FLOOD VULNERABILITY and CONTINGENCY PLAN

Warrap State, South Sudan

Mapping and Assessment Report

December 2013

ShelterCluster.org
Coordinating Humanitarian Shelter

CHF The Common Humanitarian Fund South Sudan

REACH Informing more effective humanitarian action

CONTENTS

List of Tables, Maps & Figures

List of Acronyms

ACTED	Agency for Technical Cooperation and Development
CGI	Corrugated Galvanized Iron
FVI	Flood Vulnerability Index
GHACOF	Greater Horn of Africa Climate Outlook Forum
IOM	International Organization for Migration
NFI	Non-food Item
NGO	Non-governmental Organization
SPOT	Satellite Pour l'Observation de la Terre (*translation: Satellite for Observation of Earth*)
SSRRC	South Sudan Relief and Rehabilitation Commission
UNOCHA	United Nations Organization for the Coordination of Humanitarian Affairs
UNOSAT	United Nations Operational Satellite Applications Program

Geographic Classifications

Boma	Lowest level of local government administration
Payam	Intermediate administrative level including several Bomas
County	Primary administrative level below the State including several Payams
State	Administration of local government including several Counties

SUMMARY

In South Sudan, Warrap State was rated as the most flood-affected state in 2013 and has historically been a critically challenging state in which to provide relief during floods due to inaccessibility. Inaccessibility has also led to a lack of quality data on the location of the most flood-affected communities, needs and vulnerability.

In response to these challenges, the Shelter and Non-food Items Cluster in South Sudan, in partnership with REACH, conducted a flood vulnerability mapping exercise June-August 2013 across Warrap State. This flood vulnerability research in Warrap aims to strengthen the coordination between aid actors during flood emergency responses; to provide information to the South Sudanese government and aid actors and to inform the development of a disaster risk reduction strategy for Warrap State.

The methodology used for this study employed three interrelated steps: (1) identification of inundation areas using remote sensing technology; (2) sampling of flood-prone villages; and (3) primary data collection on the living conditions, flood mitigation and preparedness methods and perceptions of communities in flood prone areas in Warrap State. Descriptive statistics and statistical regressions were run along variables of access to services, displacement, shelter damage, casualties, community perception of impact, and community mitigation and preparedness.

Additionally, a Flood Vulnerability Index (FVI) was created using data on community mitigation and preparedness, leading to a contingency plan for use by the Shelter/NFI Cluster.

The **main findings** from this flood vulnerability mapping exercise are the following:

- The majority of potentially flood-prone villages were located across northern parts of Warrap State, primarily in Twic and Gogrial West counties. Overall, communities reported an increase in both the frequency and the severity of flooding between 2008 and 2012.

- The typology of housing is reported as highly dependent on the local materials available locally, and the availability of building materials is reported as variable according to seasons. The majority of communities use grass (96.6%) and wood (86.2%) for the roofs of their housing, while the vast majority of villages use mud (97.4%) for the walls of their house. Floors are mainly made of mud (93.1%) as well. The source of shelter materials varied across villages, but the main sources were the bush or in the vicinity of the compound (grass, wood, soil, rope, brick and bamboo).

- Surveyed communities report engaging in different housing repair, reinforcement and reconstruction activities at different time periods throughout the year. The seasonality of these activities are important for aid actors to understand in order to provide appropriate mitigation and preparedness responses at appropriate times of the year. At the time of the study, the highest numbers of housing units damaged by flooding were found in Twic and Gogrial West counties.

- With regard to the impact of flooding among the surveyed communities, the average percentage of households displaced outside their boma of origin as a consequence of the floods in 2012 was highest in Twic, Tonj North and Gogrial West Counties. Although most displaced households were reported to have returned, a gap was observed in all counties, with the highest proportion of displaced that never returned seen in Twic County.

- The average number of displaced households was found to vary depending on severity of flooding (since 2008) – where the number of displaced households was higher among communities with a Very High flood severity rating (75-100) compared to those with a High (50-75) and Medium (25-50) rating. The highest average number of displaced households was found among communities with a Low flood severity rating (0-25), suggesting that communities with larger populations tend to be located in areas that were less affected by flooding, or that households in less affected areas found it easier to migrate temporarily as surrounding areas may have been easier to access.

- The preparedness strategy most commonly rated as most effective by the communities was dyke construction (considered the most effective by 68% of communities). The second most efficient preparedness strategy according to communities was water channel construction (considered as the second most efficient by 50% of communities assessed).

- Reconstruction of dykes was most commonly considered as the most effective mitigation method, cited by 36% of communities. Change in mode of livelihood was the second most commonly cited mitigation method (20%) followed by shelter reconstruction and reconstruction of canals.

- With regard to the Flood Vulnerability Index, Twic County has the highest concentration of High and Moderate vulnerability classified villages along the index while Gogrial East and West have higher concentrations at the Low and Moderate ends of the index. Overall, there are 24 villages considered to be highly vulnerable, 68 moderately vulnerable and 43 with low vulnerability classification.

The resulting strategic response and contingency plan outlines specific activities for humanitarian actors and the government to implement both before and during a flood event for each classification of the FVI. Combined with detailed information about location of agencies and supplies/materials available, a full contingency plan can be developed by the Shelter/NFI Cluster.

INTRODUCTION

Climate change poses a particular threat to developing countries due to greater challenges in adapting to an increase in natural disasters compared to countries with higher levels of resources. Given its geographic location, South Sudan has been dramatically affected by an increase in flooding over recent years, posing a challenge to this new country. Most recently, the Greater Horn of Africa Climate Outlook Forum (GHACOF) reported that South Sudan experienced above-normal rains during the 2012 rainy season, which led to flooding that in some parts of the country prompted displacement of thousands of households.

Warrap State in particular has experienced a high level of precipitation in recent years. In September 2013, UN Office for the Coordination of Humanitarian Affairs (UNOCHA) reported that Warrap was affected by flooding in its entirety, making it the most flood affected state in South Sudan in 2013. Interagency rapid assessments, conducted in August 2013, reported that 16,880 people were directly affected. The impact of floods on the population in Warrap remains largely unknown, given that most of the flooded area in the state has been inaccessible at the time of the assessments. The interagency assessments hence relied on figures collected by the South Sudan Relief and Rehabilitation Commission (SSRRC) and Payam authorities.

Lack of accessibility creates significant challenges to an effective humanitarian response in the event of flooding, including ability to identify gaps in the emergency flood response and to determine vulnerability and needs of affected communities affected. In response to these challenges, the Shelter and Non-food Item (Shelter/NFI) Cluster in South Sudan partnered with REACH to conduct a flood vulnerability mapping exercise across Warrap State between June and August 2013.

In South Sudan, the Shelter/NFI Cluster is led by the International Organization for Migration (IOM) and works closely with national and local authorities. REACH facilitated this research as part of its overall standing partnership with the global Shelter Cluster, and with funding from the Common Humanitarian Fund. The REACH team on the ground used technical expertise from IMPACT Initiatives, a Swiss-based organization and operational support from the Agency for Technical Cooperation and Development (ACTED), a French humanitarian and development organization.

The flood vulnerability mapping in Warrap aims to strengthen the coordination between aid actors during flood emergency responses; to provide information to the South Sudanese government and aid actors; and to inform the development of a disaster risk reduction strategy for Warrap State.

This report presents the results of this study, using the analysis to directly inform a contingency plan for humanitarian actors in Warrap State. The following **structure of the report** allows each section to build upon the next:

(1) Review of findings across key variables to inform the creation of a Flood Vulnerability Index;

(2) Consolidation of key variables and presentation of FVI; and

(3) Contingency plan based on the FVI.

METHODOLOGY

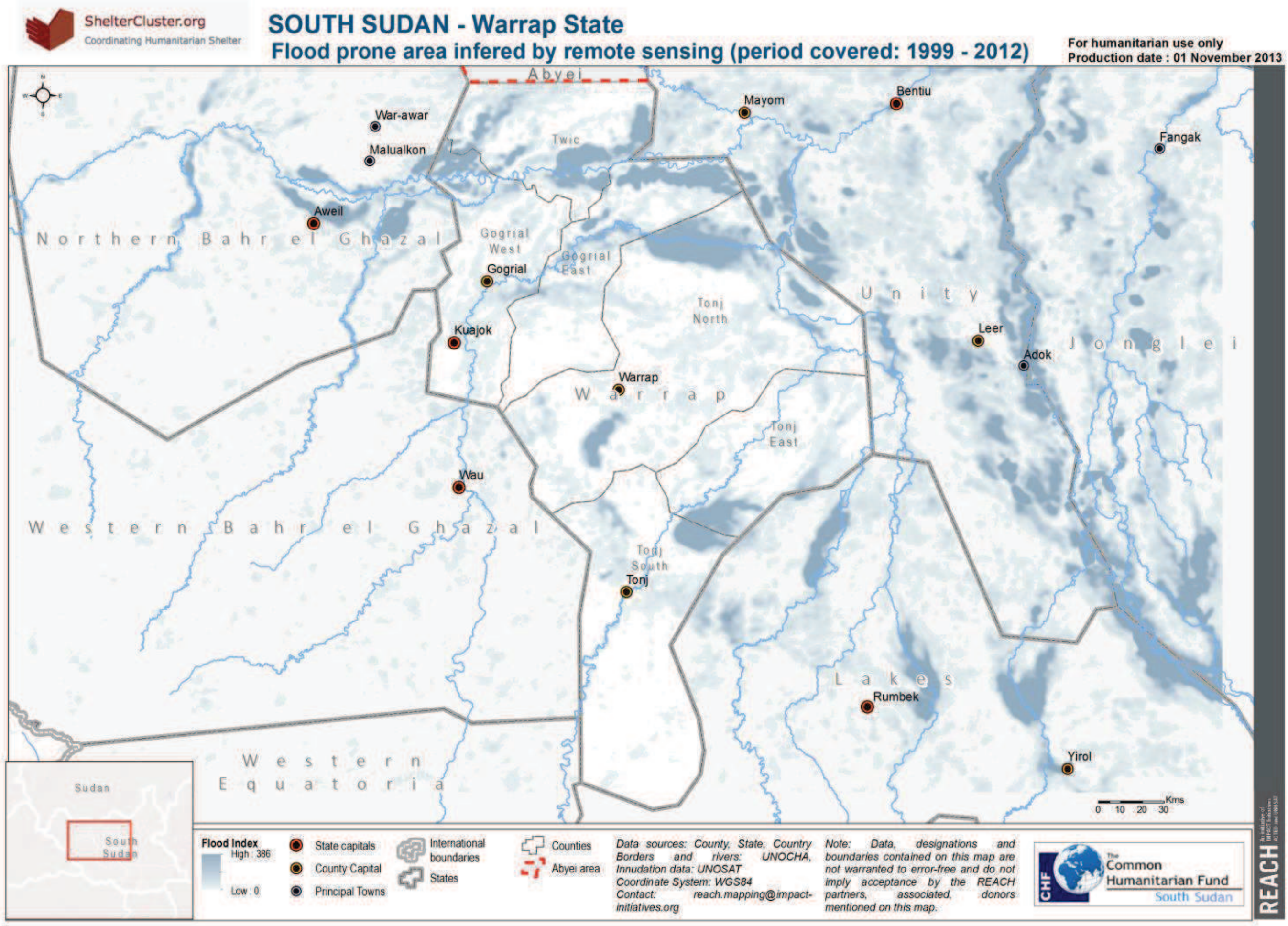
Remote Sensing

The first step in the flood mapping methodology deployed here was the identification of inundation areas in Warrap State using remote sensing technology. Water inundation maps produced by the United Nations Institute for Training and Research (UNITAR) Operational Satellite Applications Programme (UNOSAT) were used to identify flood prone villages.

