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Bolstering household resilience to food insecurity in protracted crisis: the Case of Upper-Nile State, South Sudan

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Abstract. This study assessed food insecurity in four counties of Upper Nile State using the Food Consumption Score (FCS) and Household Hunger Scale (HHS). It also ascertained the coping mechanisms adopted by households in response to food insecurity using the Reduced Coping Strategy Index (rCSI), it also formulated recommendations to bolster the ability of households to withstand food insecurity. Quantitative data were collected through a structured household survey of 440 randomly selected respondents from 21 payams using two-stage cluster sampling with probability proportionate to size. Qualitative data were gathered via focus group discussions and interviews with community leaders. The findings reveal alarming food insecurity levels. Over half (55%) of households fall into the poor FCS category, characterized by minimal dietary diversity and insufficient protein, fruits, and vegetables, while 34.3% are borderline, and only 10.7% achieve acceptable dietary standards. The HHS shows 76.1% of households experience moderate hunger, reflecting significant health and well-being challenges. Coping mechanisms reveal further distress, with Baliet County reporting the highest mean rCSI (21.5), followed by Ulang (20.7), Melut (19.3), and Nasir (18.9). These findings underscore the urgent need for targeted interventions. Recommendations include promoting resilience through diversified livelihood activities such as small-scale agriculture, poultry, and goat-rearing, coupled with training and resource provision. Investments in drought-resistant seeds, improved farming techniques, and market access initiatives are essential. Additionally, community-based projects to rehabilitate irrigation systems and provide agricultural extension services could help sustain food security. The FCS, HHS, and rCSI metrics offer crucial insights into the extent and nature of food insecurity, guiding efforts to support the most vulnerable populations in Upper Nile State.

Key words: food insecurity, household resilience, protracted crisis, South Sudan, Upper-Nile.

INTRODUCTION

South Sudan is one of the most fragile and least developed countries in the world (Moszynski, 2011; The Fund for Peace, 2020). Following nearly half a century of protracted conflict, the country has been left with widespread poverty, underdeveloped infrastructure, and severely disrupted social services. As a result, South Sudan ranks near

the bottom of the Human Development Index, positioned 192nd out of 193 countries in 2024 (UNDP, 2024). Additionally, the country lags significantly behind on most of the Sustainable Development Goals (SDGs). Obstacles such as limited political commitment, weak governance structures, systemic corruption, poor integration of SDGs into national planning, and lack of institutional capacity have hampered progress. For example, SDG 1 aims to eradicate extreme poverty by 2030, defined as individuals living below $1.90 per day. In South Sudan, multidimensional poverty affected 89.3% of the population as of 2015 (South Sudan Ministry of Finance and Planning, 2017). A major challenge in achieving such targets lies in the absence of reliable, up-to-date, and disaggregated data necessary for effective, evidence-based planning and programming (UN, 2021).

South Sudan's economic fragility is further exacerbated by conflict and climate-induced shocks that have severely impacted agricultural production - the backbone of the country's economy and primary source of livelihoods. According to the Food and Agriculture Organization (FAO), 95% of South Sudanese people are engaged in farming, herding, or fishing. Disruptions in these sectors have cascading effects on food availability and national economic stability. Food prices have soared due to inflation, market disruptions, and low food production, intensifying already alarming levels of food insecurity (USAID, 2024).

Despite ongoing humanitarian assistance, food insecurity in South Sudan remains a persistent and critical issue. The situation is shaped by a complex interplay of factors including armed conflict, economic instability, environmental challenges, and displacement (Dorosh et al., 2016; Doocy et al., 2023). The FAO defines food insecurity as a condition in which people lack secure access to sufficient, safe, and nutritious food for normal growth, development, and a healthy life. Scholars like Piperata (2023) further characterize food insecurity as a multidimensional phenomenon closely linked to poverty and socioeconomic vulnerability.

Literature on conflict-affected settings emphasizes the importance of understanding the contextual dynamics of food insecurity, particularly in fragile states such as South Sudan (Doocy et al., 2023). Civil unrest, intercommunal violence, and political instability have disrupted agricultural activities, displaced populations, and compromised food supply chains. Economic fragility, marked by high inflation, limited job opportunities, and a dependency on imports, further limits household access to food (Shams et al., 2024).

In light of these challenges, building household resilience is increasingly recognized as a pivotal strategy for addressing food insecurity in contexts of recurrent conflict (Kurtz & McMahon, 2015). Resilience, though a relatively recent concept in development economics, has long been used in other disciplines such as mental health, where it is defined as the ability to withstand and recover from disruptive life events (Walsh, 2003). In the development context, resilience refers to the capacity of households to absorb, adapt to, and recover from shocks and stressors - especially those that threaten food security (Otchere & Honda, 2022). While resilience does not eliminate vulnerability, it reflects the ability to bounce back and avoid chronic poverty and food insecurity in the face of adverse conditions.

In South Sudan, household resilience to food insecurity remains an aspiration that can only be realized through comprehensive efforts to address both human-made and natural disasters. The November 2024 Integrated Food Security Phase Classification

(IPC) projected that 7.7 million people - representing 57% of the population - will face Crisis-level or worse acute food insecurity (IPC Phase 3+) during the 2025 lean season (April to July). Alarmingly, around 63,000 individuals are expected to face Catastrophe (IPC Phase 5), underscoring the urgency of strengthening household and community resilience to food shocks.

Our research endeavor was directed towards uncovering the prevalent state of food insecurity and the coping strategies households are currently employing within Ulang, Nasir, Baliet and Melut counties within the Upper-Nile State. Through this, the study provides a comprehensive understanding of the food insecurity dynamics in the region, critically assessing the effectiveness of current coping mechanisms. The paper also proposes actionable interventions designed to enhance household resilience to food insecurity, drawing upon the insights gathered to suggest sustainable solutions tailored to the unique needs of the population in Ulang, Nasir, Baliet, and Melut counties. Consequently, we delineated three specific objectives to guide our study:

- To elucidate the current status of food insecurity in Upper-Nile State, thereby offering a detailed understanding of the extent and severity of this pressing issue within the community.
- To assess the coping mechanisms adopted by households in response to food insecurity, shedding light on the strategies they employ to navigate and mitigate the challenges associated with limited access to food.
- To formulate intervention strategies designed to bolster household resilience to food insecurity, drawing upon the findings and insights gleaned from our research to propose practical and sustainable solutions tailored to the unique needs and circumstances of Ulang County.

