villages were randomly selected across all the villages in the geographical area of study, with a probability of selection proportional to population size (PPS). Secondly, a total of 12 households were randomly selected within each previously selected cluster, based on the calculation in table 4 below, which takes into account how many households per day one survey team can cover, considering different factors as detailed in the table.

#### Sampling strategy: selection of clusters

The smallest geographic unit used for the study is called a cluster, and in this instance, villages were the administrative level used as clusters. The list of all 925 villages, with populations ranging from as little as 12 individuals to as many as 10,320, was collected from the Tonj North County Health Department (CHD). As per the calculation (see table 5), 44 clusters needed to be selected out of this list in order to achieve the desired level of precision. Using the ENA software, 44 villages were hence randomly selected from the list, along with 5 reserve clusters (RC), using the PPS method.

For clusters with more than 150HHs, segmentation was used to select one portion of the cluster that will represent the cluster. Selection of segments were done using either PPS or simple random

sampling depending on the population sizes of the specific segments<sup>10</sup>. In the selected segment, the process of HH selection was the same used for each cluster to select the 12 HH to be surveyed within that particular segment/cluster.

The survey teams were able to visit all 44 selected clusters and reached a total of 493 households (94% of the total 525 households planned) as well as 683 children under five (135% compared to the 506 needed to achieve representation) ,hence, there was no need to activate the reserve clusters as the minimum required sample for both clusters and number of children was achieved, as per the SMART guideline.

### Sampling strategy: selection of households

*Definition of household for the survey:* A household was defined as a group of people living together, who cook and eat from the same cooking pot. Polygamous families were also defined based on the same principle, if each wife had her own pot, even if they were living in the same compound, they were treated as different households.

*Household selection techniques*: One of these two methods was used for household listing; (1) a verbal listing from one or more community leaders and, when not possible, (2) a manual house to house listing. Twelve households were then randomly selected from the complete list of HHs using a random number generator application.

In selected households, all eligible children (aged 6-59 months) were measured and the household questionnaire applied. Empty households and households with absent children were re-visited and information of the outcome recorded on the cluster control form. This form was also used to record information on empty and non-responding households.

Parameter	Tonj North County	Justification
Estimated Prevalence (%)	18.4%	Tonj North SMART survey was conducted in March 17 to 22, 2021 by ACF, 18.4 % (14.2 - 23.7 95% CI). The point estimate was taken from this survey.
Desired Precision	4.3	Based on the Last SMART survey Guide
Design Effect	1.49	From the 2021 SMART Survey Conducted by ACF
Children to be Included	506	
Average Household Size	5.9	From the 2021 SMART Survey Conducted by ACF
% children Under-Five	19.9%	From the 2021 SMART Survey Conducted by ACF
% Non-Respondents	3%	From previous experience
Households to be Included	525	

 Table 2: Sample size (Anthropometric)

<sup>&</sup>lt;sup>10</sup> As per the SMART Guidelines, if the Segments will have almost equal population sizes, then, SRS will be used; but if the population sizes will be different, then PPS method will be use

#### Table 3: Sample size (Mortality)

Parameter	Tonj North County	Justification
Estimated death rate per 10,000/day	0.85	Tonj North County SMART survey, March 17-22, 2021 by ACF, 0.85 % (0.53 -1.37, 95% CI). Point estimate taken as no special events happened since the last survey.
Desired Precision	0.4	This is taken as per the SMART guidance
Design Effect	1.03	Tonj North County SMART survey, March 17-22, 2021 by ACF
Recall Period	94	Starting from Sep 4, 2023 (start of harvest season)
Population to be Included	2461	
Average Household Size	5.9	Tonj North County SMART survey, March 17-22, 2021 by ACF
% Non-Respondents	3%	From previous experience
Households to be Included	430	

The maximum sample size was returned by the anthropometry sample size calculation and this was considered the final sample size, in which 525 households were to be surveyed.

Table 4: Number of households team interviews per day

Activity	Estimated Time
Departure from Office	7:30 AM
a. Daily morning Briefings	15min
b. Travel to clusters	60 min
c. Introduction and HH list development	30 min
d. Lunch break	30 min
e. Total Time from one HH to another	5 min
f. Travel back to base	60 min
Total time for HH listing, travelling and breaks ( $a + b + c + d + f$ )	195 min
Arrival back to Base	5:30 PM
Total Available time in a day	10:00hrs (600 minutes)
Available time for work	600 - 195 minutes= 405
	minutes
Time taken to complete one questionnaire	30 minutes
Total time per household + e	35 minutes

Given the above, the number of households that a team can comfortably visit in a day is calculated as follows:

405 (min) / 35 (min) =11.6 HH/per day ~ 12 HH

Accordingly, the number of clusters is presented in the table 5 below:

Table 5: Number of clusters

	Tonj North
Total number of HH based on sample size calculation	525
Total number of HH to be assessed per day per team	12
Clusters Needed	43.75
Rounded UP	44

### Survey teams, training, data collection and data management

<u>Survey teams</u>: Six teams of four members (1 Team Leader, 1 measurer, 1 assistant, 1 enumerator) were involved in the collection of the data. In each cluster, a local guide was employed to facilitate data collection at the household level. The survey teams were recruited by World Vision International (WVI) with the involvement of the local officials at Tonj North County. To the extent possible, the team members were a mix of both males and females and were recruited from the local communities. Supervisors were consisting of a mix of World Vision International (WVI), Relief and Rehabilitation Commission (RRC), County Health Department (CHD) and REACH staff.

**Training**: The survey teams were trained for five days between November 27<sup>th</sup> to 1 <sup>st</sup> of December, 2023. The training covered various components including: taking anthropometric measurements, sampling of households, data collection tools, digital data collection, data quality checks, and standardization exercise among other themes. The training of the enumerators was facilitated by SMART certified staff and staff with experience conducting SMART surveys.

**Supervision**: The overall management of the survey was done by REACH Initiative with support from WVI dedicated staff. Maximum supervision of the survey teams was ensured to facilitate quality data.

**Data entry and management:** Data was collected through REACH tablets using Kobo. The data collection tools were programmed and uploaded in the tablets which were used by the survey teams. The teams were uploading the collected data to a central server on daily basis to allow the survey manager to review the data collected each and every day and clean the data and give the feedback every morning to the teams.

### **Data quality**

In order to ensure optimal and high data quality, a number of measures were put in place. The main ones included:

- a) The survey was done in accordance with the submitted protocol, ensuring the following:
  - a. That the training of survey teams was done using standardised material as recommended by SMART Methodology.
  - b. That standardisation test was undertaken as part of the training; taking appropriate steps thereafter based on performance of the survey teams.
  - c. That appropriate calibration of survey equipment, during the training and on every morning before proceeding to the field for data collection, was followed.
  - d. That plausibility checks were conducted on a daily basis and informed the daily debriefing sessions which were conducted every day.
- b) Data was collected through digital platform, and control checks and skip patterns were programmed to improve the data quality.
- c) Anthropometry data was auto analysed using ENA software anthropometry section. The same software was also used to analyse the mortality data.

### Questionnaire

The survey was conducted using structured data collection tools which have been developed by the Global SMART Team for both anthropometric and mortality surveys using KOBO. Other indicators were collected using the modules in line with current FSNMS questionnaires as much as possible.

## Data collected

- 1. Anthropometry
  - **Age:** was determined using birth/health cards/ records when available and local calendar of events which were jointly developed by local leaders and survey enumerators.
  - Sex: Male or female
  - **Weight:** Children's weights was taken without clothes using mother and child digital weighing scales (SECA scales with precision of 100gm).
  - **Height/length:** Children were measured using the wooden UNICEF measuring boards (precision of 0.1cm). Children less than 2 years of age were measured lying down, while those 2 years of age or older were measured standing up.
  - **Mid-upper arm circumference:** MUAC measurements were taken at the mid-point of the left upper arm using both the child and adult MUAC tapes (precision of 0.1cm) for children 6-59 months and for adult women 15-49 years of age.
  - **Bilateral pitting oedema:** Bilateral pitting oedemas were assessed by the application of normal thumb pressure on both feet for 3 seconds.
- 2. **Demographics and mortality:** Every current household member's age in years, their sex, place of birth, and the date they joined the household were all variables gathered throughout

the recall period. The age in years, the sex, and whether or not the household member was born into the family during the recall period were all gathered for those household members who departed during the recall period. Age in years, sex, whether the deceased was born or joined the household during the recall period, estimated cause of death, and place of death were all variables recorded for those who passed away during the recall period.

- 3. **Health interventions data:** Vitamin A supplementation, Deworming and Measles immunization data were collected through health cards or recall.
- 4. **Morbidity**: Two-week retrospective morbidity data was collected from mothers/caregivers of all children (6-59 months) included in the anthropometric survey.

#### 5. Food Security Indicators:

- a. Food Consumption Scores (FCS): An indicator of the general quantity and quality of foods being consumed in a household, based on how many days any household members have consumed 9 distinct food groups within a 7-day recall period. Households were categorized into categories of severity based on their responses. FCS is often used as a proxy for quality of food consumed. Standard FCS thresholds are <21 for 'poor', 21-<=35 for 'borderline' and 35+ for 'acceptable'.</p>
- b. **Household Hunger Scale (HHS):** Measures the perceived hunger by asking the frequency a household has experienced three common experiences associated with hunger in the past 30 days (no food in the house, slept hungry, gone whole day and night without food). HHS is often used as a proxy for quantity of food consumed. Thresholds and categories used for analysis are those used for IPC AFI in South Sudan.
- c. **Livelihood Coping Strategies (LCS):** Measures behaviours or actions households are taking to cope with not having enough food or resources to get food. Ten coping strategies were probed for and then categorized as Emergency, Crisis, or Stress strategies.
- 6. **WASH** indicators on main water source, access to latrines, distance/time to water source, and water treatment were asked.