The UNOSAT water inundation maps were based on satellite imagery collected for the African continent by *Satellite Pour l'Observation de la Terre* (SPOT) satellites from 1999 until 2013. The SPOT images were first processed by the Geoland2 research project to identify areas of water coverage in a one kilometer pixel during 10 day sample periods for each year. To produce the water inundation maps, UNOSAT then analyzed the 10 day sample periods for each year across the entire range of imagery from 1999 until January 2013. Pixels with the 'maximum' (100%) level of flooding indicated that water was present within the km^2 pixel during each of the10 day periods recorded from 1999 until 2013. Correspondingly, pixels with the 'minimum' (1%) level of flooding indicated that water was present within the km^2 pixel during 1% of the 10 days periods.

The inundation dataset thus provided information about the frequency of flooding, from 1999 until 2013. Assuming that areas that were frequently flooded during this period are also likely to be flooded in the future, the inundation dataset indicates which areas are likely to be flooded during the coming years. Map 1 highlights flood prone areas that were identified in Warrap State using the water inundation maps.

Map 1: Flood Prone Area Inferred by Remote Sensing



Sampling

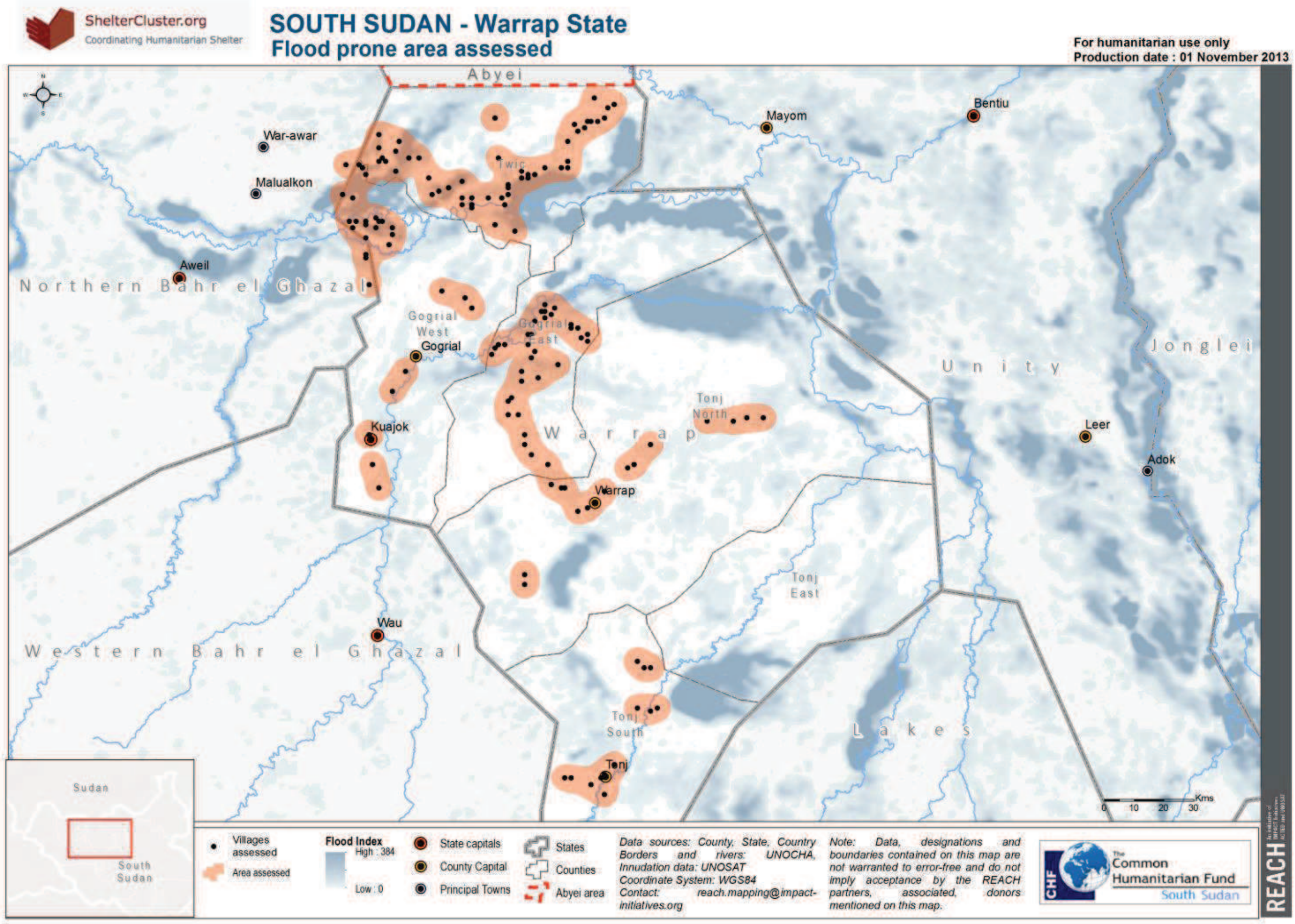
The sampling for primary data collection during the present study was based on: (1) the water inundation data provided by UNOSAT and (2) the UNOCHA data on the geographic location of settlements in Warrap State. By combining the two data sets, 135 villages in flood-prone areas were identified. Areas that had been flooded at least once for 10 consecutive days during the last decade were considered as flood prone.

This methodology was chosen to limit the bias introduced by the satellite imagery. Each pixel in the water inundation map covers an area the size of one square kilometer (1 km^2) and each pixel is considered as flooded if 100% of the surface is covered with water. This low resolution leads to a potential bias in the categorization of flooded areas, given that water is not detected by the satellites where the area flooded is less than km^2. Similarly, where the inundated area covers several pixels but neither in full, the water is not detected, leading to categorization of areas as not flooded. In addition, the geographic data on settlements across South Sudan obtained from UNOCHA was outdated; mainly from a map of 1972, where some locations had not been verified for several decades.

To address these potential biases in the sampling methodology, the field team cross-checked available maps with local authorities and elders, to ensure the villages affected by floods were correctly identified and assessed.

The final sample included 151 villages that were identified as particularly flood prone using the above methodology, representing 63,084 households living in flood prone areas. Map 2 shows the location of the assessed villages. It should be noted that areas of high inundation on the map (dark blue) were found to consist of very few or no villages, suggesting that any previously existing villages had likely moved due to repeated flood events.

Map 2: Flood Prone Areas Assessed



The majority of potentially flood-prone villages were located across northern parts of Warrap State, primarily in Twic and Gogrial West counties. The assessment aimed to assess several villages that were potentially flood prone in Tonj East County but data collection was not possible given inaccessibility to the county due to poor road conditions.

Primary Data Collection

The objective of primary data collection method was to gather information on the living conditions, flood mitigation and preparedness methods and perceptions of communities in flood prone areas in Warrap State. Two data collection tools were designed to facilitate two complementary data collection methods – direct observation and community discussion.

The questionnaires were designed to answer the following research questions:

- How can the efficacy of the emergency response to flooding be improved?
- To what level is the population in flood prone areas exposed to flooding?
- What are the impacts of flooding on the population?
- What are the main modes of preparedness used by the population?
- What are the main mitigation techniques used by the population?
- What type of support is needed from governmental and humanitarian actors?
- What strategy can be implemented to reduce the effect of floods in Warrap State?

Data collection was conducted using mobile data collection technology on the Open Data Kit (ODK) platform. Two teams of three enumerators were deployed to the sample areas over a period of 8 weeks June-August 2013. This time period was chosen, as it coincides with the middle-end of the rainy season and, thus allows for access to villages, while also allowing for collection of information on most recent flood events. All completed questionnaires were geo-referenced and stored in an associated geo-database.

Community Discussion Questionnaire

The objective of the community discussion method was to collect information on the perception of people about the effect of floods on their communities. The tool collected information on the living conditions of communities in flood prone areas across several variables such as shelter damage, access to services and demography of the community. Additionally, the participatory ranking methodology integrated the cultural and local context by asking communities about the perception of the main impact of floods and the most efficient preparedness activities they use to mitigate against the impact of flooding.

Direct Observation Questionnaire

The direct observation questionnaire was used as a way to cross-check information from the community discussion. This tool collected information related to the shelter situation of the communities, including materials used and types of shelter constructed. The tool also elicited information on specific infrastructure constructed to deal with flood hazards. The tool required a recording of the shelter types by photograph, leading to a picture database of shelters that could be used to regroup and verify the main construction materials used by communities.

Flood Vulnerability Index

A flood vulnerability index was designed to assess differences in flood vulnerability across communities included in the present study. The index is based on the hypothesis that communities are more resilient to the effects of flooding if they are prepared and use mitigation techniques to limit the effects. The index includes two components: (1) a mitigation score and (2) a preparedness score. The answers to specific questions in the questionnaires were ranked by the communities from the least efficient to the most efficient. Each community was assigned a cumulative preparedness and mitigation score which were based on the three preparedness and mitigation strategies they had reported using. Ranking of effectiveness of these strategies were supplied by a community ranking exercise.

Communities were asked which preparedness and mitigation techniques they felt were most effective. Based on these responses, mitigation and preparedness techniques were: (1) identified and (2) weighted according to the level of their respective level of efficacy in limiting negative effects of flooding, as determined through ranking by the consulted communities. The preparedness and mitigation scores both ranged from 0 to 9 and were divided into 3 categories: low [0-3]; medium [3-6]; and high [6-9] levels of preparedness/mitigation. An example of the preparedness index is shown below.