MATERIALS AND METHODS

This study has used both quantitative and qualitative data collection techniques. The survey was carried out in March 2024 and involved randomly selected households within Ulang, Nasir, Melut and Baliet counties within the Upper-Nile State in South Sudan. It was conducted through a quantitative survey administered at the household level using structured questionnaire.

Interviews were held with systematically and randomly sampled households. The qualitative survey involved Focus Group Discussions (FGDs) with community members and Key Informant Interviews (KIIs) with county government technical staff and humanitarian partner staff - they were conducted in April 2024. Information from FGDs and KIIs were used to triangulate and enrich the data obtained from the household survey. These qualitative insights provided detailed perspectives that helped to contextualize and deepen the understanding of the findings drawn from the quantitative data collected. Respondents were household heads, spouses of the household heads, or an adult household member who was determined knowledgeable to respond to questions. Data was inputted through the Open Data Kit (ODK) which is a data collection tool, and processed using Excel and data analysis was done through Statistical Package for the Social Sciences (SPSS) to produce descriptive statistics, including frequency distributions and percentage calculations.

Focus group discussions were held in selected communities.

Sampling frame:

- Community members, community leaders and stakeholders (government and non-government)
- Sample size:
- Cochran's sample size formula was used to determine standard sample, which is:

$$n_0 = \frac{Z^2 pq}{e^2} \quad (1)$$

where Z = 1.96 at 95% confidence level; e = the desired level of precision (i.e. the margin of error); P = the (estimated) proportion of the population which has the attribute in question; $Q = 1 - p$.

To determine the sample size for this study, the above sample formula was applied, where Z represented 1.96 at 95% confidence level, e is 0.5% margin of error, simple calculation was therefore shown as; $((1.96)^2\ (0.5)\ (0.5))\ /\ (0.05)^2 = 440$. The survey covered 21 Payams across the 4 target counties of Melut, Baliet, Ulang and Nasir in Upper Nile. A number of standard food insecurity indicators have been measured as follows - to ascertain the food insecurity status of vulnerable households in Baliet, Melut, Nasir and Ulang Counties.

Reduced Coping Strategy Index (rCSI)

Since 2003, the CSI has been widely used by the World Food Programme, CARE International and other non-governmental organizations and humanitarian agencies, governments, and researchers as an indicator of food insecurity in a variety of applications (Maxwell & Caldwell, 2008). The reduced Coping Strategies Index (rCSI) is an indicator used to compare the hardship faced by households due to a shortage of food. The index measures the frequency and severity of the food consumption behaviours the households had to engage in due to food shortage in the 7 days prior to the survey (World Food Programme, 2019). The index reflects both the frequency of each behaviour (i.e. how many times the coping strategy was used by any member of the household) and severity (i.e. how serious the strategy).

Five food-related coping mechanisms that the household employed in the seven days before the study served as the basis for the rCSI. The rCSI raw scores are determined by multiplying the frequency with which a behaviour was used by a universally used severity weight, then the weighted scores for each coping strategy are summed up. A household that used all five techniques daily for the previous seven days would have a raw score of 56, which is the maximum raw rating for the rCSI.

Food Consumption Score (FCS)

The household Food Consumption Score (FCS) is associated with household food access and is used as a proxy indicator for household food security. The respondents were asked about the household food consumption with a reference time of the last seven days prior to the survey. The foods were grouped into eight categories: meat and fish, vegetables and fruits, cereals, tubers, pulses, milk, and dairy products, sugar and oil. Their weights were allotted according to their nutritive content. The food consumption score was then computed by summing up the cumulative consumption frequency for each food group multiplied by the weight of that specific food group. The FCS was then

categorized into 3 levels: 0 to 28 as Poor Food Consumption score, 28.1 to 42 as Borderline and above 43 being Acceptable FCS.

Household Hunger Scale (HHS)

The HHS is a food deprivation scale which estimates the proportion of households experiencing three varying levels of household hunger. Only three hunger-related components of insecure food access are included in the HHS, which is based directly on the Household Food Insecurity Access Scale (HFIAS). This is because it has been demonstrated that these items are culturally invariant across various sociocultural contexts, allowing for cross-location comparisons. Because it evaluates only the most extreme cases of food insecurity, HHS differs from the other household food insecurity indicators. Every one of the six questions have a score between 0 and 2, where 0 means 'did not occur' 1 being 'rarely and sometimes,' and 2 being 'often.'; HHS is divided into three categories: 'severe hunger' (4–6), 'moderate hunger' (2–3), and 'little to no hunger in the household' (0–1).

RESULTS AND DISCUSSION

Demographic Information

The survey was carried out among 440 households, which were randomly selected from 21 payams across the four target counties of Ulang, Melut, Baliet, and Nasir in Upper Nile State. The household sample was chosen using a two-stage cluster sampling method, with probability proportionate to size (PPS). This approach ensured that the sample accurately represented the population distribution across the different payams and counties, allowing for robust data collection and meaningful analysis that reflects the region's varied socioeconomic and demographic features. The use of PPS in the sampling process further strengthened the reliability and validity of the survey results. The details are as in Table 1 below:

Table 1. Respondents by County

County	Number of respondents	Total population by county*
Melut	116	126,691
Baliet	100	56,348
Ulang	109	137,691
Nasir	115	286,628
Total	440	607,358

***** OCHA, IPC Technical Working Group, SSNBS, 2020.

Overall, 207 (47.1%) of the respondents were male and 233 (52.9%) were female. Additionally, 360 (81.8%) households were Male and Female households (M&F), 66 households (15%) of respondents were Female No Male (FNM) and Male No Female (MNF) households were 13 (2.9%). There was only 1 (0.3%) Child no adult households (CAN) that participated in the study.