**Referral:** All children with acute malnutrition and not already enrolled in treatment were referred using referral forms to existing TSFP and OTP programs in the county. During the collection of these anthropometric data, all children whose measurements indicated they were acutely malnourished, and who were not already enrolled in nutrition treatment programs, were referred to the relevant partners using referral forms to existing TSFP and OTP programs in the area.

## **Classifying malnutrition**

#### Individual classification of nutritional status

Individual classifications for nutritional status by different anthropometric measurements are summarized in table 6 below for wasting, stunting, and underweight.

Type of Malnutrition	Grade of Malnutrition	Anthropometric Indicators and Cutoffs
Wasting		<-2 z-scores weight-for-height (WFH) and/or oedema
	Global Acute Malnutrition (GAM)	<125mm mid-upper arm circumference and/or oedema
	Moderate & severe wasting	Presence of bilateral pitting oedema
		<-3 z-scores weight-for-height (WFH) and/or oedema
	Severe Acute Malnutrition (SAM)	<115mm mid-upper arm circumference and/or oedema
	Severe wasting	Presence of bilateral pitting oedema
Stunting	Global Chronic Malnutrition Global Stunting	<-2 z-scores height-for-age (HFA)
	Severe Chronic Malnutrition Severe Stunting	<-3 z-scores height-for-age (HFA)
Underweight	Global Underweight	<-2 z-scores weight-for-age (HFA)
	Severe Underweight	<-3 z-scores weight-for-age (HFA)

 Table 6: Individual malnutrition classifications by WHO

#### Population cut-offs for malnutrition

Table 7 below defines the population cut-offs for determining the severity of the malnutrition when the prevalence of acute and chronic malnutrition is known. These levels are internationally agreed upon and provide an objective basis for developing responses to increased levels of acute and chronic malnutrition<sup>11</sup>. To interpret proportions at a population level with meaning, absolute numbers are also necessary.

 Table 7: WHO/UNICEF Classification for Severity of Malnutrition by Prevalence among Children 6-59

 months<sup>12</sup>

	PREVALENCE OF THRESHOLDS %						
LEVELS	WASTING	OVERWEIGHT	STUNTING				
Very low	<2.5	<2.5	<2.5				
Low	2.5- <5	2.5- <5	2.5- <10				
Medium	5- <10	5- <10	10- <20				

<sup>&</sup>lt;sup>11</sup> Physical Status: The use and interpretation of Anthropometry. Report of a WHO expert committee, 1995. Chapter 5, p208 & 212

<sup>&</sup>lt;sup>12</sup> <u>Threshold classification according to WHO 2018</u>

High	10- <15	10- <15	20- <30
Very high	>=15	>=15	>=30

Table 8: IPC AMN classifications for severity of malnutrition prevalence among children 6-59 months<sup>13</sup>

IPC AMN Phase	PREVALENCE OF THRESHOLDS %						
Classification	WASTING by GAM by Weight for Height z-score	WASTING by GAM by Mid- Upper Arm Circumference <sup>14</sup>	Priority Response Objective				
Acceptable	<5	< 5%	Maintain the low prevalence of acute malnutrition				
			Strengthen existing response capacity and resilience. Address contributing				
Alert	5- <10	5 - <10%	factors to acute malnutrition. Monitor conditions and plan response as required.				
Serious	10- <15		Urgently reduce acute malnutrition levels through scaling up of treatment and prevention of affected populations				
Critical	15- <30	10 - <15%	Urgently reduce acute malnutrition levels through significant scale up and intensification of treatment and protection activities to reach additional				
Extremely Critical	>=30	>= 15%	Urgently reduce acute malnutrition levels through addressing widespread acute malnutrition and disease epidemics by all means				

#### 1.1.1 Data cleaning and analysis

The anthropometric and mortality data was analysed using ENA for SMART (Jan 2020 version). The other additional data (immunization, maternal nutrition, morbidity etc.) were analysed using R. Various statistics have been computed on the data, including percentages, means, and median among others. The analysed data is presented in both tabular and graphical form. The preliminary datasets was made available within 7 days after the last day of data collection, and the preliminary report within 14 days. The preliminary report has gone through REACH validation processes, and was also submitted to the Nutrition Information Working Group (NIWG) for validation.

During the data collection exercise, daily quality checks were performed to ensure the process was running smoothly and that enumerators were well trained on the procedures to be performed.

<sup>&</sup>lt;sup>13</sup> <u>Threshold classification according to IPC Acute Malnutrition reference tables</u>

<sup>&</sup>lt;sup>14</sup> IPC AMN classification by MUAC should only be done in the absence of GAM by WHZ data. Whether a higher or lower IPC AMN Phase is classified depends on the historical relationship between WHZ and MUAC in the unit of analysis. See IPC AMN Guidance for more details.

Moreover, specific checks on the anthropometric and mortality results were carried out, specifically the following:

- Check SMART Flagged children Input the anthropometric data into ENA and run the plausibility report. This should identify children without z-scores and if a flagged child cannot be corrected this way, we keep the child in the dataset as it contributes to our quality score.
- Cleaning extreme MUAC values MUAC values <5cm or >20cm or likely errors and will be removed for children 6-59 months.
- **Cleaning reported deaths** If date of death is available, removing reported deaths that occurred outside of the recall period of interest.

## **Results**

A total of 493 households and 3542 individuals were included in the survey. The average household size was 7.2 individuals. Out of the surveyed households, 88% had children under five, bringing the total number of children included in the survey to 683. The proportion of head of households showed a slight inclination towards women, with 58% of the total households being female headed while the remaining 42% being male headed households. As the survey achieved the minimum number of children, households and clusters as per SMART guideline, there was no need to activate reserve clusters.

	Target	Achieved		Abse	Absent		Refused	
	N	N	% of Target	N	% of Target	Ν	% of Target	
Children	506	683	134	3	0.6	1	0.2	
Households	525	493	94	2	0.4	5	1	
Clusters	44	44	100	N/A	N/A	N/A	N/A	

Table 9: Survey sample and non-response

## **Anthropometric Results**

From 44 villages in Tonj North County, a total of 683 children aged 6-59 months (334 boys and 349 girls) were measured to assess acute malnutrition status. In this survey, all planned 44 clusters were surveyed with 493 (94%) of all initially planned households and 683 (135%) of all initially planned children measured for anthropometry. With respect to outliers, the data has been checked with +/-3 from the observed mean and those values identified as outliers were flagged by SMART software as not being plausible either for height, weight, or age. The SMART flags were excluded from the analysis but not from the data. In total, 16 data points were flagged for the weight-for-height z-score, hence, 667 children were analyzed. Similarly, 666 (17 excluded) children were analyzed for weight-for-age, and 619 (64 excluded) for heigh-for-age. This analysis was conducted using WHO 2006 standards.

	Boys		Girls		Total		Ratio
AGE (mo)	no.	%	no.	%	no.	%	Boy:girl
6-17	78	55.7	62	44.3	140	20.5	1.3
18-29	52	40.3	77	59.7	129	18.9	0.7
30-41	95	51.6	89	48.4	184	26.9	1.1
42-53	78	45.1	95	54.9	173	25.3	0.8
54-59	31	54.4	26	45.6	57	8.3	1.2
Total	334	48.9	349	51.1	683	100.0	1.0

Table 10: Distribution of age and sex of sample

Figure 2: Population pyramid for age and sex



#### GAM by WHZ

The prevalence of GAM defined as WHZ (WHZ < -2 and/or oedema) among children 6-59 months was estimated at 13.6% (10.8 – 17.0, 95% CI) (see table 11 below), which categorizes as "Serious" level as per IPC AMN classification<sup>15</sup>. Correspondingly, a GAM rate falling in the Serious phase require scaling up of treatment and prevention of the affected population<sup>16</sup>. The prevalence of

<sup>&</sup>lt;sup>15</sup> Integrated Phase Classification (IPC) Technical Manual Version 3.1

<sup>&</sup>lt;sup>16</sup> ibid

SAM per WHZ among children 6-59 months was 3.1% (2.0 - 5.0, 95% CI). No nutritional bilateral oedema case was observed during the assessment.

A previous SMART survey conducted in April 2021 by ACF had an estimated GAM rate of 18.4% (14.2 – 23.7, 95% CI) which is higher than the current GAM rate of 13.6% (10.8 – 17.0, 95% CI) estimated through this survey. When comparing both surveys GAM rates it is noticeable that their confidence intervals overlapped, which can indicate that the change in the overall GAM rate might not be significant. However, statistical tests were necessary to prove whether this difference is really statistically significant or not. After analyzing the results with CDC statistical calculator, results showed that the difference between the GAM rates was statistically significant, with a p-value of 0.0296. Therefore, we can say that the current nutritional status of the under-five population in Tonj North County cannot be compared with the results obtained in April 2021, as there is a significant change between the two estimates. This difference might be due to the fact that the current study was conducted during the main harvest season, while the previous ACF SMART survey was conducted when households were already running out of food stocks, starting what is considered the lean season.