Table 1: Preparedness Index

Preparedness	Rank	Weight
Construction of dyke	1	3
Construction of water channel	2	3
Displacement on higher land before the floods	3	3
Preparation of water pond	4	2
Sharing community resources	5	2
Raising the house/compound	6	2
Planting trees to mitigate effect of flood	7	2
Contingency stocks of non-food items	8	2
Protect belonging against floods effect	9	2
Strengthening of the shelter before floods	10	1
Early cultivation	11	1

These two indexes were then combined to create the FVI in order to categorize communities as to their potential vulnerability to flooding. Table 2 shows this matrix.

Table 2: Flood Vulnerability Index

	Mitigation Index		
Preparedness Index	[0,3]	[3,6]	[6,9]
[0,3]			
[3,6]			
[6,9]			

The results can thus be interpreted as follows: a village that has high preparedness and high flood mitigation scores is considered to be more resilient and less vulnerable (highlighted in green in Figure 2) while a village with low preparedness and low mitigation scores would be more vulnerable (highlighted in red in Figure 2).

Housing Design Report

As a complement to this research, a Canadian-based urban planning and design firm – planningAlliance – was commissioned by the Shelter/NFI Cluster and facilitated by REACH and ACTED to conduct a housing design study. This study reviewed current housing construction methods and materials among the same communities covered by this vulnerability study and provided recommendations for flood mitigation construction methods. The resulting report from October 2013 was used to inform the contingency plan contained within this vulnerability study.

Limitations of Methodology

Four main limitations of the methodology for this study were identified:

(1) the remote sensing methodology used only identifies a square kilometer area as flooded if the entire square kilometer area is flooded, hence flood prone areas inside the square kilometer pixels that are not fully flooded are not detected on UNOSAT inundation maps;

(2) Tonj East County was not accessible due to poor road conditions at the time of the assessment;

(3) although the community discussion mode of data collection allows for data to be collected on large populations using limited resources, it restricts the reliability of the information collected as it relies heavily on a select few number of individuals; and

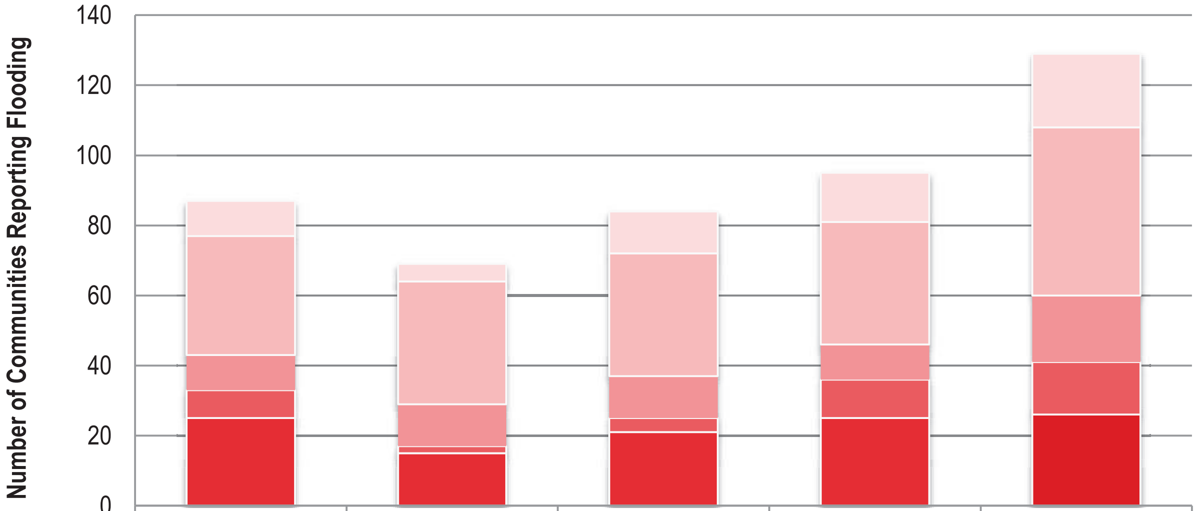
(4) Given limited resources, only 1-2 shelters were assessed in each village, limiting the generalization of observed shelter construction to entire populations (although a Shelter Expert enlisted during the project, concluded that the various types of shelter construction were limited).

FINDINGS

Characteristics and Location of Floods 2008-2012

Overall, communities reported an increase in frequency of flooding between 2008 and 2012[1]. While 87 of 151 assessed communities reported there had been flooding during 2008, this figure rose to 129 during 2012. Figure 1 shows the reported frequency of floods in the assessed communities.

Figure 1: Frequency of Reported Floods (by County)



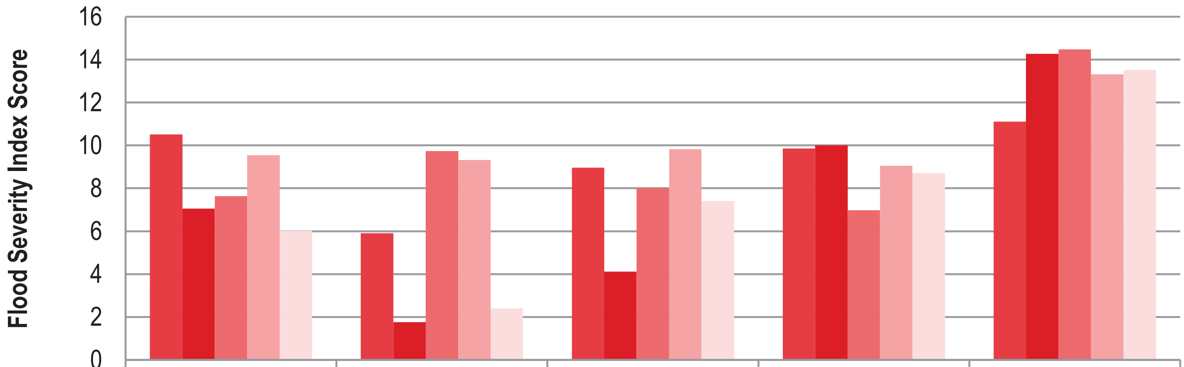
	2008	2009	2010	2011	2012
Gogrial West	10	5	12	14	21
Twic	34	35	35	35	48
Tonj South	10	12	12	10	19
Tonj North	8	2	4	11	15
Gogrial East	25	15	21	25	26

This finding has to be considered with caution given: (1) the possibility of recall bias among community discussion participants who may have found it easier to recall more recent flood events (although flooding in 2008 was perceived to have been significantly more widespread than the following year); and (2) selection bias based on recall bias amongst Payam administrators who may in turn have been more likely to suggest villages that were recently flooded as potential communities to survey. However, NGO key informants also perceived that the level flooding had increased recently with the floods during 2013 perceived as even more severe than those occurring during the preceding years.

In addition to frequency of flooding, the severity of flooding was measured by multiplying the proportion of the community that was flooded by the duration in days of the flooding. The index shows that not only did the incidence of flooding increase in Warrap since 2008 (as seen in Figure 1), the severity of the floods was also perceived to have increased. The Warrap State flood severity index was 8.6 in 2008 and rose to 13.1 in 2012, a reflection of community perception of flooding as longer and more widespread. Figure 2 shows the flood severity score for each Warrap State county over the period 2008-2012.

[1] To estimate the level of flooding in Warrap three main data sources were consulted and triangulated: (1) UNOSAT inundation maps; (2) community discussion groups and; (3) NGO key informants. UNOSAT inundation maps based on satellite imagery and primary data gathered through community discussions. UNOSAT data is not possible to disaggregate by year but yields an average level of flooding during the period. Yearly variation was instead assessed through community discussions, which seemed to indicate an increase in duration and volume of flooding during more recent years

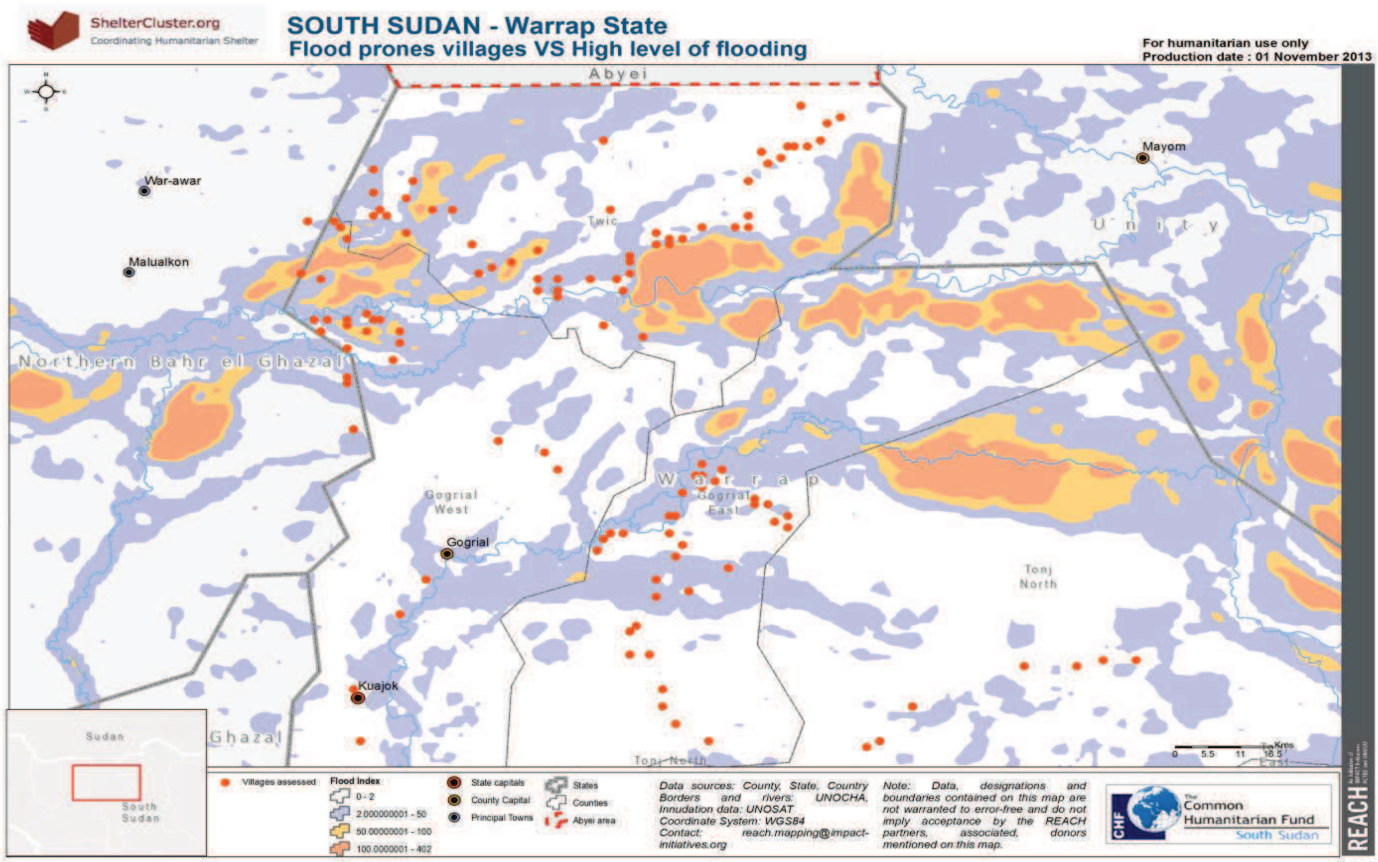
Figure 2: Severity of Floods in Assessed Villages by County (2008-2012)