Access to Farmland

The study examined respondents whether they owned land or had access to land for farming and the acreage of land that the household cultivated in the current season. The findings revealed that 298 (67.7%) of the households owned land or had some form of access to land while 142 (32.3%) did not own or had any access to land. Analysis displayed that land inaccessibility remains prevalent in Melut where 48.7% of respondents reported not to have easy access to farmland nor did they own farmland. The occurrence of land inaccessibility was recorded to be 35.7%, 18.2% and 15.7% in

Baliet, Ulang and Nasir counties respectively. Factors contributing to these occurrences included persistent land conflicts and insecurity which has continued to restrict hundreds of rightful landowners the opportunity to productively engage in farming. The study findings also showed that land accessibility remains hardest amongst female headed households (worst for those widowed) than for anybody else. Out of households that owned/ had access, 77.5% of them had cleared land and had planted in the current season whereas 22.5% had not planted any crops.

As shown in Table 2 above, land ownership was highest amongst M&F households, as 78.3% owned land, followed by FNM households at 74.2%. It was also shown that 46.2% of MNF households owned land and ownership was 0% for CAN. Further analysis indicated that the level of planting was lowest in Melut where 77.1% of the respondents have not opened any farmland the most recent cropping season; in Baliet, Nasir and Ulang counties, 47.2%, 34.2% and 27.6% respectively of the farmers did not engage in any farming activity in the current season. The average size of farmland opened per household in the current season was recorded at 1.7 acres. Respondents in Baliet county farmed larger farmland, averaging 2.2 acres; Melut county had the lowest farm size average at 0.57 acre. Across all counties, major constraints to farming cited by respondents included lack of seeds, land wrangles, lack of technical agronomic skills and poor conditions for farming.

Table 2. Land ownership by gendered household

Gendered household	Count (N)	% Land ownership
M&F	360	(*n* = 282) 78.3%
FNM	66	(*n* = 49) 74.2%
MNF	13	(*n* = 6) 46.2%
CNA	1	(*n* = 0) 0%

Livestock Ownership

Respondents were asked whether they had livestock and how many they had and results showed that 58.7% of respondents owned at least some type of livestock, with varying numbers from one household to another. Fig. 1 below shows the number of households with livestock per county.

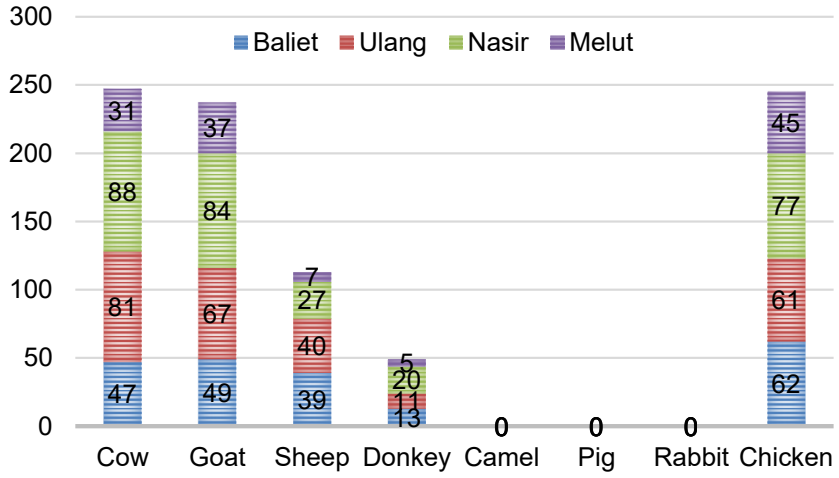

Figure 1. Livestock ownership by County.

Overall, most of the households (70.2%) kept at least one type of livestock with the highest being in Nasir, followed by Ulang, Baliet and least in Melut county. A total of 67.5% households had cows with the highest in Nasir, 63.3% owned goats, chickens (63.2%), sheep (27.8%), donkeys (11.5%). Pigs and camels were owned by 0.5% of the respondents and rabbits were owned by only 0.21% of the respondents. In general, households in Nasir county has more livestock in contrast to the other counties, it was followed by Ulang and Melut. Overall, the level of livestock ownership and rearing remained least in Baliet county. The high proportion of households owning small livestock in Nasir can be attributed to its strategic location near the Gambella region in Ethiopia, which fosters vibrant cross-border trade activities between the two communities. This cross-border interaction has enabled the exchange of goods and livestock, creating economic opportunities and strengthening the resilience of households in the area. Additionally, participants in the focus group discussions (FGDs) highlighted that Nasir and Ulang counties have benefited from restocking initiatives implemented by various humanitarian and development partners. These programs were designed to replenish livestock herds that were depleted during periods of conflict or crisis, thereby playing a critical role in reviving livelihoods, enhancing food security, and supporting the long-term economic stability of the community.

Household Income Source

In relation to household income sources, a total of 113 (21.3%) respondents had no income sources. A total of 327 (74.3%) respondents were engaged in income generating activities and obtained some income albeit irregular from these activities. Fig. 2 below shows the main income sources for households.

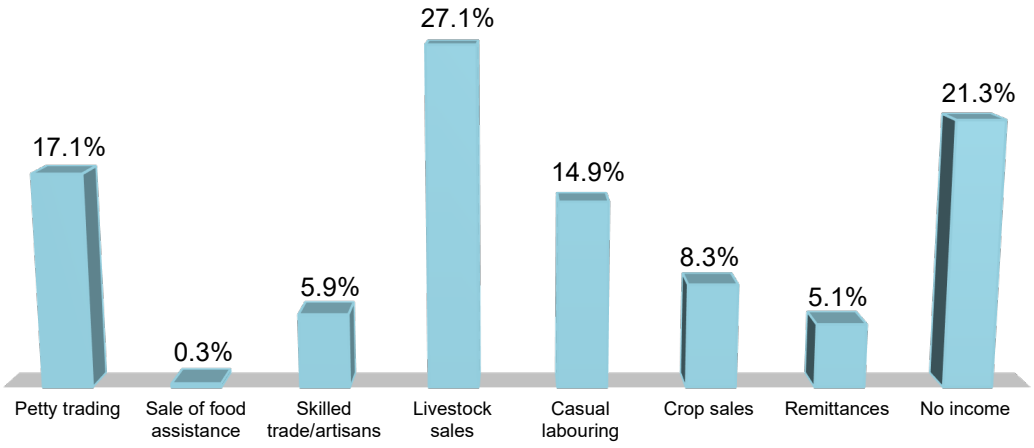

Figure 2. Major income sources.