Weight-for-Height z-scores % of Children (n = 667)45 WHO standards 40 35 30 25 20 15 10 5 -3 -2 -1 0 1 2 ٩ 4 5 Z-score SMART flags

Figure 3: Gaussian curve for Weight-for-Height z-scores

The mean and standard deviation of Weight-for-Height in Z-score were -0.86 and 1.10 showing that there are more malnourished children in the surveyed population than in the WHO reference population. The quality of measurement was in the recommended range of 0.8 - 1.2. The community surveyed was found to be more homogenous than anticipated during the planning stage as shown by the Design Effect (DEFF) of 1.33 for WHZ where DEFF of 1.49 was used at the

planning stage. Skewness and kurtosis were found to be -0.15 and -0.10 meaning that the data is normally distributed and authentic.

	All	Boys	Girls
	n = 667	n = 322	n = 345
Prevalence of global	(91) 13.6 %	(54) 16.8 %	(37) 10.7 %
malnutrition	(10.8 - 17.0	(13.1 - 21.2	(7.7 - 14.7
(<-2 z-score and/or oedema)	95% C.I.)	95% C.I.)	95% C.I.)
Prevalence of moderate	(70) 10.5 %	(43) 13.4 %	(27) 7.8 %
malnutrition	(8.2 - 13.3	(10.1 - 17.4	(5.4 - 11.2
(<-2 z-score and >=-3 z-score,	95% C.I.)	95% C.I.)	95% C.I.)
no oedema)			
Prevalence of severe	(21) 3.1 %	(11) 3.4 %	(10) 2.9 %
malnutrition	(2.0 - 5.0	(1.8 - 6.4	(1.4 - 5.8
(<-3 z-score and/or oedema)	95% C.I.)	95% C.I.)	95% C.I.)

Table 11: Prevalence of acute malnutrition based on weight-for-height z-scores (and/or oedema) and by sex

The prevalence of oedema is 0.0 %

The overall GAM rate was13.6 % (10.8 - 17.0 95% C.I.). Both SAM and MAM prevalence was higher in boys than girls, with no bias in representation (P=0.566). These results exceeded the cutoff point of 10% established by WHO to classify the situation as "serious", and since they fall in the range between 10-14.9 it would be aligned with an IPC classification of Phase 3.

Table 12: Prevalence of acute malnutrition by age, based on weight-for-height z-scores and/or oedema

		Severe (<-3 z·	wasting ·score)	Mod was (>= -3 a z-sc	erate ting and <-2 ore )	Nor (> = -2	mal z score)	Oed	ema
Age (mo)	Total no.	No.	%	No.	%	No.	%	No.	%
6-17	135	11	8.1	19	14.1	105	77.8	0	0.0
18-29	128	3	2.3	12	9.4	113	88.3	0	0.0
30-41	177	1	0.6	16	9.0	160	90.4	0	0.0
42-53	170	5	2.9	14	8.2	151	88.8	0	0.0

54-59	57	1	1.8	9	15.8	47	82.5	0	0.0
Total	667	21	3.1	70	10.5	576	86.4	0	0.0

Children between the age of 6-17 months were most affected by both severe and moderate wasting. This might imply that there is poor complementary feeding practices as children of this age need additional calories apart from breastfeeding.

#### GAM by MUAC

Table 13: Distribution of acute malnutrition and oedema based on weight-for-height z-scores

	<-3 z-score	>=-3 z-score	
Oedema present	Marasmic kwashiorkor. 0	Kwashiorkor. 0	
	(0.0 %)	(0.0 %)	
Oedema absent	Marasmic	Not severely malnourished.	
	No. 30	653	
	(4.4 %)	(95.6 %)	

The prevalence of GAM rate by MUAC was 7.2 % (5.0 – 10.1, 95% C.I.) and SAM rate was 1.5% (0.8 – 2.8, 95% C.I.). both SAM rate and MAM rate by MUAC were most prevalent among younger children of 6-17 months. However, it is worth noting that MUAC measurement has been shown to be biased towards detecting malnutrition in younger children.

Table 14: Prevalence of acute malnutrition based on MUAC cut off's (and/or oedema) and by sex

	All	Boys	Girls
	n = 683	n = 334	n = 349
Prevalence of global	(49) 7.2 %	(24) 7.2 %	(25) 7.2 %
malnutrition	(5.0 - 10.1	(4.9 - 10.3	(4.6 - 11.1
(< 125 mm and/or oedema)	95% C.I.)	95% C.I.)	95% C.I.)
Prevalence of moderate	(39) 5.7 %	(22) 6.6 %	(17) 4.9 %
malnutrition	(3.8 - 8.6	(4.3 - 9.9	(2.7 - 8.5
(< 125 mm and >= 115 mm, no	95% C.I.)	95% C.I.)	95% C.I.)
oedema)			
Prevalence of severe	(10) 1.5 %	(2) 0.6 %	(8) 2.3 %
malnutrition	(0.8 - 2.8	(0.1 - 2.4	(1.1 - 4.9
(< 115 mm and/or oedema)	95% C.I.)	95% C.I.)	95% C.I.)

		Severe ( (< 11	wasting 5 mm)	Mod was (>= 1' and < 1	erate ting 15 mm 25 mm)	Nor (> = 12	mal 5 mm )	Oed	ema
Age (mo)	Total no.	No.	%	No.	%	No.	%	No.	%
6-17	140	8	5.7	14	10.0	118	84.3	0	0.0
18-29	129	1	0.8	7	5.4	121	93.8	0	0.0
30-41	184	1	0.5	9	4.9	174	94.6	0	0.0
42-53	173	0	0.0	6	3.5	167	96.5	0	0.0
54-59	57	0	0.0	3	5.3	54	94.7	0	0.0
Total	683	10	1.5	39	5.7	634	92.8	0	0.0

Table 15: Prevalence of acute malnutrition by age, based on MUAC cut off's and/or oedema

Tables 14 and 15 above clearly show that more children with acute malnutrition (wasting) were being detected with weight for height measurements (WHZ) rather than with MUAC measurements. Rates of malnutrition found through MUAC were overall less than those obtained with weight for height measurements. As a matter of fact, and as it can be seen in table 17 below, only 31% (33) of the cases of acute malnutrition were detected by both methods, and results show that WHZ measurement was more effective, as it captured more acute malnutrition cases (58 cases), than MUAC measurement (16 cases).

Table 16: Prevalence of combined GAM and SAM based on WHZ and MUAC cut off's (and/or oedema) and by sex\*

	All	Boys	Girls
	n = 683	n = 334	n = 349
Prevalence of combined GAM	(107) 15.7 %	(61) 18.3 %	(46) 13.2 %
(WHZ <-2 and/or MUAC < 125	(12.4 - 19.6	(14.6 - 22.6	(9.4 - 18.1
mm and/or oedema)	95% C.I.)	95% C.I.)	95% C.I.)
Prevalence of combined SAM	(25) 3.7 %	(12) 3.6 %	(13) 3.7 %
(WHZ < -3 and/or MUAC < 115	(2.4 - 5.5	(2.0 - 6.4	(2.0 - 6.9
mm and/or oedema	95% C.I.)	95% C.I.)	95% C.I.)

\*With SMART or WHO flags a missing MUAC/WHZ or not plausible WHZ value is considered as normal when the other value is available

	GAM		SAM	
	no.	%	no.	%
MUAC	16	2.3	4	0.6
WHZ	58	8.5	15	2.2
Both	33	4.8	6	0.9
Oedema	0	0.0	0	0.0
Total	107	15.7	25	3.7

\*Total Population: 683

#### GAM by WAZ

Underweight is a nutritional index that measures the weight of a child in comparison to age. According to the WHO 2006 growth standards on which our analysis was based on, weight for age Z-score of < -2 SD and > -3 SD is considered as moderately underweight and z- score of < - 3 SD is considered as severely underweight. We found the overall prevalence of underweight to be 21.2% (17.1 - 25.9, 95% C.I.), the age and sex breakdown of the data is described in the tables 18 and 19 below respectively. The overall prevalence of underweight was greater among boys than girls with results showing a statistically significant difference (p-value= 0.004).

Figure 4: Gaussian curve for Weight-for-Age z-scores



	All	Boys	Girls
	n = 666	n = 324	n = 342
Prevalence of underweight	(141) 21.2 %	(74) 22.8 %	(67) 19.6 %
(<-2 z-score)	(17.1 - 25.9 95% C.I.)	(18.1 - 28.5 95% C.I.)	(14.4 - 26.0 95% C.I.)
Prevalence of moderate	(104) 15.6 %	(53) 16.4 %	(51) 14.9 %
underweight	(12.6 - 19.2	(12.5 - 21.1	(10.7 - 20.4
(<-2 z-score and >=-3 z-score)	95% C.I.)	95% C.I.)	95% C.I.)
Prevalence of severe	(37) 5.6 %	(21) 6.5 %	(16) 4.7 %
underweight	(3.6 - 8.5	(4.0 - 10.4	(2.6 - 8.2
(<-3 z-score)	95% C.I.)	95% C.I.)	95% C.I.)

Table 18: Prevalence of underweight based on weight-for-age z-scores by sex

Table 19: Prevalence of underweight by age, based on weight-for-age z-scores

		Severe underweight (<-3 z-score)		Moderate underweight (>= -3 and <-2 z-score)		Nor (> = -2	mal z score)	Oed	ema
Age (mo)	Total no.	No.	%	No.	%	No.	%	No.	%
6-17	134	5	3.7	28	20.9	101	75.4	0	0.0
18-29	126	10	7.9	15	11.9	101	80.2	0	0.0
30-41	180	11	6.1	32	17.8	137	76.1	0	0.0
42-53	170	6	3.5	20	11.8	144	84.7	0	0.0
54-59	56	5	8.9	9	16.1	42	75.0	0	0.0
Total	666	37	5.6	104	15.6	525	78.8	0	0.0

The results for underweight also show that its prevalence is more severe on younger children (6-29 months) as they constitute almost half (44.5%) of the cases compared to their older (30-59 months) counterparts.