	2008	2009	2010	2011	2012
Gogrial East	10,51470588	5,902777778	8,958333333	9,861111111	11,11111111
Tonj North	7,058823529	1,764705882	4,117647059	10	14,26470588
Tonj South	7,631578947	9,736842105	8,026315789	6,973684211	14,47368421
Twic	9,545454545	9,318181818	9,818181818	9,045454545	13,31818182
Gogrial West	6,018518519	2,407407407	7,407407407	8,703703704	13,51851852

As mentioned above, UNOSAT inundation maps were used to identify highly flood prone areas. Once in the field, however, areas identified as highly flood prone on UNOSAT inundation maps, were largely found to be uninhabited. This links with the finding explained later that one of the main flood coping strategies for communities is to relocate. Map 3 below shows that across the flood prone areas, communities considered as most affected by floods in the state were actually in 2013 situated outside the most flood prone areas. The major exception to this was in northwestern Warrap State where many communities were located in the highest flood prone areas.

Map 3: Flood-Prone Villages vs High Level Flooding



Housing Typology

In order to inform more effective shelter sector response, information on the types of building materials used, their sources and the seasonal differences in construction activities was collected. Table 3 shows the percentage of villages reporting each construction material type by housing component. The majority of villages use grass (96.6%) and wood (86.2%) for the roofs of their housing, while the vast majority of villages use mud (97.4%) for the walls of their house. Floors are mainly made of mud (93.1%) as well. Some housing units were made of cement and corrugated galvanized iron (CGI) sheets, but were not considered in the analysis as they constituted less than 1% of construction material types.

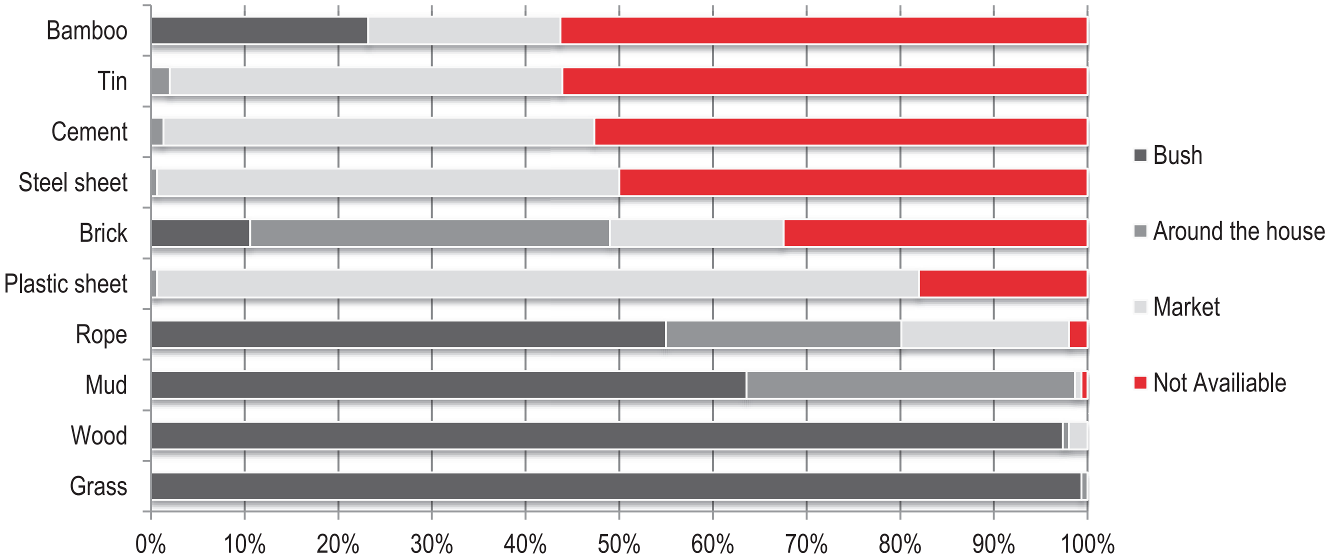
Table 3: Housing Construction Material by Housing Element

	Wall	Floor	Roof
Soil	97.4	93.1	9.5
Bamboo	9.5	0.9	22.4
Wood	59.5	15.5	86.2
Grass	33.6	1.7	96.6

Communities reported containing on average between 3 and 4 housing units within each compound, with on average between 4 and 5 individuals sleeping in one house. No significant variation was found between sub-tribes or counties in Warrap State in the average number of housing units within compounds and average number of individuals sleeping in each house. The most common uses of built units were sleeping, kitchen and food storage.

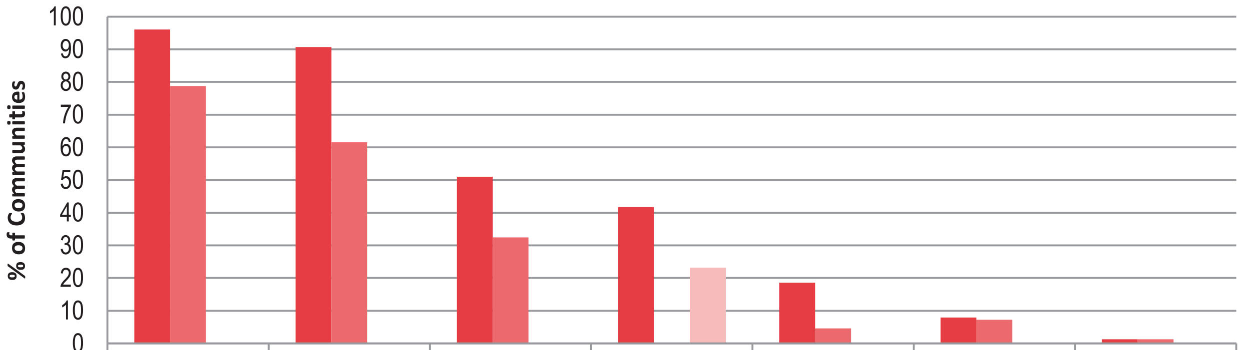
The source of building materials varied across villages, but the main sources were the bush or in the vicinity of the compound (grass, wood, soil, rope, brick and bamboo). Fewer villages cited the local market as the main source of materials, but materials such as tin, cement, steel sheets and plastic sheets were largely sourced from the market.

Figure 3: Housing Material Sources



Unsurprisingly, the typology of housing is reported as highly dependent on the local materials available locally, and the availability of building materials is reported as variable according to seasons. Surveyed communities reported an increase in the price of materials from the market during the rainy season and flood events. Plastic sheeting was reported as having the greatest price increase with 61% of communities reporting an increase of price during the rainy season and 75% of communities reporting an increase of price during the flood events. Steel sheets, cement and tin – all sourced from the market – followed as having price increases.

Figure 4: % of Communities Reporting Shortage of Materials

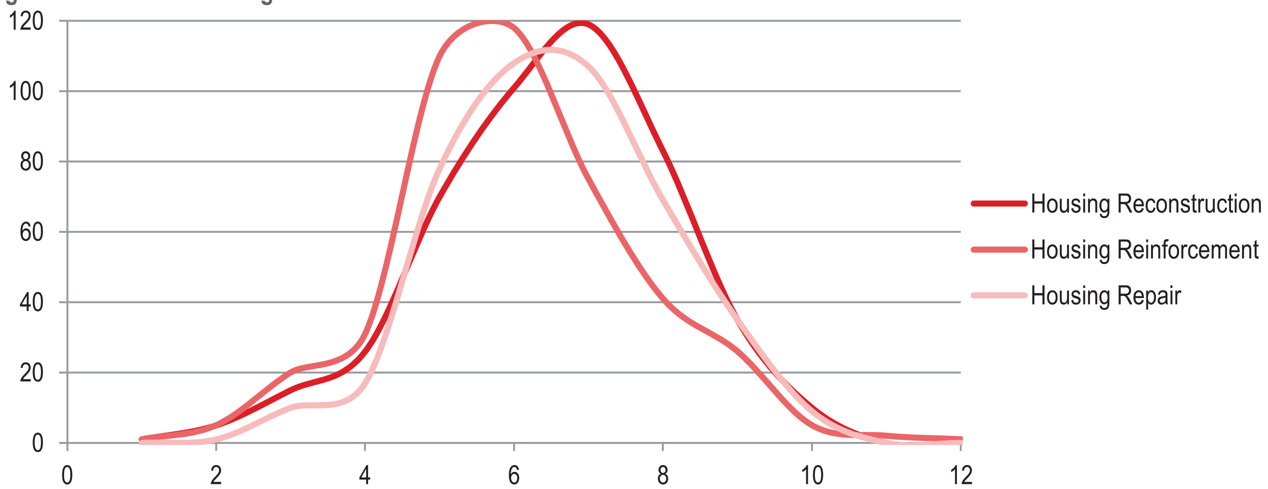


	Grass	Wood	Rope	Soil	Bamboo	Brisck	Tin
Flood	96,02649007	90,72847682	50,99337748	41,7218543	18,54304636	7,947019868	1,324503311
Rain	78,80794702	61,58940397	32,45033113	0	4,635761589	7,284768212	1,324503311
Dry	0	0	0	23,17880795	0	0	0

Given that most communities do not source materials from the market and instead collect them from the bush and in the vicinity of the house, it is more useful to understand which materials are reported as being unavailable or difficult to source. The main building material types of grass, wood, rope and soil are reported as having much higher shortages than other materials, especially during flood events. Figure 4 illustrates the relative shortage of materials during flood, rain and dry seasons. It is important to note that since most of the building materials are reported to be sourced from the bush and in the vicinity of the house, that this has a potential impact on the environment. Intensively using natural resources can lead to deforestation and degradation of soils, among other environmental impacts that can lead to increased flood vulnerability over time. An effective medium-longer term disaster risk reduction solution and relief assistance should include a focus on mitigating environmental impact and promoting sustainable use of natural resources by affected communities.