The most common source of income reported was sale of livestock, mainly cattle and poultry (27.1%). Other sources of income included petty trading (17.1%); casual farm labor and off-farm laboring at 14.9%; foreign remittances (5.1%), sale of food crops (8.3%), skilled artisanal jobs (5.9%). It was also noted that 0.3% of the respondents had ever sold distributed food to raise household income. The communities in the Greater Upper Nile region predominantly rely on cattle as their primary source of income and

economic livelihood. Beyond serving as a financial asset, cattle hold significant cultural and social importance, particularly in the context of marriage, where they are a vital component of dowry negotiations and ceremonies. However, the high value placed on cattle has also contributed to persistent intercommunal tensions and conflict. Armed youth often organize raids to steal cattle from neighboring communities, driven by economic incentives or cultural pressures to accumulate wealth. These raids frequently escalate into violent confrontations, triggering cycles of retaliation and revenge killings that deepen divisions among communities. The dual role of cattle as both an economic resource and a catalyst for conflict underscores the need for targeted interventions to address underlying socio-economic vulnerabilities and foster peaceful coexistence.

Overall Discussions of Findings Across Indices:

The three indices - Reduced Coping Strategy Index (rCSI), Food Consumption Score (FCS), and Household Hunger Scale (HHS) - collectively paint a deeply concerning picture of food insecurity across the surveyed counties in Upper Nile State. Despite measuring different aspects of household vulnerability, all three indices consistently indicate high levels of food insecurity, with a majority of households employing undesirable coping mechanisms, consuming inadequate diets, and experiencing moderate hunger. The convergence of these findings across indices not only validates the severity of the situation but also underscores the systemic nature of the food crisis in Upper-Nile State. High rCSI scores reveal that households are frequently resorting to extreme survival strategies, while poor FCS results and high rates of moderate hunger further emphasize that these coping strategies do little to secure adequate and nutritious food intake.

A key pattern emerging across all three indices is the relative variation between counties - most notably, Baliet and Ulang counties consistently rank among the worst-affected areas, regardless of the metric used. Baliet showed the highest rCSI and the poorest FCS, while Ulang had the highest proportion of households experiencing moderate hunger. These repeated patterns suggest that specific structural and environmental factors, such as protracted conflict, population displacement, and recurrent flooding, are disproportionately affecting these counties. Conversely, Nasir County, though still significantly affected, demonstrated comparatively better outcomes across all three indices, largely due to mitigating factors like cross-border trade and access to humanitarian assistance, which appear to provide a buffer against the worst food insecurity effects.

The analysis further highlights the impact of household composition and gender dynamics on food security outcomes. Across indices, households with both male and female adults (M&F) generally fared better than those without, particularly Child No Adult (CAN) and Male No Female Adult (MNF) households, which consistently reported higher rCSI scores and poorer FCS. This suggests that the absence of adult female household members may be associated with limited caregiving capacity, fewer livelihood options, and reduced food access - factors that increase household vulnerability. Ultimately, the findings from the three indices align to depict a multidimensional food insecurity crisis driven by conflict, climate shocks, and social vulnerabilities, necessitating an integrated response that addresses immediate needs while strengthening long-term household and community resilience.

Reduced Coping Strategy Index (rCSI)

When livelihoods are negatively impacted by a shock/crisis as remains the case in Upper Nile, households' resort to implementing various mechanisms which are infrequently practiced under normal circumstances. This is often undertaken to cope with the impacts of decreasing access to food.

As depicted in Fig. 3 above, the mean Reduced Coping Strategies Index (rCSI) was highest in Baliet County, with a value of 21.5. This indicates that respondents in Baliet resorted to more frequent and severe undesirable coping strategies, underscoring a dire food insecurity situation in the area. Ulang and Melut Counties followed with rCSI values of 20.7 and 19.3, respectively, reflecting similarly concerning levels of food insecurity. Conversely, Nasir County recorded the lowest rCSI at 18.9, suggesting a relatively better food security situation. This comparatively favourable status is attributed largely to cross-border trading activities with the Gambella region of Ethiopia, which provide residents with improved access to food and other essential items. Focus group discussions (FGDs) highlighted conflict as the primary driver of these coping patterns. Prolonged instability has severely disrupted subsistence agriculture - the mainstay of livelihoods in the Upper Nile region. As a result, residents face significant resource constraints, limiting their ability to access food items and undermining their resilience to food insecurity.

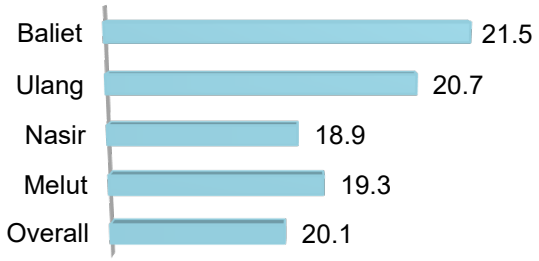

Figure 3. rCSI by county.

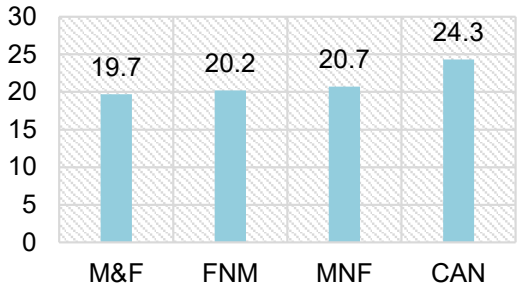

Figure 4. rCSI by gendered household.

As reflected in Fig. 4 above,across gendered household consideration, analysis indicated that Child no adult (CAN) households had the worst rCSI at 24.3 followed by Male no Female Adult (MNF) households at 20.7. The rCSI analysis for gendered households shows more resilience and lower level of engagement in undesirable practices among M&F households compared to MNF and FNM households.