Figure 5: Gaussian curve for height-for-age z-scores

Stunting is the situation in which children's growth and development have been impaired and it is directly related to chronic or recurrent malnutrition. When a child experiences stunting, his or her height-for-age is more than two standard deviations below the WHO child growth standards median. It usually reflects the persistent, cumulative effects of poor nutrition and other problems that are often intergenerational, which is caused by failure to receive adequate nutrition over a long period of time and is also affected by recurrent and chronic illness. It can also infer the overall socio-economic stand of a community beyond nutritional factors.

The overall prevalence for stunting was found to be 24.6% (20.4 - 29.2, 95% C.I.). Stunting is higher among boys, and most prevalent in the age group of 30-41 months. The distribution curve of height-for-age Z-scores (figure 5 above) of the sampled children is shifted to the left of that of the reference population, with a mean of -0.90 (±1.40 standard deviation) and relatively shorter curve. This indicates that the surveyed population is more stunted compared to the reference population.

	All	Boys	Girls
	n = 619	n = 300	n = 319
Prevalence of stunting	(152) 24.6 %	(82) 27.3 %	(70) 21.9 %
(<-2 z-score)	(20.4 - 29.2	(21.7 - 33.7	(17.4 - 27.3
	95% C.I.)	95% C.I.)	95% C.I.)

Table 20: Prevalence of stunting based on height-for-age z-scores and by sex

Prevalence of moderate stunting	(100) 16.2 %	(57) 19.0 %	(43) 13.5 %	
(<-2 z-score and >=-3 z-score)	(13.3 - 19.5	(14.7 - 24.2	(10.5 - 17.2	
	95% C.I.)	95% C.I.)	95% C.I.)	
Prevalence of severe stunting	(52) 8.4 %	(25) 8.3 %	(27) 8.5 %	
(<-3 z-score)	(6.2 - 11.3	(5.7 - 12.0	(5.8 - 12.2	
	95% C.I.)	95% C.I.)	95% C.I.)	

Table 21: Prevalence of stunting by age based on height-for-age z-scores

		Severe stunting (<-3 z-score)		Moderate stunting (>= -3 and <-2 z-score)		(>	Normal = -2 z score)
Age (mo)	Total no.	No.	%	No.	%	No.	%
6-17	127	4	3.1	13	10.2	110	86.6
18-29	113	12	10.6	24	21.2	77	68.1
30-41	166	19	11.4	36	21.7	111	66.9
42-53	159	12	7.5	21	13.2	126	79.2
54-59	54	5	9.3	6	11.1	43	79.6
Total	619	52	8.4	100	16.2	467	75.4

Table 22 below shows the summary of mean Z-score with their standard deviation, design effect and the number of children with flag signs that were excluded in the analysis.

Table 22: Mean z-scores, design Effects and excluded subjects

Indicator	n	Mean z- scores ± SD	Design Effect (z-score < - 2)	z-scores not available*	z-scores out of range
Weight-for- Height	667	-0.81±1.10	1.33	0	16
Weight-for-Age	666	-1.05±1.15	1.88	0	17
Height-for-Age	619	-0.90±1.40	1.59	0	64

\* contains for WHZ and WAZ the children with Oedema.

## **Mortality results**

The survey, which included a total of 3,542 individuals across all surveyed households, specifically gathered information related to mortality. To probe respondents on this topic, a recall period of 94 days (4<sup>th</sup> September 2023 until the mid-time of the data collection period) was used. With this parameter set, participants were asked to retrospectively re-call any deaths that had occurred within their household during the established recall period.

Table 23: Mortality rates

CMR (total deaths/10,000 people / day): 0.45 (0.27-0.75, 95% CI)
U5MR (deaths in children under five/10,000 children under five / day): 0.80
(0.36-1.79, 95% CI)

The total number of deaths reported by participants during the recall period established was of 15 (6 of them of were under-5 children and 9 of them of adults). These numbers resulted in a CDR of 0.45 (0.27 - 0.75, 95% CI) and U5DR of 0.80 (0.36 - 1.79, 95% C.I.). When comparing with the official emergency thresholds of 1.14 for total population and 2.3 for children under five, (1.14/10,000 deaths per day for total population and 2.3/10,000 deaths per day for children under five), the results are way below these thresholds, which potentially indicates that the overall health status of the population in Tonj North county can be deemed of steady.

Table 24: General demographic information on mortality sample

Average Household Size	7.2
Mid-Interval Population	3542
% of children Under-5 years	23.3
Birth Rate	1.23
In-Migration Rate (Joined)	0.93
Out-Migration Rate (Left)	1.89
Design Effect for CDR	1

Table 25: Broad Causes of Death

	%
Illness	46.7
Trauma/Injury	13.3
Other	40

Table 26: Location of death

	%
Place of Current Residence	66.7
During Migration	6.7
Place of Last Residence	26.7
Other	0

About 66.7% of deaths occurred in the current location of residence of the respondent, and close to half (47%) of the causes of death reported were associated with illness followed by unknown death (40%) and trauma/injury (13%).

### **Child Morbidity and Access to Health Care**

In order to assess the prevalence of common diseases (as pre-identified through secondary information sources) in children 6-59 months, retrospective morbidity data was collected for those children considering a two-week recall period. Accordingly, the survey results showed that a quarter of children, 21.6% (15.9 – 28.4, 95% C.I.) had suffered at least one episode of illness in the 2 weeks prior to data collection. Fever and cough were the most reported illnesses, accounting for 78.4% and 31.8% of cases among the children (6-59 months) who were reported to have had some illnesses in the two week prior to data collection. The most common disease children were facing in the area, according to the respondents, was malaria, which could potentially be associated with the existence of favourable conditions for mosquito breeding in the area and the low use of treated mosquito nets as could be identified through observation by the assessment officers.

Table 27: Prevalence of reported illness in children in the two weeks prior to interview (n=176)

	6-59 months
Prevalence of reported illness	21.6 % (15.9 – 28.4, 95% C.I.)

Table 28: Symptom breakdown among children who reported illness in the two weeks prior to interview (n=176)

	6-59 months
Diarrhoea	11.9 % (7.4 – 17.0, 95% C.I.)
Cough	31.8 % (25.6 – 38.6, 95% C.I.)
Fever	78.4 % (71.6 – 84.1, 95% C.I.)
Measles	0 %
Other	25.6 % (19.3 – 32.4, 95% C.I.)

Table 29: Health care seeking behavior reported by caretakers of sick children 6-59 months of age (n=193)

	6-59 months
No treatment sought	19.3 % (14.2 – 25.6, 95% C.I.)
Primary Health Care Centre	68.8 % (61.9 – 75.6, 95% C.l.)
Hospital	0 % (0.0 – 0.0, 95% C.l.)
Other	11.9 % (7.4 – 16.5, 95% C.I.)

Children 6-59 months who had been sick in the two weeks prior to data collection were more likely to be malnourished than their counterparts who had not been ill. Generally, ill children were more at risk of malnutrition than healthy children<sup>17</sup>.

More than three quarters (80.7%, n=142) of the children (6-59 months) who had reportedly been ill in the 2 weeks prior to data collection had reportedly been brought by their caretakers to a health facility for treatment, with the reported types of facilities differing depending on the distance and accessibility. In case of illness, the most common reported behavior was to go to a primary health center (68.8%). Amongst the children who had reportedly been ill, the remaining 19.3% were not brought to health facilities by caretakers for treatment.

## Nutrition and Health Program Coverage

Table 30: Measles vaccination coverage for children 9-59 months

	Measles (with card)= 3.5%	Measles (with card or confirmation from mother)= 53.6%
YES	(No. 24) 3.5 % (2.2 – 4.9, 95% C.I.)	(No. 368) 53.6 % (49.5 – 57.4, 95% C.I.)

Table 31: Vitamin A (6-59 months) and deworming treatment (12-59 months) coverage

	Vitamin A Supplementation last 6	Deworming Treatment last 6 months				
	months n= 66.0 %	n= 68.6 %				
YES	(No. 466) 66.0 %	(No. 431) 68.6 %				
	(62.5 – 69.4, 95% C.I.)	(64.8 – 72.3, 95% C.I.)				

<sup>&</sup>lt;sup>17</sup> National Library of Medicine

In order to gather information, the survey team asked caregivers if their children had received vitamin A capsules or deworming tablets in the six months previous to the assessment. As table 31 above illustrates, 66% of children aged 6-59 months (n=466, 62.5 – 69.4, 95% C.I.) had reportedly received vitamin A supplementation. Moreover, approximately 68.6% of children aged 12-59 months (n=431, 64.8 – 72.3, 95% C.I.) had received deworming capsules in the six months preceding data collection.

## Infant and Young Child Feeding Practice (IYCF)

Proper feeding of infants and young children can increase their chances of survival and also promote optimal growth and development, especially in the critical window from birth to 2 years of age<sup>18</sup>.

Information regarding child feeding practices was collected for all children aged 0-23 months and analyzed as described below. The sample sizes obtained in this type of survey for IYCF practices were small and the results should therefore only be interpreted as an indication; but they should not be taken as representative of the population's knowledge and practices.