Interestingly, communities report different housing repair, reinforcement and reconstruction activities during different seasons of the year. Figure 5 illustrates the seasonal differences in housing construction activities starting in September and running until August. Housing reinforcement activities commonly run from December to March; the majority of communities conducting these activities in January. Repair activities run a little later in the dry season – from January to April – with the majority of communities conducting these activities in February. Reconstruction activities run longer throughout the dry season from December to April, but the majority of communities report that they undertake these activities later in the dry season; most commonly in March. These activity times are important for aid actors to understand in order to provide appropriate mitigation and preparedness responses at appropriate times throughout the calendar year.

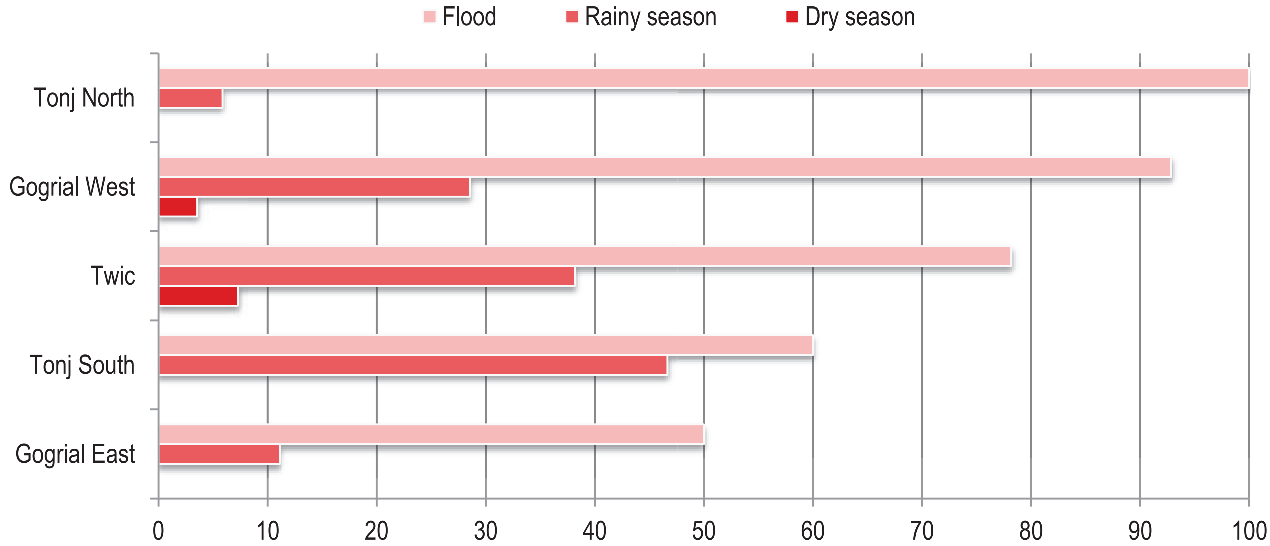
Figure 5: Seasonal Housing Construction Activities



Access to Services

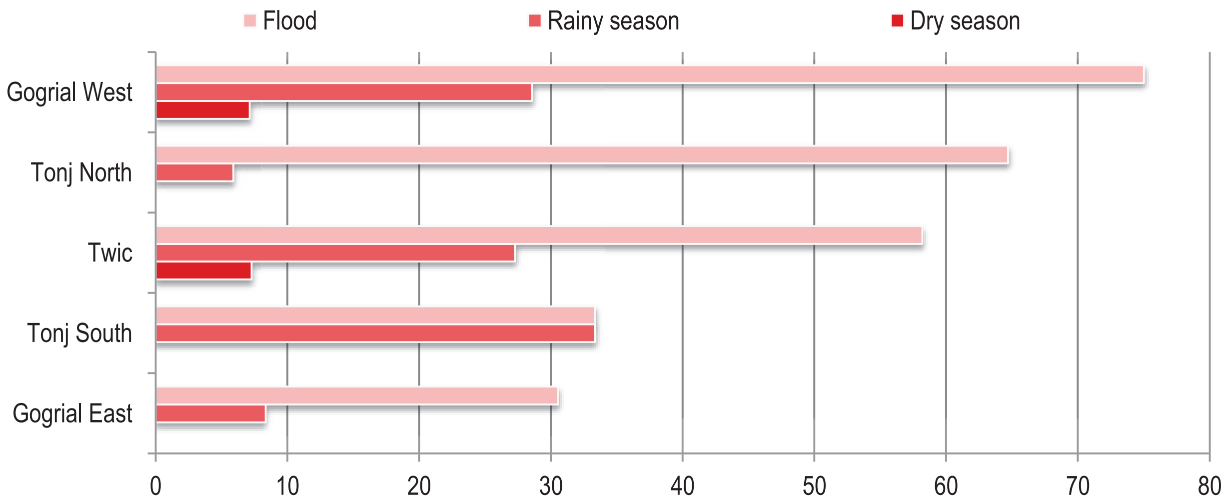
Overall, communities reported that access to services such as markets and health care were severely affected by flooding with some variation depending on county. For market access, communities assessed in Tonj North and Gogrial West were severely affected by lack of access to markets due to flooding during 2012, reported by 100% and 93% of villages, respectively. The rainy season alone, however, rarely caused lack of access to markets among villages in Tonj North (6%) and similarly for a smaller proportion of villages in Gogrial West (29%). In Tonj South, on the other hand, lack of access to markets was reported during the rainy season regardless of flooding by almost half of villages (47%) with flooding restricting access for 60% of villages. Figure 6 illustrates the lack of access to markets by county.

Figure 6: % of Communities Reporting Lack of Access to Markets



As far as health care access, communities assessed in Gogrial West and Tonj North were most likely to report a lack of access to health care services brought on by flooding; 75% and 65% of communities, respectively. Similar to market access, the rainy season alone caused little restriction for villages in Tonj North (6%) and to a lesser extent in Gogrial West (29%). In Tonj South, access to health care services was affected by the rainy season in 33% of cases, with the addition of flooding making no difference (33%). Figure 7 illustrates the lack of access to health care centers by county.