Prepared food is served first to children, then men and finally women. Because women are the last people to eat, they are the first to suffer the impacts of food shortages (Tappis et al., 2013). During the focus group discussions conducted in Ulang Payam, participants highlighted a common coping mechanism adopted by households facing food insecurity: prioritizing children's access to food by restricting adults from consuming it. This strategy reflects a collective effort to safeguard the nutritional needs of the most vulnerable members of the household, especially children, who are more susceptible to malnutrition and its long-term consequences. Participants explained that this practice is often driven by the community's cultural values and a sense of responsibility to protect the younger generation, even at the expense of adult well-being. However, they also acknowledged the adverse impacts on adults, including increased

weakness and reduced productivity, which further exacerbate the cycle of vulnerability and food insecurity within households. This finding underscores the severe strain on resources that forces families to make such difficult and unsustainable choices.

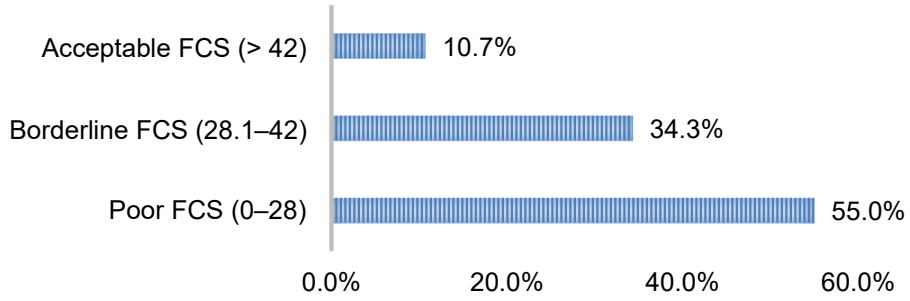

Figure 5. Food Consumption Score (FCS).

The food consumption score (FCS) results depicted in Fig. 5 reveal significant disparities in household food security, with 34.3% of households falling into the borderline category, 55% classified as having poor FCS, and only 10.7% achieving an acceptable FCS. This data highlights a concerning trend in the dietary well-being of households in the surveyed area.

• Borderline Food Consumption (34.3%): Households on the borderline are typically characterized by fluctuating access to food. These households may experience periods of adequate food consumption, but their situation remains precarious. The borderline group often faces challenges in maintaining consistent access to a diversified diet, which may lead to nutrient deficiencies or periods of food insecurity. The significant proportion (over one-third) of households falling into this category suggests that while some may be managing to meet basic dietary needs, they remain vulnerable to shocks, such as price fluctuations, climate events, or disruptions in food supply chains. The period in which they experience shortage of food is the lean season where the unconditional food assistance may not suffice or comes with delays.

• Poor Food Consumption (55%): Over half of the households are in the poor FCS category, indicating that the majority of the population in this sample struggles to maintain even a minimally adequate diet. This poor FCS status may reflect limited access to food sources, reliance on fewer food groups, and insufficient quantity to meet the dietary needs of household members. Such households are likely to experience more frequent instances of hunger, malnutrition, and inadequate food diversity, contributing to poor health outcomes, especially for vulnerable groups such as children, pregnant women, and the elderly.

• Acceptable Food Consumption (10.7%): Only 10.7% of households have an acceptable FCS, meaning these households are better able to meet their nutritional needs. While this group is relatively small, it may indicate better overall food security in terms of both quantity and variety of food available. These households likely have more stable income sources, better access to markets or agricultural produce, and can afford a balanced diet. However, the fact that such only a tiny portion of the population fits into this category underscores the widespread food insecurity challenges faced by the majority across the four counties of Ulang, Nasir, Baliet and Melut.

The Fig. 6 indicates the FCS per county - analysis shows that Baliet county has the worst FCS as 72.3% of the respondents scored poor FCS, the situation was not any better in Ulang county where 70.4% of respondents had poor FCS and 22.5% had borderline FCS. Overall, the FCS was considerably better in Nasir followed by Melut county.

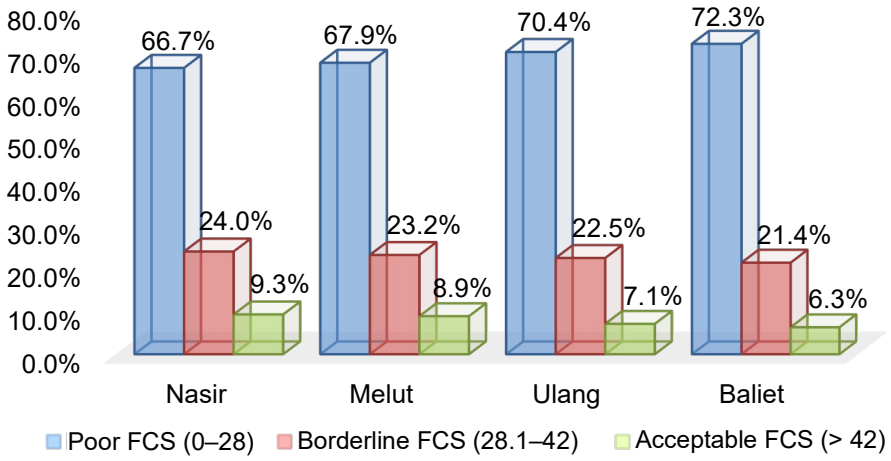

Figure 6. FCS by county.

Further analysis indicated there are marked differences in the FCS scores between the four counties, with overall food consumption scores better in Nasir, distantly followed by Ulang, Melut ranked third and the Baliet had the worst levels of food consumption score. Conflict and climate change are the primary drivers of food insecurity in the Upper-Nile region, significantly disrupting livelihoods and community stability. Persistent intercommunal violence frequently leads to population displacements, forcing families to abandon their homes, agricultural activities, and sources of income. These displacements exacerbate vulnerabilities, leaving affected populations heavily reliant on humanitarian assistance for survival. Moreover, the cyclical nature of violence and displacement undermines efforts to build household resilience, as families struggle to recover and rebuild their lives in the face of ongoing uncertainty. Compounding this challenge, the effects of climate change - such as prolonged droughts, erratic rainfall patterns, and flooding - further diminish agricultural productivity, disrupt food systems, and intensify competition over scarce resources.

Together, these interconnected crises create a protracted cycle of dependency, weakening the ability of households to adapt and thrive. Addressing food insecurity in the Upper-Nile region and Ulang county in particular, requires a holistic approach that not only provides immediate relief but also tackles the root causes of conflict, fosters peacebuilding, promotes climate adaptation, and strengthens the resilience of communities to withstand future shocks.