In this survey, mother/caretakers of 140 children aged 0-23 months were interviewed. The mothers/caretakers were interviewed about the IYCF practices of their children between the ages of 0-23 months in line with the revised indicators for assessing IYCF practices by WHO & UNICEF (2021).<sup>19</sup> The findings of the survey are presented in the following tables, graphs, and discussions.

#### Ever Breastfed

When mothers were asked whether their children were ever breastfed, 83.6% (n=117, 77.1 – 89.3, 95% CI) reported that they had, at some point in their lifetime, breast fed their children 0-23 months. Out of those ever-breastfed children, 80% (n=112, 73.6 – 86.4, 95% CI) had reportedly been initiated to breastfeeding immediately within one hour of birth, as per WHO recommendation.

IYCF (Ever Breastfed & early Initiation)									
Indicator Name	Age group	n	%	95% CI					
Child ever breastfed	0-23 months	117	83.6	77.1 – 89.3					
Breastfeeding initiation	0-23 months	112	80.0	73.6 – 86.4					

 Table 32: IYCF child ever breastfed and early initiation of breastfeeding

<sup>&</sup>lt;sup>18</sup> <u>Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect</u>. Victora, Cesar G et al. The Lancet , Volume 387 , Issue 10017 , 475 – 490.

<sup>&</sup>lt;sup>19</sup> Indicators for assessing infant and young child feeding practices (WHO 2021)

#### Exclusive breastfeeding (EBF)

The WHO Global Strategy for IYCF recommends that infants be exclusively breastfed until they turn six months of age. Exclusive breastfeeding is the safest and healthiest option for children everywhere, guaranteeing infants a food source that is uniquely adapted to their needs while also being safe, clean, healthy, and accessible. Evidence suggests that infants in low and middle-income countries who received mixed feeding (foods and liquids in addition to breast milk) before six months were nearly three times more likely to die than those who were exclusively breastfeed.<sup>20</sup> Exclusive breastfeeding protects against diarrhea, lower respiratory infections, acute otitis media and childhood overweight and obesity.<sup>21</sup> In Tonj North, 45% (n=63, 37.1 – 52.9, 95% Cl) of children 0-5 months had reportedly been exclusively breasted. This value was below the minimum UNHCR's standards<sup>22</sup>, according to which the proportion of exclusively breastfed infants (0-5 months) in emergency context should be at least seventy percent.

#### Continued breastfeeding

Children should continue breastfeeding for two years or beyond as per the global WHO IYCF recommendations.<sup>23</sup> Children who are still breastfed after one year of age can meet a substantial portion of their energy needs with breast milk in their diet. Continued breastfeeding is also vital during illness: while sick children often have little appetite for solid food, continued breastfeeding can help prevent dehydration while also providing the nutrients required for recovery<sup>24</sup>.

Accordingly, children aged 12-23 months were assessed based on the recall period of the previous 24 hours and results showed that 73.9% of children had received continued breastfeeding as illustrated in table 33 below.

Continued breastfeeding practice (12-23 months)								
Indicator Name	Age group	n	%	95% CI				
Continued breastfeeding	12-23 months	88	73.9	65.6 – 81.5				

Table 33: Continued breastfeeding of children 12-23 months

#### Minimum Dietary Diversity

WHO guiding principles recommend that children aged 6-23 months be fed a variety of foods to ensure that nutrient needs are met.<sup>25</sup> Food group diversity is associated with improved linear

 <sup>&</sup>lt;sup>20</sup>Guidelines on optimal feeding of low birth-weight infants in low- and middle-income countries (who.int)
 <sup>21</sup> ibid.

<sup>&</sup>lt;sup>22</sup> Infant and young child feeding threshold - UNHCR Emergency Handbook

<sup>23</sup>WHO & UNICEF (2003). Global Strategy for Infant and Young Child Feeding

<sup>24</sup> ibid

<sup>&</sup>lt;sup>25</sup> WHO (2005): Guiding principles for feeding non-breastfed children 6-24 months of age

growth in young children. A diet lacking in diversity can increase the risk of micronutrient deficiencies, which may have a damaging effect on children's physical and cognitive development.

On this regard, the survey findings showed that about half of the children (49.6 %)received food from at least 5 of 8 food groups (including breast milk) during the indicated recall period of 24 hours as per IYCF guideline recommendation. These findings suggest that meals were likely not adequately diverse for most of the children aged 6-23 months, indicating a limited diversity in terms of nutrients received.

#### Minimum Acceptable Diet

Among both breastfed and non-breastfed children, "meat, poultry, fish, or eggs should be eaten daily, or as often as possible" as per WHO guiding principles.<sup>26</sup> There is evidence that children who consume eggs and flesh foods have higher intakes of various nutrients important for optimal linear growth. Consuming eggs is associated with increased intakes of energy, protein, essential fatty acids, vitamin B<sub>12</sub>, vitamin D, phosphorus, and selenium, and with higher recumbent length. Introduction of meat as an early complementary food for breastfed infants is also associated with improved protein and zinc intake<sup>27</sup>.

As per the survey result in Tonj North, only 17.5% (n=24, 11.7 – 24.1, 95% CI) of surveyed children aged 6-23 months had received a minimum acceptable diet in the in the 24 hours prior to data collection.

### Women's Nutritional Status by MUAC

A total of 166 pregnant and lactating women (PLW) were measured using MUAC to identify PLW nutritional status. PLW's nutritional status is important, because malnourished PLW cannot provide the required nutritional intake for infants, especially for those under 6 months. From the total PLW, about 53% were lactating and the remaining 47 % were pregnant women. As it can be seen in table 34 below, 37 women (22.3%) showed a proxy GAM below the 230 mm MUAC measurement threshold, indicating their nutritional status was critical, while the remaining 77,7% PLW showed a normal nutritional status.

	MUAC for PLWs	N (sample size)	Proportion (%)
Severe Acute Malnutrition	<21.0cm	0	0 %
Moderate Acute Malnutrition	<23.0cm	37	22.3 %
Normal	>23.0cm	129	77.7 %

Table 34: MUAC status among PLWs

<sup>&</sup>lt;sup>26</sup>WHO & UNICEF (2021). Indicators for assessing infant and young child feeding practices: definitions and measurement methods

<sup>&</sup>lt;sup>27</sup> Guiding principles for feeding non-breastfed children 6-24 months of age.pdf

## **Contributing Factors**

### Water, Sanitation, and Hygiene (WASH)

#### Source of Drinking Water

Consumption and use of unsafe water can cause diarrhea, which can prevent children from getting the nutrients they need to survive, ultimately leading to malnutrition. Malnourished children are also more vulnerable to waterborne diseases like Cholera. Inadequate access to minimum water, hygiene, and sanitation is estimated to account for around 50 per cent of global malnutrition.<sup>28</sup> During the assessment, a set of systematically grouped close ended questions were asked to respondents, which were then automatically coded as an improved or unimproved source of water in the database. About a quarter of survey respondents 27.2 % (n=134, 23.3 – 31.0, 95% CI) reported fetching their water from unimproved water sources.

#### Time to collect water

Another important indicator assessed in relation to the source of drinking water is the time it takes for households to collect water, keeping in mind queuing time and variation between villages with respect to distance are not included or taken into consideration during the analysis. Just about half of respondents (50.1%) could reportedly access their main household water source within 30 minutes to 1 hour, followed by 33.3% of households reporting being able to access the source of water between in less than 30 minutes, and 15% of households reporting traveling more than an hour to half day to fetch water from their main source.

#### Water treatment used

Unsafe water is among the main sources of life-threatening, waterborne diseases. This indicator therefore assesses the prevalence of households using effective methods for treating drinking water, which is particularly relevant as one of the main child morbidity issues in the assessed area was incidence of diarrheal disease, amongst other factors. The prevalence of diarrhea can be minimized by improving access to safe water, promotion of water treatment, improving sanitation and hygiene promotion as well as focusing on the home management of childhood illness.

Close to the entirety of interviewed households 94.9 % (n=407, 92.9 - 96.8, 95% Cl) reported doing nothing to the water collected prior to consumption, either from improved or unimproved sources, at household level. Very few respondents (4.9%) used filtering with clothes while other mechanisms are insignificant (less than 1%).

#### Hygiene and sanitation

This combined indicator measures the affected population's access to a sufficient number of safely located latrines with functioning handwashing facilities, which is a crucial precondition for ensuring a sanitary environment and preventing diseases. Lack of access to safe latrines in the household is key contributing factor which can lead to elevated malnutrition and mortality rates.

<sup>&</sup>lt;sup>28</sup> <u>4 things you need to know about water and famine (UNICEF 2022)</u>

When the households were asked if they have access to latrines in their households, almost all of them (96.8%) (n=477, 94.9 – 98.2, 95% CI) responded not having access to such sanitation facilities and using open defecation instead. Very few (1.8%) (n=9, 0.8 – 3.0, 95% CI) households reported having access to shared latrines

A complementary indicator for the above is access to soap for handwashing, as this can break the vicious cycle of diarrhea and undernutrition<sup>29</sup>. Children are especially susceptible to infection by bacteria and viruses, found in fecal matter, that cause diarrhea. When children get diarrhea, they often eat less food, and have a reduced ability to absorb and benefit from nutrients in the food they do eat. The indicator therefore assesses the proportion of households having soap available for their use. Only 5.7 % (n=28, 3.7 - 7.9, 95% Cl) of households reported having access to soap (confirmed by enumerators) and 1.6% (n=8, 0.6 - 2.8, 95% Cl) reported having access to soap (however not confirmed by enumerators), while a significant number households (92.7%) (n=457, 90.1 - 94.9, 95% Cl) reported not having access to soap.