Figure 7: % of Communities Reporting Lack of Access to Health Care Centers

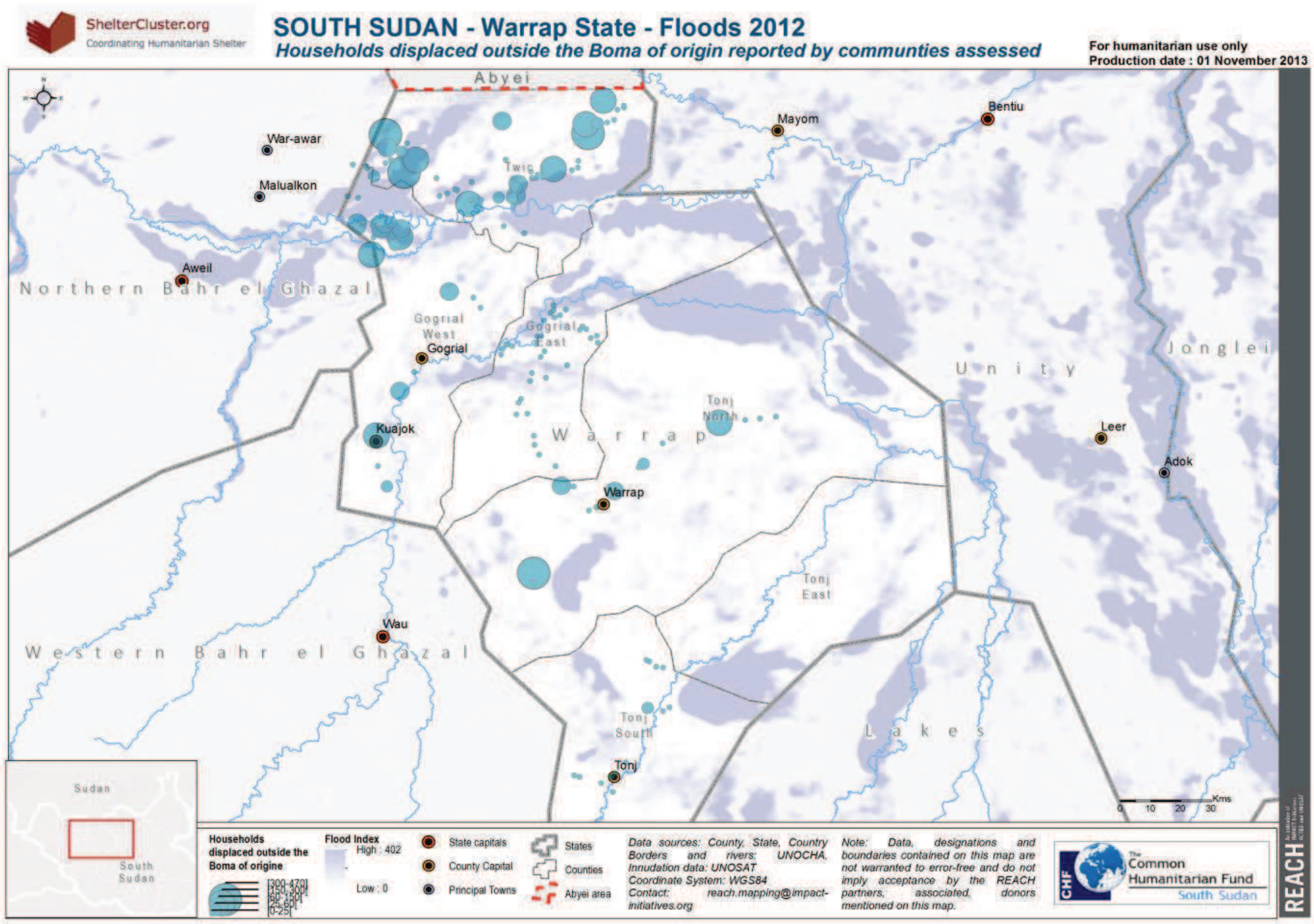


Flood Impact

Displacement

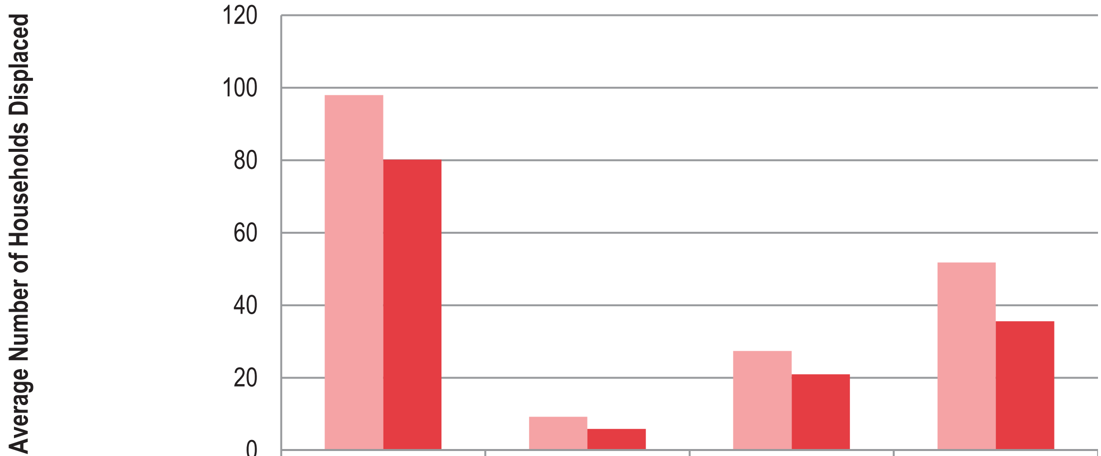
Among the surveyed communities, the average percentage of households displaced outside their boma of origin as a consequence of the floods in 2012 was highest in Twic, Tonj North and Gogrial West Counties. Although most displaced households were reported to have returned, a gap was observed in all counties, with the highest proportion of displaced that never returned seen in Twic County (14.4%). Map 4 illustrates the number of households displaced outside the Boma of origin per village.

Map 4: Households Displaced Outside Boma of Origin



The average number of displaced households was found to vary depending on severity of flooding (since 2008) – where the number of displaced households was higher among communities with a Very High flood severity rating (75-100) compared to those with a High (50-75) and Medium (25-50) rating. Interestingly, the highest average number of displaced households was found among communities with a Low flood severity rating (0-25). This could indicate that communities with larger populations tended to be located in areas that were less affected by flooding. It may also be the case that households in less affected areas found it easier to migrate temporarily as surrounding areas may have been easier to access. Figure 8 illustrates the number of households displaced outside the boma of origin by flood severity index.

Figure 8: Average Number of Households Displaced Outside Boma of Origin by Flood Severity Index



	(0,25]	(25,50]	(50,75]	(75,100]
Households dispalced outside the Boma	97,92	9,197368421	27,32352941	51,8
Household returns	80,12	5,868421053	20,97058824	35,53333333

Housing Damage

The highest proportions of housing damage caused by flooding were found in Twic and Gogrial West counties. On average, 135 housing unit were reported to have been damaged in Twic communities and 83 housing units were said to have been damaged in Gogrial West communities. In contrast, communities surveyed in Tonj South reported the lowest average damage to the housing stock (42).

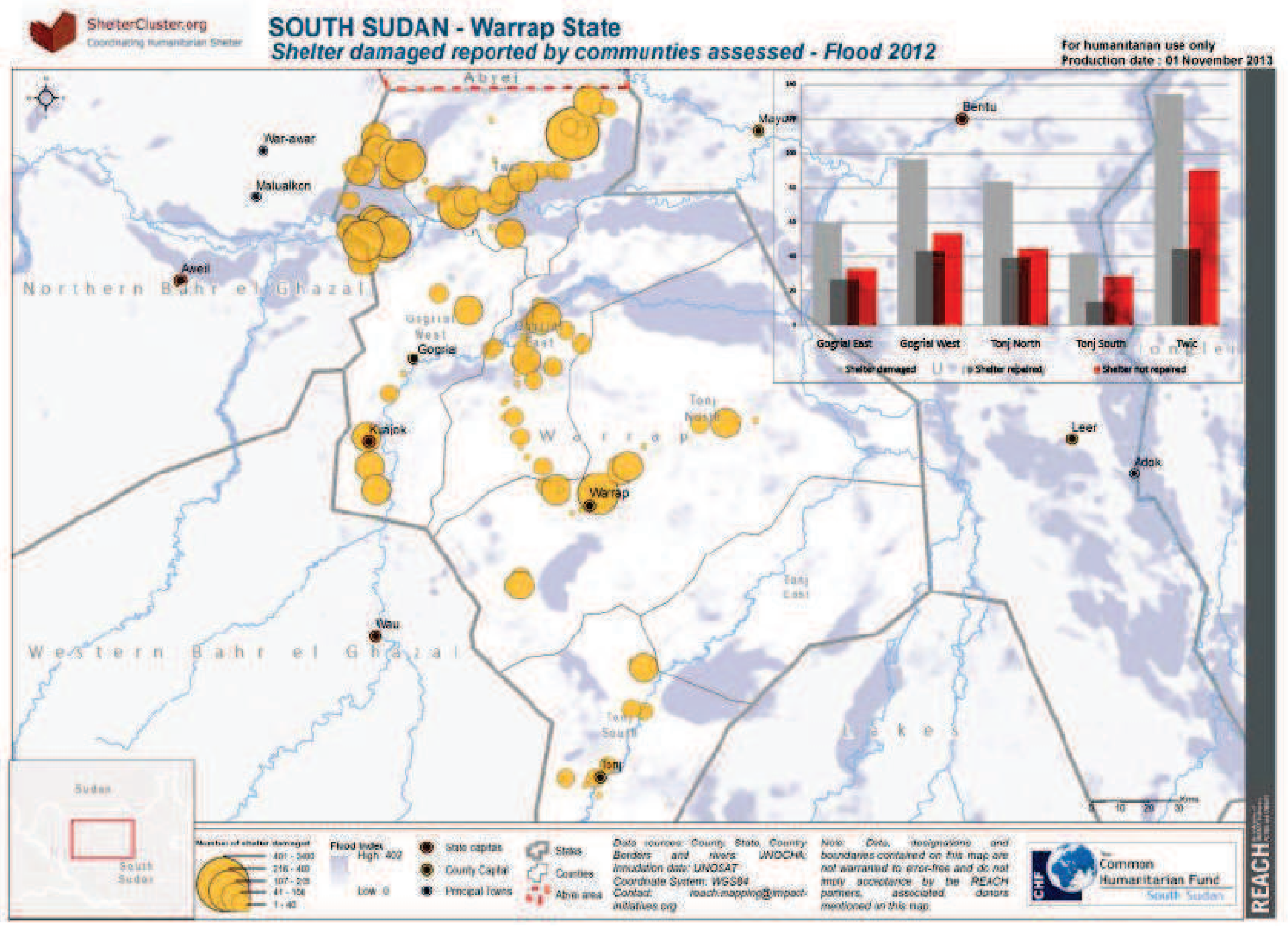
More than half of damaged housing units had been repaired across all counties, with the highest proportion of repaired houses found in Twic and Tonj South, where 67% of damaged houses were said to have been repaired. The lowest proportion of repaired houses was found in Tonj North (53%). Table 4 shows the numbers of houses damaged and assesses the percentage of houses not repaired.

Table 4: Shelter Damage & Repair by County

County	# Shelters damaged	# Shelters repaired	# Shelters not repaired	% of Shelters not repaired
Gogrial East	59	27	33	55%
Gogrial West	97	43	53	55%
Tonj North	84	39	44	53%
Tonj South	42	14	28	67%
Twic	135	44	90	67%
Total	**95**	**36**	**58**	**61%**

As noted earlier, materials used for housing construction were observed to be the same across all counties, hence the difference in the number of damaged housing units must be explained by other factors, such as the severity of floods.

Map 5: Reported Shelter Damage by Communities Assessed



Casualties

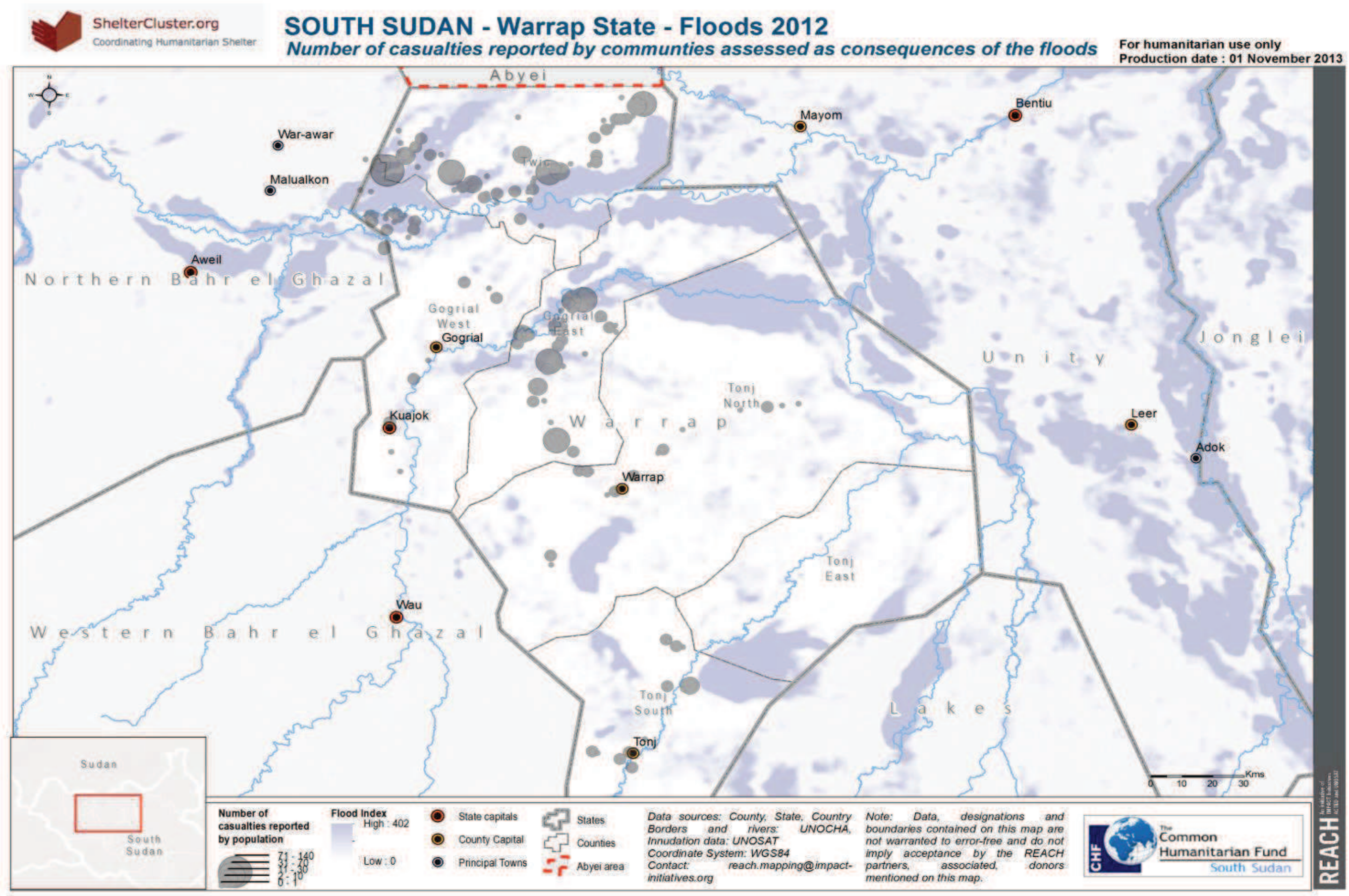
Communities assessed in Twic County reported the highest number of casualties with 449 individuals reported to have died as a consequence of the 2012 floods, followed by Gogrial West (292) people. This amounted to 8 individuals on average per community in each county, respectively. The lowest total number of casualties was reported in Tonj North county (24), with on average 2 casualties per community.