According to focus group discussions (FGDs) conducted across the four counties of Melut, Baliet, Ulang and Nasir most households consume mainly starchy foods, sorghum meal, maize meal, beans, vegetable oil, meat and vegetables. They also consume fruits harvested from the wild. Communities mostly in Ulang and Nasir

Counties rely on food assistance received from the WFP channelled through World Vision International for last mile delivery whilst some harvested food from their own farms planted with the seeds distributed by different humanitarian partners such as the UNFAO and the World Vision International. The most consumed food items over the past seven days were largely starchy foods; sorghum meal (100%), maize meal (64.1%), fish (88.8%), lentils (87.2%), vegetable oil (90.5%) and vegetables (84.4%). The least consumed foods included meat products (12.1%) and eggs (1.1%).

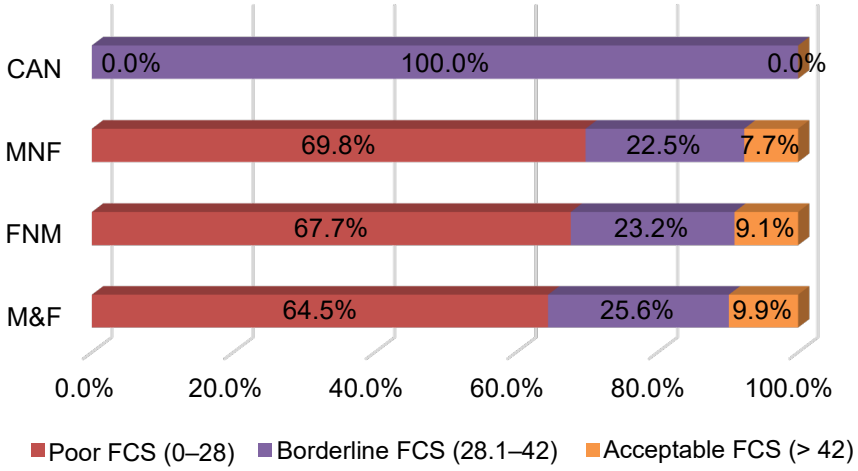

Figure 7. FCS by gendered household.

Fig. 7 above presents the findings of the Food Consumption Score (FCS) analysis, disaggregated by gendered household composition. The data reveals that, overall, households with both male and female adults (M&F) exhibited better food consumption scores compared to the other household types. Specifically, M&F households tended to report higher levels of food security and a greater diversity of food consumption, which is indicative of more stable access to adequate food. In contrast, the most concerning trend emerged from the Male No Adult Female (MNF) households, where the food consumption scores were significantly lower. These households exhibited the poorest food security indicators, suggesting heightened vulnerability to food insecurity. The lack of an adult female member may point to gender-specific challenges, such as limited household labor, reduced caregiving capacity, or poorer access to food resources, which could exacerbate food insecurity.

While the M&F households performed relatively better, it is important to note that even these households had generally low scores in terms of acceptable food consumption. This indicates that, despite some advantages, food insecurity is widespread across all household types in the surveyed population. It suggests that factors beyond household gender composition - such as economic constraints, access to markets, and regional challenges - are also significantly impacting food consumption patterns. In conclusion, addressing food insecurity will require a more holistic approach that considers both household gender dynamics and the broader socioeconomic factors influencing food access.

Based on the survey findings, as illustrated in Fig. 8 above, it is evident that a significant majority of households (76.1%) experience moderate hunger, with a smaller proportion (23.9%) reporting little or no hunger. This pattern is consistently observed across several counties, although the extent of hunger varies somewhat between them. In Nasir County, 74.3% of households reported experiencing moderate hunger, indicating that a substantial portion of the population faces food insecurity. Baliet County also reflects a similar situation, with 73.3% of households experiencing moderate hunger. In Melut County, 73.9% of households report facing moderate hunger as well.

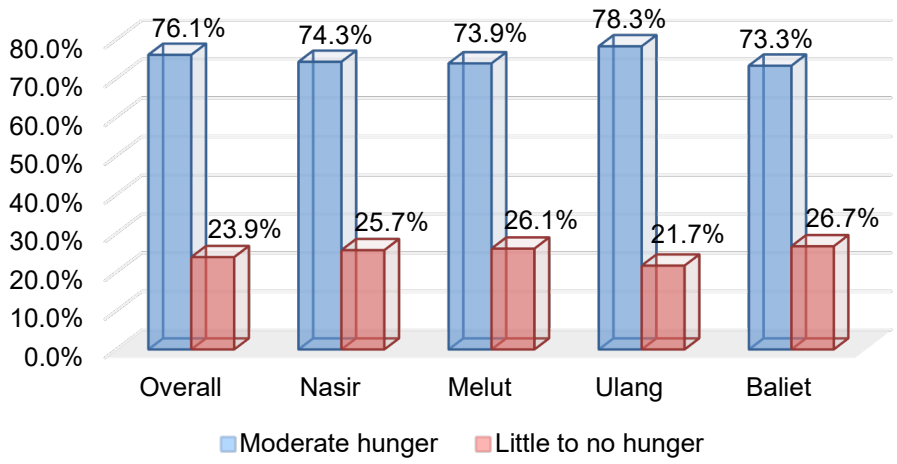

Figure 8. Household Hunger Scale by county.

However, Ulang County stands out with the highest level of moderate hunger among all the counties surveyed. A striking 78.3% of households in Ulang County experience moderate hunger, the most severe hunger situation observed in the survey. The heightened food insecurity in Ulang County can be attributed to several factors, notably recurring intercommunal violence and seasonal flooding, both of which have had a detrimental impact on food production and access, which weakens household resilience to recurring shocks. The violence disrupts agricultural activities and displaces communities, while flooding destroys crops and exacerbates challenges in food production and distribution.

These findings underscore the urgent need for targeted interventions to address the root causes of food insecurity, particularly in areas like Ulang County, where the combination of conflict, environmental hazards, and limited access to resources significantly hampers the ability of households to produce and access sufficient food. Addressing these issues is critical to improving the nutritional status and overall wellbeing of affected populations in these regions.