Figure 6: Percentage of households per type of latrine they reported having access to

<sup>&</sup>lt;sup>29</sup> Why Handwashing. Global Handwashing Partnership

## Food Security and Livelihoods (FSL)

#### Food Consumption Score

The FCS is considered as a proxy indicator of current food security status. It's a composite score based on the types of food eaten, its frequency and relative nutrition importance of different food groups. The indictor is calculated based on the amount of food groups that a household has consumed for a recall period of the past 7 days, and classified into three categories: poor consumption (FCS= 0 to 21); borderline (FCS = 21.5 to 35); and acceptable consumption (FCS=>35.0).

According to the survey results, more than half of the respondents (60 %, n=296) had an acceptable food consumption score, followed by 28.4 % (n=140) with a borderline food consumption score and 11.6 % (n=57) with a poor food consumption score.





#### Household Hunger Scale (HHS)

HHS is a proxy indicator of household's food access that captures insufficient food quantity based on the hunger experienced in a household over the past 4 weeks/30 days prior to the survey date. It measures whether households fall into moderate or severe categories of hunger or whether they experienced little/no hunger. Using this composite indicator, a respondent can score between zero and six depending on their answers. Individuals scoring from zero to one experience the least hunger and respondents scoring six will experience the most hunger. Hence, the index was calculated and the scores are categorized as none or light hunger (HHS= 0-1), moderate hunger (HHS= 2-3) and sever hunger (HHS= 4-6). According to the findings, 65.1% (n=321) of households experienced moderate hunger, 7.3 % (n=36) experienced little hunger, and 27.2% (n=134) did not experience any hunger in the 30 days recall period. There is little information about the households experiencing severe and extremely severe hunger, as only one household (0.2%) was found to be suffering from these difficulties.



Figure 8: Percentage of households per HHS category

#### Household Income Source

The main activities that households reported having engaged in the last 3 months to earn income were overwhelmingly related to the selling of agricultural products, accounting for 87% (n=429) of the responses, and followed by the selling of animal products with 3.9% (n=19) of responses, and engaging in daily labour with 3.2% (n=16) of responses.

78.9% of the sampled households reported their household was affected by some type of shock in the last 6 months prior to the survey. Among these, the vast majortiy (35.3 %, n=174) identified insecurity as the main shock, followed by flooding (13.8 %, n= 68), drought 11.6% (n=57) and high food prices with 10.8 %, (n=53).

## Discussion

## **Nutritional status**

During the data collection period 493 households from 44 clusters were visited to gather mortality, child and maternal nutrition, and other contextual factors information (FSL and WASH). A total of 683 children of 6-59 months were assessed with anthropometric survey from the planned 506 children. However, only the information of 667 of the 683 children was analyzed for weight for height, with 16 being excluded from the analysis due to the presence of SMART flags that identify them as out of range values.

The prevalence of GAM among the sampled children was estimated at 13.6% (10.8 – 17.0, 95% C.I.) and SAM prevalence was 3.1% (2.0 - 5.0, 95% C.I.) based on Weight-for-Height and the presence of bilateral oedema. During the survey, no children were identified with nutritional bilateral oedema. The current nutrition status of the county is classified as "Serious" based on IPC AMN technical guideline classification thresholds. The prevalence is higher both on MAM and SAM cases among boys when compared to girls, , considering that there was no representation bias (P=0.566)

The current malnutrition status of the county, when compared to the results of the previous most recent survey conducted in April 2021, shows that there has been some improvement. However, there is statistically significant difference observed (P-value=0.0296) and therefore it is not possible to conclude that this change actually represents an improvement. Moreover, the timing of these two surveys was different as the former was conducted when households were running out of food stock going into the lean season, while the current was conducted during the main harvest season.

## Mortality

The total number of deaths reported during the recall period were 15 (6 under 5 children and 9 adults), giving as result a CMR of 0.45 (0.27 - 0.75, 95% CI) and U5MR of 0.80 (0.36 - 1.79, 95% C.I.)both below the emergency threshold for both under five children as well as crude mortality rate for the whole population.

## **Causes of malnutrition**

Malnutrition is generally a greater danger for sick children than for healthy children. In light of this, almost a quarter (24.6%) of children aged 6-59 months had been sick during the two-week recall period, with the incidence of diarrhea episodes in children aged six to fifty-nine months being around 11.9%, with fever (78.4%) and cough (31.8%) being the most common symptoms for them. Given that the dry season will persist from January through April, the situation will probably substantially worsen. Additionally, cattle will be moving to the Toch area during this dry season in search of pasture and water, which will increase population density and perhaps

contaminate the water supply, which could result in diarrhea. Furthermore, through observational procedures, assessment officers noticed a decrease in mosquito net availability in the payams assessed.

In terms of program coverage, only over half (53.6%) of the children aged 9 to 59 months had received measles vaccination, whereas 68% had received a vitamin A vaccination. Lack of vitamin A, which is critical for immunity and measles infection, increases the risk of malnutrition in children under five and makes it more difficult for them to recover from should it occur.

When it comes to IYCF practices, results showed that child feeding practice is low, as only 49.6% of children 6-23 months of age had received the minimum dietary diversity requirement, and as little as 17.5% of these children had received the minimum acceptable diet which comprises both dietary diversity and meal frequency. Children who are unable to get the minimum nutrition requirements are highly at risk of malnutrition. In addition to 95% of households not treating their water before use, over a quarter (27.2%) of households got their domestic water from unimproved sources. This could put the community at large at risk for water-borne illnesses like diarrhea, particularly for children under five and pregnant and nursing mothers, which would increase the prevalence of malnutrition.

## Conclusions

The survey result shows that the GAM rate is 13.6 % (10.8 - 17.0, 95% C.I.), this value lies in the "serious" category according to IPC-AMN guideline. The SAM rate is 3.1 % (2.0 - 5.0, 95% C.I.) based on weight for height/WHZ.

According to the Integrated Food Security Phase Classification (IPC), the current nutritional status of Tonj North county is classified as Phase 3 "Serious", as it falls within the thresholds of 10-14.9% established by the IPC and WHO. This results is in line with the recent South Sudan IPC analysis projection for the same period (Oct 2023 – Mar 2024), in which Tonj North County was classified as Emergency (IPC Phase 3 level). In addition, based on the IPC AMN reports, when comparting the phase classification that was attributed to Tonj North county during the 2022 IPC for the same projected period, it was also Phase 3 "Serious", similarly to what was assigned during the 2023 IPC<sup>30</sup>. Nevertheless, the 2023 IPC projected that the situation might deteriorate in the upcoming months, as households have started to deplete their food stocks and might face food insecurity which can also affect their food utilization abilities, ultimately affecting their nutrition status as these are all immediately related causal factors as per the IPC conceptual framework.

The high GAM rate could be mainly associated with the current food insecurity situation in the area, as well as with the low vaccination coverage, poor access and utilization of water, and poor feeding practices of infants and young children. Given the existence of aggravating factors, which

<sup>&</sup>lt;sup>30</sup> South Sudan: Acute Malnutrition Situation July - October 2022 and Projections for November 2022 - February 2023 and March - June 2023

include low food production, macroeconomic shocks like rising food prices, high levels of food insecurity (caused by a variety of factors, including insecurity and flooding among others), there is a possibility that the situation could worsen in the coming months and, therefore, close monitoring of risk factors is recommended.

## **Recommendations and priorities**

### Nutrition

The GAM rate was 13.6% which indicates the current nutritional status of Tonj North county was classified as "Serious" according to IPC classification. Moreover, indications that the situation could progressively deteriorate, which could lead to increasing levels of acute malnutrition that would require a scale up of treatment and prevention programs targeting the affected population. Accordingly, the following recommendations are drawn:

- ⇒ Continue, and potentially scale up, the implementation of the ongoing CMAM program, trying to better integrate primary health care services and community mobilization programs run by the existing humanitarian actor, WVI, in order to treat and prevent acute malnutrition among vulnerable community, more specifically under five children.
- ⇒ Strengthen the community outreach efforts of early detection of cases, referral and treatment through community based screening as well active case finding of defaulters, especially in those areas where insecurity usually occur.
- ⇒ Raising community knowledge about the importance of diversified diets to enhance the nutritional status of the population in the county, and prevent it from deteriorating to crisis level.
- ⇒ Nutrition partners that are actively involved in the county, like WVI, ought to strengthen the current CMAM program and expand its reach into areas that are still underserved, despite WVI's great efforts.

Most IYCF indicators showed poor child feeding practice (EIBF= 80.0%, ExBF=45%, CBF=73.9%, MDD=49.6%, MAD=17.5%), however, most of them were way below the emergency thresholds. Consequently, the recommendations that follow are made:

- ⇒ Raise community awareness about the importance of eating a balanced diet, specifically to vulnerable groups such as under five children and PLWs.
- ⇒ Encourage optimal IYCF behaviors, emphasizing a balanced diet, efficient food use, and adequate consumption of often-ignored food groups including fruits and vegetable.
- ⇒ Provide awareness sessions to the community on importance of breastfeeding practices such as ExBF and CBF.

#### Health programme coverage

All vaccination coverages (Vit A = 66.0%, Measles = 53.6% and Deworming = 68.6%) are far below the sphere standards of >95%. This might require to strengthen routine VIT A and deworming campaigns across the county, in order to reach remote areas. Tonj North CHD in collaboration

with UNICEF/WHO and other humanitarian actors like WVI, should look into the possibilities of strengthening these activities.