Linear Regression – Access to Health Centers and Casualties

Significant variation was found in reported casualties due to flooding across the following variables: (1) severity of flooding; (2) health care access; and (3) market access. The key findings include:

- An increase of one point on the flood severity index was associated with a 0.2% increase in the proportion of casualties due to flooding during 2012, controlling for access to health care and markets.
- Reported lack of access to health care centers due to flooding was associated with a 4% increase in proportion of casualties due to flooding, controlling for severity of flooding and access to markets.

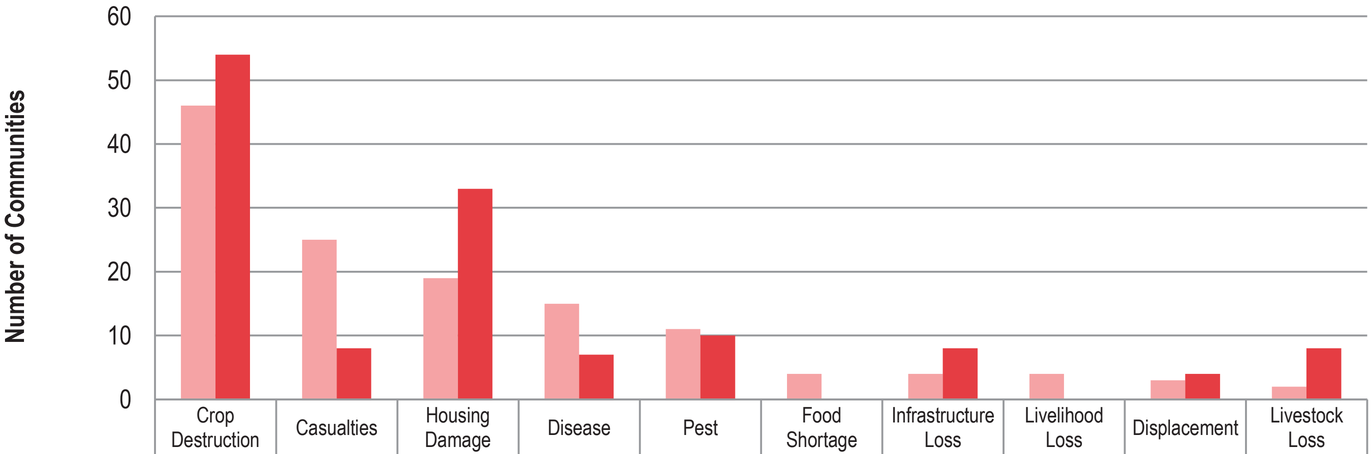
Map 6: Number of Casualties as a Consequence of Floods



Perceived Impact of Flooding on Communities

The primary impact of flooding according to the communities assessed was the destruction of crops which was rated as the main impact by 34% of communities. Casualties was the second most often reported primary impact, rated as the main impact by 19% of communities, followed by destruction or damage of houses which was rated as primary impact by 14% of communities. The secondary impacts according to the assessed communities were crop destruction (reported by 40%); destruction of houses (24%); and casualties (7%). Figure 9 illustrates these results.

Figure 9: Primary and Secondary Impact of Flooding Reported by Communities



	Crop Destruction	Casualties	Housing Damage	Disease	Pest	Food Shortage	Infrastructure Loss	Livelihood Loss	Displacement	Livestock Loss
Main Impact	46	25	19	15	11	4	4	4	3	2
Second Main Impact	54	8	33	7	10	0	8	0	4	8

Preparedness & Mitigation Strategies

Preparedness

Although crop destruction was the most commonly cited primary impact of flooding, a correspondingly small proportion of communities reported preparedness measures against crop destruction as their main preparedness measure – only 1.5% of communities said early cultivation was their main preparedness strategy. An additional 3.7% of communities reported early cultivation as their secondary preparedness strategy.

During the participatory rating exercise, the preparedness strategy most commonly rated as most effective by the communities was dyke construction (considered the most effective by 68% of communities). The second most efficient preparedness strategy according to communities was water channel construction (considered as the second most efficient by 50% of communities assessed). Most of the villages that mentioned dyke construction as the most effective preparedness strategy mentioned water channel construction as the second most efficient preparedness strategy. Table 5 illustrates these results.

Table 5: Community Preparedness Strategies

Preparedness Strategy	% reported as Primary strategy	% reported as Secondary strategy	% reported as Third strategy
Construction of dykes	68%	13%	4%
Construction of water channel	17	51	13
Resource sharing	7	3	4
Construction of water storage	2	2	3
Displacement	2	12	24
Early cultivation	1	4	0
Leveling compound	1	1	4
Contingency items	1	0	9
Protection of belongings	0	3	0
Tree plantation	0	1	1
Housing reinforcement	0	1	0

When looking at the effect of preparedness strategies on other variables, there are interesting results associated with displacement and level of housing damage. Through linear regression modeling, it was found that:

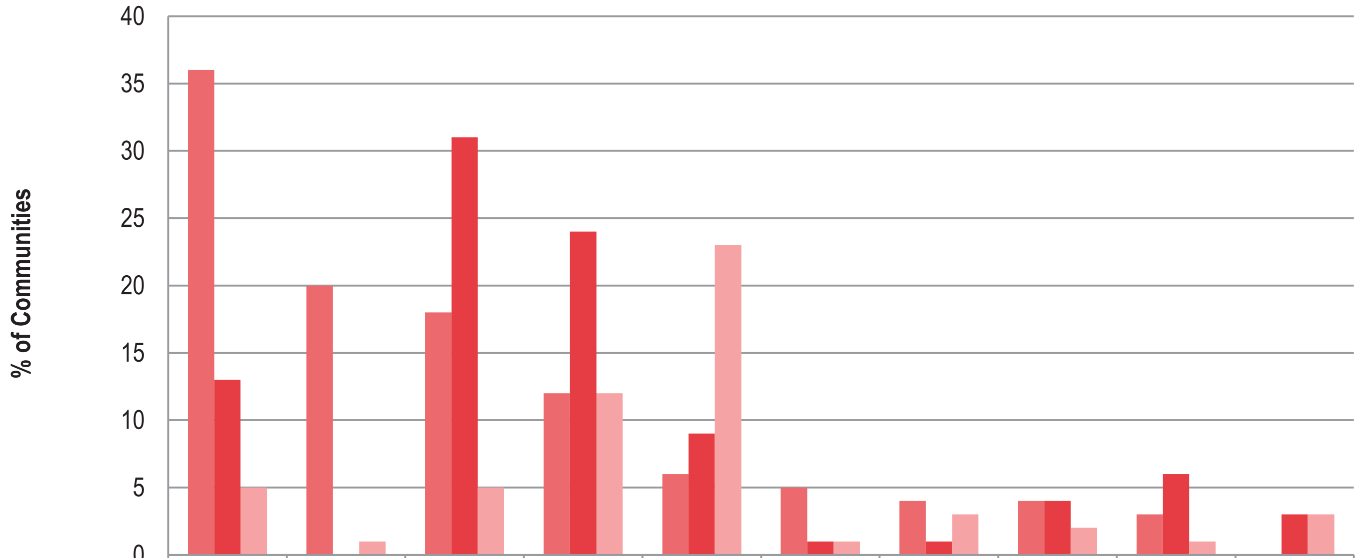
- Migration as a preparedness strategy has a significant negative effect on the number of reported casualties. In other words, migration is associated with a decrease in the number of reported casualties.
- Construction of dykes before flooding was found to be associated with lower levels of displacement outside the Boma of origin (migration). Communities where dykes were constructed had on average 32 fewer displaced households.
- Construction of a water channel also reduced displacement outside the Boma of origin (migration). Communities constructing water channels had on average 31 fewer displaced households than those that had not constructed water channels.
- Communities that reported constructing dykes in public spaces and around compounds also experienced a higher level of housing damage. This counter intuitive finding may simply be due to the fact that communities that were constructing dykes did so because they were overall more severely affected by flooding than those that did not, hence being more at risk of housing damage.

Mitigation

Reconstruction of dykes was most commonly considered as the most effective mitigation method, cited by 36% of communities. Change in mode of livelihood was the second most commonly cited mitigation method (20%) followed by shelter reconstruction and reconstruction of canals.

Interestingly, communities that mentioned reconstruction of dykes as a mitigation strategy in the event of flooding were less likely to have had shelters damaged and were more likely to have had a lower number of displaced people. On the other hand, communities that mentioned a change of livelihood as a mitigation strategy were more likely to report a higher number of displaced households.

Figure 10: Mitigation Methods Used by Assessed Communities (%)



	Dyke Recon.	Livelihood Change	Housing Recon.	Canal Recon.	Displacement	Comm. Infra. Recon.	Humanitarian	Protection of Belongings	Sharing Resources in Comm.	Leveling of Compound
1st Effective Method	36	20	18	12	6	5	4	4	3	
2nd Most Effective Method	13		31	24	9	1	1	4	6	3
3rd Most Effective Method	5	1	5	12	23	1	3	2	1	3

Linear Regression – Mitigation Methods, Housing Damage and Displacement

When looking at the effect of preparedness strategies on other variables, there are interesting results associated with displacement and housing damage. Through linear regression modeling, it was found that:

- Communities where dykes were reportedly reconstructed following the floods reported a lower level of displacement. Reconstruction of dykes was associated with on average 291 fewer households being displaced as consequence of the floods, a significant effect which remained when comparing communities that experienced the same severity of flooding.
- Similarly, communities where water channels were reportedly reconstructed after the floods also reported a lower level of displacement. On average 273 fewer households were displaced as consequence of the floods, an effect that remained when comparing communities that experienced the same severity of flooding.