CONCLUSIONS

This study provides a comprehensive analysis of food insecurity in the four counties of the Upper Nile State using three key indicators: The Food Consumption Score (FCS), Household Hunger Scale (HHS), and Reduced Coping Strategy Index (rCSI).

Collectively, these metrics depict a dire and multifaceted food insecurity crisis across the region. Over half (55%) of surveyed households were found to have severely inadequate diets, dominated by staple foods and lacking in vital nutrients. An additional 34.3% of households fell into the borderline category, suggesting vulnerability to even minor shocks, while only 10.7% had acceptable FCS levels. The HHS findings echo this, with 76.1% of households reporting moderate hunger, reflecting serious threats to health and well-being.

Coping strategies further underscored this precarious situation: all counties recorded high rCSI scores, indicating widespread reliance on harmful practices like reducing meal sizes, skipping meals, or selling assets. Notably, Baliet and Ulang counties consistently ranked worst across all three indices, pointing to localized structural challenges such as recurrent flooding, displacement, and conflict. Conversely, Nasir County exhibited relatively better food security outcomes, likely due to mitigating factors such as humanitarian access and cross-border trade.

Demographic analysis also highlighted that household composition matters: those with both male and female adults (M&F) were generally more resilient than those without adult caregivers - particularly Child-No-Adult (CAN) and Male-No-Female (MNF) households. This points to gendered vulnerabilities and caregiving gaps that exacerbate food insecurity. Ultimately, the convergence of these findings suggests that food insecurity in Upper Nile State is not only severe but also systemic, requiring coordinated, multi-sectoral interventions that combine immediate humanitarian support with long-term resilience-building strategies.

Innovative aspects of this study include but are not limited to: (1) Multi-index integration: This study is among the few to triangulate FCS, HHS, and rCSI across counties in Upper Nile State, offering a holistic picture of household vulnerability. (2) Gender-disaggregated insights: The analysis of household types (M&F, MNF, CAN) provides important policy insights into vulnerability linked to household structure. (3) Conflict-sensitive framing: The study links food insecurity with conflict and displacement patterns, underscoring the need for integrated peacebuilding.

To improve household resilience to food insecurity, the following recommendations for local-level policy makers have been formulated:

- Given the poor Food Consumption Score (FCS) and high Household Hunger Scale (HHS) observed in Upper-Nile State, there is an urgent need to enhance access to consistent and reliable food assistance to mitigate immediate hunger. Specifically, targeted interventions such as multi-purpose cash transfers should be implemented to empower households, enabling them to purchase food locally. This approach not only addresses nutritional gaps but also stimulates local economies by supporting accessible markets. Furthermore, multi-purpose cash (MPC) transfers should be linked with nutrition-sensitive programs, such as community-based awareness campaigns, to encourage households to diversify their diets by purchasing nutritious foods.
- Launch cash-for-work initiatives focused on community asset development such as construction of dykes to prevent flooding, roads, water sources, agricultural projects, markets, among other key public infrastructure.
- Support farmers with subsidized agricultural inputs namely seeds, tools, and fertilizers timed with planting seasons.

• To promote long-term resilience and reduce dependency on food assistance, a comprehensive approach should be adopted to diversify livelihoods among vulnerable households in Upper-Nile State. This can include targeted training programs in small-scale agriculture, poultry farming, and goat-rearing, tailored to local climatic and economic conditions. In addition to training, vulnerable households should be provided with the necessary resources, such as high-quality seeds, tools, and livestock, to support these activities. For example, providing drought-resistant crop seeds and poultry breeds that are well-adapted to the region's environment will enhance productivity. Support should also include technical assistance on sustainable farming practices, livestock care, and market access, ensuring that households can generate income and improve their food security.

• To enhance long-term agricultural productivity and food security in Upper-Nile State, investments should focus on promoting the use of improved agricultural techniques, drought-resistant seeds, and quality inputs. Specifically, targeted programs should provide farmers with training on modern, sustainable farming practices, such as conservation tillage, agroforestry, and integrated pest management, tailored to local conditions. In parallel, providing drought-resistant seed varieties, such as sorghum and millet, will help mitigate the impact of unpredictable weather patterns. A key component of these efforts should be facilitating improved market access by developing supply chain infrastructure, linking farmers to local markets, and providing storage facilities to reduce post-harvest losses. Furthermore, community-based projects aimed at rehabilitating irrigation infrastructure - such as repairing existing canals and building new systems for water management - should be prioritized to increase agricultural productivity. Finally, expanding agricultural extension services will be critical to disseminating knowledge, providing technical support, and fostering the adoption of best practices.

• To reduce reliance on negative coping strategies and improve household resilience in Upper-Nile State, programs should be designed to provide predictable, multi-seasonal support that alleviates immediate economic pressures. For example, cash-for-work initiatives should be implemented that focus on community-driven projects, such as rehabilitating local infrastructure, improving water sources, or supporting agricultural activities, ensuring that households can earn income over multiple seasons. These initiatives should be designed to provide sustainable income without encouraging dependency, with a focus on building community assets. Additionally, subsidized inputs, such as seeds, fertilizers, and tools, should be provided to vulnerable households to reduce their financial burden during key planting seasons. These programs should be synchronized with the agricultural calendar, ensuring that support is available during critical planting and harvesting periods. Over time, these interventions will help reduce the use of harmful coping strategies, such as selling assets or reducing food intake, thereby lowering the Reduced Coping Strategy Index (rCSI) score.

• To strengthen financial resilience and reduce reliance on negative coping mechanisms during food scarcity, community savings and loan groups should be strengthened. These groups would allow households to save small, regular amounts of money, building a financial buffer that can be accessed during times of food insecurity or economic hardship. Additionally, the groups should provide affordable loans to members, enabling them to invest in income-generating activities, such as small-scale

agriculture or trade, which can improve food access and reduce vulnerability. Training in financial literacy, group governance, and loan repayment mechanisms will be essential to ensure the sustainability of these groups. By empowering households to manage their finances collectively and providing an alternative to selling assets or relying on external aid, these community-based savings groups will enhance overall economic resilience and reduce the need for harmful coping strategies.