Almost a quarter of the children (24.6%) reported some illness during the recall period of two weeks, and the majority of them (80.7%) had caretakers seeking treatment for them. Despite the proportion of children whose caretakers sought treatment is high, there are still some households in which this behavior was not seen.. Hence, health promotion programs should be strengthened so that children are brought to health care services and get treatment on time.

## **Contributing Factors**

#### WASH:

Findings show that about a quarter of households (27.2%) were using water from non-improved sources, and close to the entirety of household (95%) were not using water treatment. Similarly, almost the entirety of households (96.8%) resorted to open defecation, and an overwhelming majority of households (92.7%) did not have access to soap. Accordingly, the following recommendations are drawn

- ⇒ Strengthen awareness raising to the community on the potential problems associated with use of open defecation, as almost the entire community was resorting to open defecation, and encourage the community members to dig pit latrines at household level to solve this problem.
- ⇒ Plan and execute community latrines by health and nutrition actors like WVI with the support of the county health department and with significant involvement of the community, in order to enhance ownership and ensure sustainability.
- ⇒ Educate the community on the importance of using water treatment techniques and ensure provision of water treatment chemicals.
- ➡ To improve use of water from improved sources, it requires to improve coverage of improved water sources and increase utilization. For this, partners and local government should give due attention for this activity.

#### **FSL**:

All food security indicators show there is a deterioration of the food security situation in Tonj North county. The food consumption score indicator shows 11.6% of households had poor food consumption and 28.4% of households were on borderline. On the other hand, about two thirds of households (65%) had experienced either little, moderate, severe or very severe hunger in their household and, given the fact that about 80% of households had experienced different shocks, the following actions are proposed:

- ⇒ Up until August 2023, WVI conducted General Food Distribution (GFD) throughout the county in all payams. Restarting this initiative with local state actors working with actors like WVI operating in the area is crucial.
- ⇒ WVI was carrying out a livelihood-related program known as "food for action" (FFA) and later renamed "asset creation livelihood" (ACL), which distributed food in exchange for labour contributions to the construction of feeder roads, dykes, and shallow wells as well

as the beginning of some fruits, vegetables, and casava gardening in backyards. However, this has also currently stopped, and the continuations of these type of activities should be encouraged, as it contributes for community food security, livelihood options and also encourage dietary diversity by WVI or similar actors operating the county.

⇒ Consider distribution of seeds for planting to the community, together with the implementation of awareness raising sessions and capacity building when/if needed to ensure that planting is as successful as possible.

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## **Appendices**

## Appendix 1 - Plausibility Report Plausibility check for: SSD2308\_REACH\_SSD\_TONJ\_NORTH\_SMART\_SURVEY\_ENA\_FIL E.as

#### Standard/Reference used for z-score calculation: WHO standards 2006

(If it is not mentioned, flagged data is included in the evaluation. Some parts of this plausibility report are more for advanced users and can be skipped for a standard evaluation)

#### **Overall data quality**

Criteria	Flags*	Unit	Excel	. Good	Accept	Problematic	Score
Flagged data	Incl	010	0-2.5	>2.5-5.0	>5.0-7.5	>7.5	
(% of out of range subject	cts)		0	5	10	20	0 (2.3 %)
Overall Sex ratio	Incl	р	>0.1	>0.05	>0.001	<=0.001	
(Significant chi square)			0	2	4	10	<b>0</b> (p=0.566)
Age ratio(6-29 vs 30-59)	Incl	р	>0.1	>0.05	>0.001	<=0.001	
(Significant chi square)			0	2	4	10	<b>4</b> (p=0.001)
Dig pref score - weight	Incl	#	0-7	8-12	13-20	> 20	
			0	2	4	10	<b>0</b> (2)
Dig pref score - height	Incl	#	0-7	8-12	13-20	> 20	
			0	2	4	10	2 (8)
Dig pref score - MUAC	Incl	#	0-7	8-12	13-20	> 20	
			0	2	4	10	<b>0</b> (6)
Standard Dev WHZ	Excl	SD	<1.1	<1.15	<1.20	>=1.20	
			and	and	and	or	
	Excl	SD	>0.9	>0.85	>0.80	<=0.80	
			0	5	10	20	5 (1.10)
Skewness WHZ	Excl	#	<±0.2	<±0.4	<±0.6	>=±0.6	
			0	1	3	5	<b>0</b> (-0.15)
Kurtosis WHZ	Excl	#	<±0.2	<±0.4	<±0.6	>=±0.6	
			0	1	3	5	0 (-0.10)
Poisson dist WHZ-2	Excl	р	>0.05	>0.01	>0.001	<=0.001	
			0	1	3	5	<b>0</b> (p=0.069)
OVERALL SCORE WHZ =			0-9	10-14	15-24	>25	<b>11</b> %

The overall score of this survey is 11 %, this is good.

Payam	Village	Рор	Clusters Assigned	Payam	Village	Рор	Clusters Assigned
Awul	MAKOI	228	1	Kirik	Panapuoth	168	23
Awul	KUEL-AKUAK	4200	2	Rualbet	Rualbet	3072	RC
Awul	ISLAMIC	1200	3	Rualbet	Rumkuac	3024	24
Awul	PANDA- ODHIE	3000	4	Rualbet	Koinhom	3102	25
Awul	PAN-THIOK	1800	5	Rualbet	Pacokdieng	126	26
Awul	LOU-NOI	4800	6	Rualbet	Achuillokot	252	RC
Awul	Madong	1677	7	Rualbet	Alueldor	108	27
Awul	Awiyier	552	8	Alabek	Muoc center	7380	28
Awul	Awul center	2346	9	Alabek	Buol	480	29
Awul	Amoth	1542	10	Alabek	Malok Center	7800	30
Awul	Mathiang Adeny	354	11	Alabek	Langkap center	9600	31,RC
Awul	Adh-thii	24	RC	Alabek	Mading-Juer	4140	32
Awul	PANACIIR	360	12	Alabek	Mariik	366	33
Awul	JOK ANGAAN	444	13	Alabek	Atuur- JoorBek	900	34
Pagol	Maluil Tiit	670	14	Alabek	Keecdew	1320	35
Pagol	Rum Bol	354	15	Aliek	Abuok -Tuot	750	36
Pagol	Rum Liet	576	16	Aliek	Wun -Thiou	810	37
Pagol	Lurchuk PHCU	10320	17	Aliek	Paweny	120	38
Pagol	Wun-Luol	2130	18	Akop	Mabar	450	39
Pagol	Wun-but	2040	19	Akop	Akuac-Riang	324	40
Pagol	Aluel-abach	372	20	Akop	Chuet-Piny	60	41
Pagol	Majook Center	7200	RC	Marial- Lou	Acharom	260	42
Kirik	Ngerou	318	21	Manloor	Lueth Mawien	444	43
Kirik	Palawan	180	22	Manloor	Kueng	216	44

## Appendix 2 - Assignment of Clusters

## Appendix 3 – Standardization Test Results

Standardi	sation test	results			Precision				Accuracy		OUTCOME	F			
Weight	Sation test	cubieste		50	max	Technical	TEM/mon	Coof of ro	Rine from	Ring from	median		From	From	
weight		subjects	mean	50	max	Technical	TENVIMENT	COEFOFTE	Dias from	Dias from	meulan		From	From	
		#	kg	kg	kg	TEM (kg)	TEM (%)	R (%)	Bias (kg)	Bias (kg)			Superviso	Median	
	Superviso	10	11.3	2.9	0.5	0.17	1.5	99.6	0	0.04	TEM poor	R value go	Bias good	Bias good	ł
	Enumerato	10	11.3	2.9	0.5	0.16	1.4	99.7	0.07	0.06	TEM poor	R value go	Bias acce	Bias acce	ptable
	Enumerato	10	11.2	3	1.4	0.33	3	98.8	0.18	0.17	TEM rejec	R value a	Bias poor	Bias poor	r
	Enumerato	10	11.1	2.7	2.0	0.7	6.2	02.2	0.21	0.28	TEM rejec	P value p	Bins rejec	Bing rejer	-+
	Enumerate	10	11.1	2.7	2.5	0.0	0.0	00.0	0.01	0.20	TEMTOJee	Duelue e	Dias rejec	Dias rejec	
	Enumerato	10	11.5	2.9	0.2	0.09	0.8	99.9	0.09	0.07	TEIVI acce	R value go	Dias acce	Dias acce	ptable
	Enumerato	10	11.3	2.8	0.7	0.29	2.5	99	0.24	0.22	TEM rejec	1 R value a	Bias rejec	Bias rejec	:t
	Enumerato	10	11.3	2.9	0.7	0.19	1.7	99.6	0.11	0.11	TEM poor	R value go	Bias poor	Bias poor	t
	Enumerato	10	11.3	2.8	0.3	0.09	0.8	99.9	0.1	0.07	TEM acce	R value go	Bias acce	Bias acce	ptable
	Enumerato	10	11.3	2.8	0.2	0.07	0.6	99.9	0.07	0.04	TEM accer	R value go	Bias acce	Bias acce	ptable
	Enumerato	10	11.3	2.8	0.8	0.2	1.8	99.5	0.15	0.11	TEM noor	R value go	Bias noor	Bias poor	e l
	anum inte	0-10	11.2	2.0	0.0	0.20	2.5	0.0	0.25		TEM roles	Dualue a	sontable.	5.65 peer	
	enum inte	9,10	11.2	2.0	-	0.59	3.5	90	-	-	TEIVITEJEC	R value a	Leptable		
	enum inte	9x10	11.3	2.8	-	0.17	1.5	99.6	-	-	TEM acce	r R value go	bod		
	inter enun	10x10	11.3	2.8	-	0.27	2.4	98.9	-	-	TEM rejec	1 R value a	ceptable		
	TOTAL intr	9x10	-	-	-	0.42	3.8	97.7	-	-	TEM rejec	R value a	cceptable		
	TOTAL+ su	10x10	-	-	-	0.41	3.6	97.9	-	-	TEM rejec	R value a	ceptable		
Height		subjects	mean	SD.	max	Technical	TEM/meau	Coaf of ra	Bias from	Bias from	median		From	From	
neight		subjects	mean	30	max	TECHINCAL	TEN/ITEA	COEF OF TE	Dias from	Dias (res)	meuran		Communication (1997)	1 form	
		Ħ	cm	cm	cm	TEIVI (CM)	TEIVI (%)	R (%)	Blas (cm)	Blas (cm)			superviso	wedian	-
	Superviso	10	87.1	12	1.1	0.47	0.5	99.8	0	0.36	TEM acce	r R value go	Bias good	Bias good	4
	Enumerato	10	87.1	11.8	0.6	0.26	0.3	100	0.32	0.27	TEM good	R value go	Bias good	Bias good	1
	Enumerato	10	87.5	11.3	2.9	0.87	1	99.4	0.92	0.72	TEM poor	R value go	Bias poor	Bias acce	ptable
	Enumerato	10	87.1	11.5	2.7	0.84	1	99.5	0.66	0.56	TEM poor	R value go	Bias acce	Bias acce	ptable
	Enumerate	10	86.0	11.6	1 2	0.2	0.2	00.0	0.74	0.49	TEM good	R value or	Bias acce	Bias acce	
	Enumerati	10	00.9	11.0	1.5	0.3	0.5	00.0	0.74	0.49	TEM	D volue	Dine	Ding acce	4
	Enumerato	10	86./	11./	1	0.34	0.4	99.9	0.58	0.38	I EIVI good	R value go	bias acce	i bias good	4 
	Enumerato	10	87.7	11.1	1.3	0.42	0.5	99.9	1.03	0.77	TEM acce	r R value go	Bias poor	Bias acce	ptable
	Enumerato	10	86.9	11.7	1.7	0.56	0.6	99.8	0.62	0.39	TEM acce	r R value go	Bias acce	f Bias good	1
	Enumerato	10	87	11.7	1.5	0.47	0.5	99.8	0.53	0.31	TEM acce	r R value go	Bias acce	Bias good	ł
	Enumerato	10	86.9	11.6	1	0.34	0.4	99.9	0.72	0.49	TEM good	R value go	Bias acce	Bias acce	ptable
	enum inte	9x10	87.2	11.3	-	0.79	0.9	99.5	-	-	TEM accer	R value go	bod		
	enum inte	9x10	87	11.4	-	0.67	0.8	99.6	-	-	TEM acce	R value go	bod		
	inter onun	10+10	97.1	11.2		0.72	0.0	00.6			TEM acce	D volue g	ad		
	TOTAL inte	10,10	07.1	11.5	-	0.72	0.8	99.0	-	-	TENTACCE	R value gu	Jou		
	TOTAL Intr	9X10	-	-	-	0.91	1	99.4	-	-	TEIVI acce	R value go			
	TOTAL+ su	10x10	-	-	-	0.89	1	99.4	-	-	TEM acce	r R value go	bod		
MUAC		subjects	mean	SD	max	Technical	TEM/mear	Coef of rel	Bias from	Bias from	median		From	From	
MUAC		subjects #	mean mm	SD mm	max mm	Technical TEM (mm)	TEM/mear TEM (%)	Coef of rel R (%)	Bias from Bias (mm)	Bias from Bias (mm)	median		From Superviso	From Median	
MUAC	Superviso	subjects # 10	mean mm 143.2	SD mm 8.9	max mm 5	Technical TEM (mm) 1.61	TEM/mear TEM (%) 1.1	Coef of rel R (%) 96.7	Bias from Bias (mm) O	Bias from Bias (mm) 2.3	median TEM good	R value ac	From Superviso Bias good	From Median Bias poor	
MUAC	Superviso Enumerato	subjects # 10 10	mean mm 143.2 147.5	SD mm 8.9 8.7	max mm 5 4	Technical TEM (mm) 1.61 1.79	TEM/mear TEM (%) 1.1 1.2	Coef of rel R (%) 96.7 95.8	Bias from Bias (mm) 0 4,3	Bias from Bias (mm) 2.3 2.33	median TEM good TEM good	R value ac R value ac	From Superviso Bias good Bias reiec	From Median Bias poor Bias poor	
MUAC	Superviso Enumerato	subjects # 10 10	mean mm 143.2 147.5 143.9	SD mm 8.9 8.7 7.7	max mm 5 4	Technical TEM (mm) 1.61 1.79 2 4	TEM/mear TEM (%) 1.1 1.2 1 7	Coef of rel R (%) 96.7 95.8 90.4	Bias from Bias (mm) 0 4.3 2 38	Bias from Bias (mm) 2.3 2.33 1.78	median TEM good TEM good TEM accer	R value ac R value ac R value pc	From Superviso Bias good Bias rejec Bias poor	From Median Bias poor Bias poor Bias accep	table
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Ap	pendix	4 –	Local	<b>Event</b>	Calendar
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MONTH OF YEAR	R ANNUAL SEASONS	2018	2019	2020	2021	2022	2023
January	New year and		58	46	34	22	10
	9th CPA		New year and 9th CPA	New year and 9th CPA	New year and 9th CPA	New year and 9th CPA	New year and 9th CPA
Feb.			57	45	33	21	9
			Cows' movement to Toch	Cows' movement to Toch	Cows' movement to Toch	Cows' movement to Toch	Cows' movement to Toch and Kong Koch Peace program
March	International Women day		56	44	32	20	8
			International Women day and Land Preparation for cultivation	International Women day and Land Preparation for cultivation	International Women day and Land Preparation for cultivation	International Women day and Land Preparation for cultivation	International Women day and Land Preparation for cultivation
April	Easter Season and First Rain Started in Tonj North, Eid ul-Fitr		55	43	31	19	7
			Easter Season and First Rain Started in Tonj North, Eid ul-Fitr	Easter Season and First Rain Started in Tonj North and Covid 19, Eid ul-Fitr	Easter Season and First Rain Started in Tonj North, Eid ul-Fitr	Easter Season and First Rain Started in Tonj North, Eid ul-Fitr	Easter Season and First Rain Started in Tonj North, Eid ul-Fitr
May	16 <sup>th</sup> May SPLM/A day Celebration and cultivation		54	42	30	18	6
			16 <sup>th</sup> May SPLM/A day Celebration and cultivation	16 <sup>th</sup> May SPLM/A day Celebration and cultivation	16 <sup>th</sup> May SPLM/A day Celebration and cultivation	16 <sup>th</sup> May SPLM/A day Celebration and cultivation	16 <sup>th</sup> May SPLM/A day Celebration and cultivation
June	Weeding and		53	41	29	17	5
	cattle movement from Toch, Eid ul-Adha		Weeding and cattle movement from Toch, Eid ul-Adha	Weeding and cattle movement from Toch, Eid ul-Adha	Weeding and cattle movement from Toch, Eid ul-Adha	Weeding and cattle movement from Toch, Eid ul-Adha	Weeding and cattle movement from Toch Cattle Raiding in Tonj North by Youth Groups, Eid ul-Adha
July	9 <sup>th</sup> July Independence Day and Martyrs Day		52	40	28	16	4
			9 <sup>th</sup> July Independence Day and Martyrs Day	9 <sup>th</sup> July Independence Day and Martyrs Day	9 <sup>th</sup> July Independence Day and Martyrs Day	9 <sup>th</sup> July Independence Day and Martyrs Day	9 <sup>th</sup> July Independence Day and Martyrs Day
August	-		51	39	27	15	3
			Harvesting Sorghum, G.Nut and Maize and Assumption of Marry.	Harvesting Sorghum, G.Nut and Maize and Assumption of Marry.	Harvesting Sorghum, G.Nut and Maize and Assumption of Marry.	Harvesting Sorghum, G.Nut and Maize and Assumption of Marry.	Harvesting Sorghum, G.Nut and Maize and Assumption of Marry.
September	Harvesting Sorhgum		50	38	26	14	2
			Harvesting of Sorghum	Harvesting of Sorghum	Harvesting of Sorghum and Flooding displacement	Harvesting of Sorghum	Harvesting of Sorghum
October	St Daniel		49	37	25	13	1

	Comboni Day		St Daniel Comboni Day and World Vision Day	St Daniel Comboni Day and World Vision Day	St Daniel Comboni Day and World Vision Day	St Daniel Comboni Day and World Vision Day	St Daniel Comboni Day and World Vision Day
November	16 <sup>th</sup> Days of		48	36	24	12	0
	activism		16 <sup>th</sup> Days of activism	16 <sup>th</sup> Days of activism	16 <sup>th</sup> Days of activism	16 <sup>th</sup> Days of activism and Appointment of Tonj North Commissioner.	
December	Christmas	59	47	35	23	11	
	Celebration	Christma s	Christmas Celebration	Christmas Celebration	Christmas Celebration	Christmas Celebration	