- To address food insecurity in protracted crises like Upper-Nile State, it is crucial to partner with local leaders and community stakeholders to promote peacebuilding and conflict mediation initiatives. These efforts should focus on establishing community dialogues, strengthening local conflict resolution mechanisms, and fostering trust among different ethnic and social groups. By training local leaders in conflict mediation and peacebuilding techniques, communities can proactively address tensions before they escalate into violence, creating a more stable environment for households. This stability will enable families to invest in sustainable food production and livelihoods, such as cultivating crops or engaging in livestock rearing, without the disruptions caused by conflict. Additionally, peacebuilding initiatives should be linked with economic recovery programs, ensuring that the community has the resources and support needed to rebuild and sustain their livelihoods.

Short-term recommendations to the global level policy makers and donors:

- Provide flexible and multi-year funding mechanisms to support both emergency food assistance and resilience-building - global donors should shift toward flexible, multi-year funding that allows humanitarian and development actors to respond rapidly to acute food insecurity while simultaneously laying the groundwork for longer-term resilience. This approach enables integrated programming – where immediate food distribution can occur alongside investments in local agriculture, livelihoods, and nutrition education – thereby reducing dependency and building sustainability over time.

Medium-to-Long-Term Recommendations:

- Fund integrated food security and peacebuilding programs, recognizing the role of conflict in driving hunger - global actors should prioritize funding programs that simultaneously address food production and intercommunal tensions. These programs can include agricultural cooperatives that bring together different ethnic groups, shared natural resource management initiatives, or conflict-sensitive livelihood training. The integration of food security and peacebuilding fosters social cohesion, reduces the likelihood of resource-related violence, and allows communities to invest in long-term food systems.
- Advocate for regional trade facilitation to ensure cross-border food flows and reduce market shocks in vulnerable counties - border regions of Upper Nile State often rely on trade with Ethiopia and Sudan to meet food and non-food needs. However, regional trade is frequently disrupted by conflicts and insecurity. Global actors should advocate for policies and infrastructure that facilitate smoother cross-border trade.
- Strengthen National Alignment with FAO's Food Security Framework: To ensure robust and holistic food security strategies, it is recommended that national and sub-national policies align closely with the Food and Agriculture Organization's (FAO) established definition and measurement of food (in)security. FAO outlines four critical dimensions – availability, access, utilization, and stability – which offer a comprehensive

framework for diagnosing and addressing food insecurity. Incorporating these dimensions into national food security assessments and programming will enhance the effectiveness, comparability, and evidence-based design of interventions, particularly in fragile contexts like South Sudan.

Recommendations for future studies:

1. There is a need to conduct a Resilience Index Measurement and Analysis (RIMA), a comprehensive framework developed by the FAO to assess and understand household resilience to food insecurity in the four counties. It provides a structured, evidence-based approach to identify the factors that contribute to resilience and to guide policies and programs that aim to strengthen it.
2. Gender-sensitive research should further examine the roles of women and caregiving dynamics in shaping household food resilience.
3. Conflict and climate impact modeling would help isolate the specific contributions of shocks to household vulnerability.

Limitations of the study: While this study offers valuable insights, it is important to acknowledge its limitations:

1. Access challenges: Insecurity and logistical constraints limited access to certain areas, potentially affecting data completeness.
2. Self-reported data: Indices such as the rCSI and HHS rely on self-reporting, which can be affected by recall bias or social desirability bias.

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REFERENCES

Doocy, S., Lyles, E., Morjan, R.K., Pfieffer-Mundt, K., Robinson, C. & Savage, K. 2023. Cash for assets during acute food insecurity: An observational study in South Sudan. *Agric. Food Secur*. **12**, 25

Dorosh, P.A., Rashid, S. & van Asselt, J. 2016. Enhancing food security in South Sudan: The role of markets and regional trade. *Agric. Econ.* **47**, 697–707.

Kurtz, J. & K. McMahon, K. 2015. *Pathways from peace to resilience: Evidence from the greater horn of Africa on the links between conflict management and resilience to food security shocks*. Washington, DC: Mercy Corps.

Maxwell, D. & Caldwell, R. 2008. *The Coping Strategies Index, Field Methods Manual* (2nd ed.).

Moszynski, P. 2011. South Sudan: A nation born in crisis. *British Medical Journal* **342**, d3726.

OCHA (2020). *Integrated Food Security Phase Classification (IPC)*. Technical Working Group, SSNBS

Otchere, F. & Handa, S. 2022 Building Resilience through Social Protection: Evidence from Malawi. *The Journal of Development Studies* **58**(10), 1958–1980. doi: 10.1080/00220388.2022.2075733

Piperata, B.A. 2023. Measuring food insecurity: An introduction to tools for human biologists and ecologists. *American Journal of Human Biology*. https://doi.org/10.1002/ajhb.23821

Shams, S.H., Sokout, S., Nakajima, H., Kumamoto, M. & Khan, G.D. 2024. Addressing Food Insecurity in South Sudan: Insights and Solutions from Young Entrepreneurs. *Sustainability* **16**(12), 5197. doi: 10.3390/su16125197

South Sudan Ministry of Finance and Planning. 2017. *South Sudan Inaugural SDG Report* (p. 35).

Tappis, H., Doocy, H., Paul, A. & Funna, S. 2013. Food security and development in South Sudan: A call to action. Cambridge University Press.

Tappis, H., Doocy, S., Paul, A., & Zangana, G. 2013. Food security and women's health in conflict-affected settings: A case study from the Kurdistan region of Iraq. *Disasters* **37**(S1), S36–S50. https://doi.org/10.1111/disa.12016

The Fund for Peace. 2020. *Fragile States Index Annual Report 2020*.

United Nations Development Programme (UNDP). 2024. *The Humanitarian Development Index*

United Nations (UN). 2021. South Sudan. *SDG data landscape diagnostic and strategic action plan*.

United States Agency for International Development (USAID). (2024). *South Sudan Agriculture and Food Security*. Accessed 10.04.2024.

Walsh, F. 2003. Family resilience: a framework for clinical practice. *Family Process* **42**(1), 1–18. doi: 10.1111/j.1545 5300.2003.00001.x

WFP. 2019. *Food security and reduced coping strategies index*. September 2019, from https://resources.vam.wfp.org/data-analysis/quantitative/food-security/reduced-coping-strategies-index