Flood Vulnerability Index

As mentioned above, a flood vulnerability index was designed to assess differences in flood vulnerability across communities included in the present study. The index is based on the hypothesis that communities are more resilient to the effects of flooding if they are prepared and use mitigation techniques to limit the effects. The index includes two components: (1) a mitigation score and (2) a preparedness score. The answers to specific questions in the questionnaires were ranked by the communities from the least efficient to the most efficient. Each community was assigned a cumulative preparedness and mitigation score which were based on the three preparedness and mitigation strategies they had reported using. Ranking of effectiveness of these strategies were supplied by a community ranking exercise.

Communities were asked which preparedness and mitigation techniques they felt were most effective. Based on these responses, mitigation and preparedness techniques were: (1) identified and (2) weighted according to the level of their respective level of efficacy in limiting negative effects of flooding, as determined by the consulted communities.

The preparedness and mitigation scores both ranged from 0 to 9 and were divided into 3 categories: low [0-3]; medium [3-6]; and high [6-9] levels of preparedness/mitigation. These two indexes were then combined to create the FVI in order to categorize communities as to their potential vulnerability to flooding. Table 6 shows this matrix.

Table 6: Flood Vulnerability Index

	Mitigation Index		
Preparedness Index	[0,3]	[3,6]	[6,9]
[0,3]			
[3,6]			
[6,9]			

The results can thus be interpreted as follows: a village that has high preparedness and high flood mitigation scores is considered to be more resilient and less vulnerable (green in Table 6) while a village with low preparedness and low mitigation scores would be more vulnerable (red in Table 6).

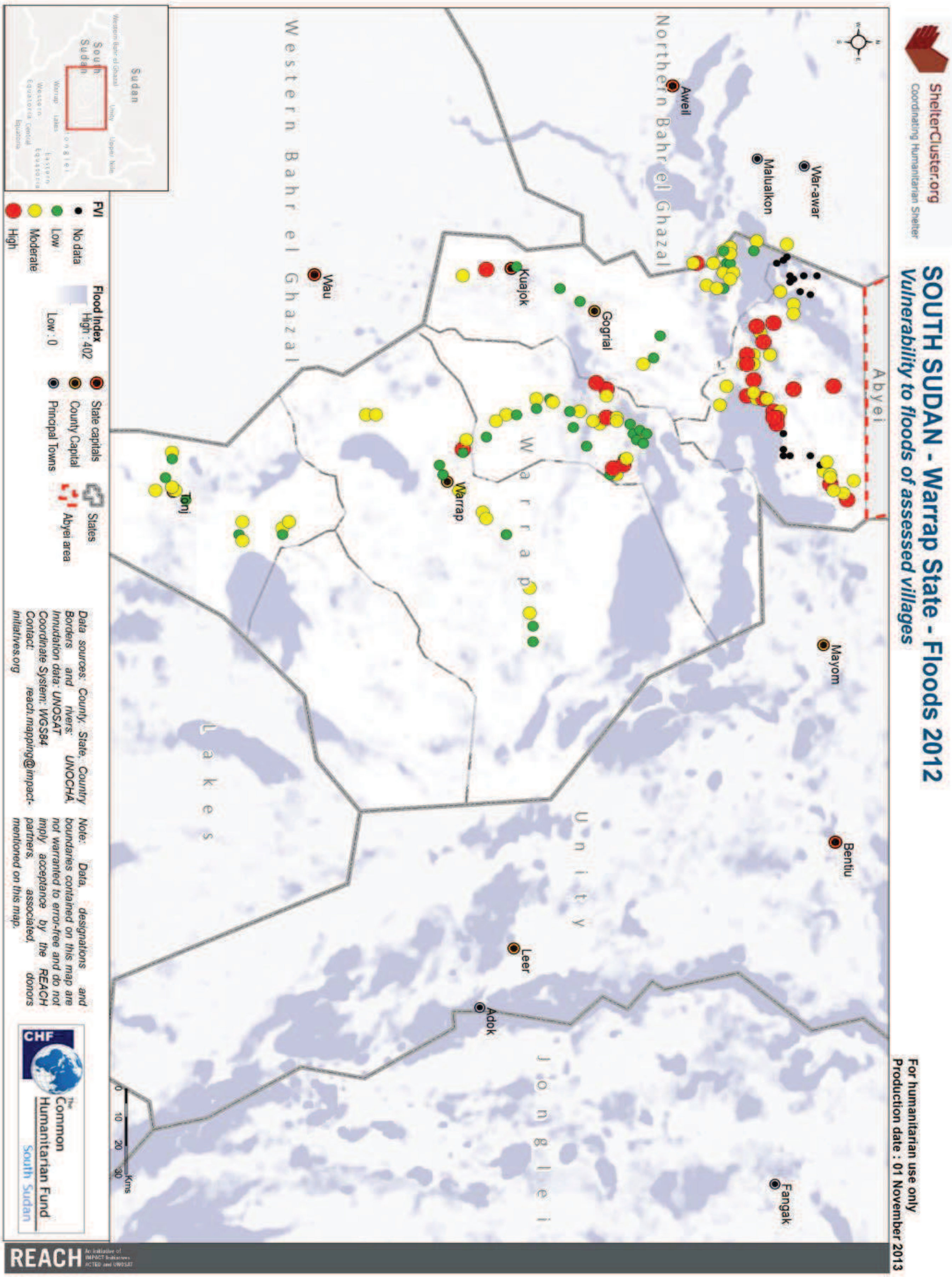
Map 7 (next page) illustrates the results of the classification of each assessed village according to the FVI. Here it can be seen that Twic County has the highest concentration of High and Moderate vulnerability classified villages along the index while Gogrial East and West have higher concentrations at the Low and Moderate ends of the index. Overall, as seen in Table 7, there are 24 villages considered to be highly vulnerable, 68 moderately vulnerable and 43 with low vulnerability classification.

Table 7: FVI Village Classification

FVI Classification	Number of Villages[1]	Number of Households
High	24	8335
Moderate	68	27597
Low	43	15390
Grand Total	**135**	**51322**

[1]Not all sampled villages have been included in the classification due to unreliable data for 16 villages (see Annex 1).

Map 7: Flood Vulnerability Index by Community



CONTINGENCY PLAN

The following contingency plan is the result of analysis of the key results alongside the Flood Vulnerability Index (FVI). This contingency plan is intended to provide humanitarian actors with information about activities to be carried out both before and during a flood event.

By using classification information for each assessed village and combining it with both the preparedness/mitigation activities already used by communities and information on support requested by communities, discreet activities were developed for each FVI classification[2]. An annotated list of villages, their classifications and key information about individual village needs and requests can be found in Annex 1. Three maps outlining the FVI classification of each village can be found in Annex 2.

The proposed contingency plan comprises activities are organized by FVI classification for both before and during a flood event. Each activity grouping includes a description. The Shelter and NFI Cluster in South Sudan will be responsible for identifying NGOs responsible for carrying out the suggested activities and deadlines.

These activities are part of a multi-sectoral strategic response plan informed by the previously outlined analysis. While some of these activities are not specifically related to the shelter sector (e.g. building dykes), they directly impact housing in flood prone areas and should be considered during any flood mitigation programming for shelter.

This section also draws on information contained within the separate Housing Design Report (October 2013) also commissioned by the Shelter/NFI Cluster and facilitated by REACH and ACTED. Information contained within the report on raising compounds/shelters, construction methods and required materials directly inform some of the activities below.

Activities to Be Carried Out Before a Flood Event

The following activities are intended to be carried out before a flood event. Using the information found in Tables 8 and 9, preparedness activities were developed for each classification of the FVI.

Table 8: Preparedness Methods Used by Communities (Number of Communities)

FVI	Water Channels	Dykes	Raising of compound/house	Shelter Preparation	Preventive displacement
High	9	18	1	0	2
Moderate	55	55	7	3	37
Low	41	41	5	0	19
Grand Total	**105**	**114**	**13**	**3**	**58**

Table 9: Support Requested Before Floods (Proportion of Communities Assessed)

FVI	DRR	Food	NFI	Others	Vegetation plantation	WASH	Grand Total
High	69.57%	17.39%	13.04%	0.00%	0.00%	0.00%	100.00%
Moderate	47.27%	25.45%	23.64%	1.82%	1.82%	0.00%	100.00%
Low	57.50%	10.00%	7.50%	5.00%	15.00%	5.00%	100.00%
Grand Total	**55.08%**	**18.64%**	**16.10%**	**2.54%**	**5.93%**	**1.69%**	**100.00%**

[2] It should be noted that, due to the lack of updated information regarding human resources and logistical capacity of cluster partners, this plan rests on the assumption that partners have unlimited capacity and are willing to participate. Geographic information about stocks and locations of humanitarian actors was not available for this study, thus it remains the Shelter/NFI Cluster's responsibility to use the information contained within this study in order to inform locations and agency responsibilities for pre-positioning and response.

Flood Vulnerability HIGH

Representing 24 villages (8,335 HH) across 4 of the counties assessed. Based on: (1) preparedness methods used by the communities and (2) the support the communities recommended, the following 6 activities have been identified:

#	Activity
1	Building of dykes in 6 communities that had not constructed dykes (could be conducted as food for asset activities)[3]
2	Building of water channels in 15 communities that had not constructed water channels (could be conducted as food for asset activities)[4]
3	Raising compound/housing units in all 24 villages (see the Housing Design Report for recommendations on how to raise buildings/compounds and required materials)
4	Reinforcing housing units in all 24 villages (see Housing Design Report for advice on recommended construction methods and materials)
5	Prepositioning of NFI kits in villages that are most difficult to access from current NGO bases during the rainy season (by creating committees in charge of the storage and distribution) in case of an emergency[5]
6	Prepositioning of shelter relief aid materials in villages the most difficult to access (by creating committees in charge of the storage and distribution) in case of an emergency[6]

Flood Vulnerability MEDIUM

Representing 68 villages (27,597 HH) across 4 of the counties assessed. Based on: (1) preparedness methods used by the communities and (2) the support the communities recommended, the following 4 activities have been identified:

#	Activity
1	Building of dykes in 12 communities that had not constructed dykes (could be conducted as food for asset activities)
2	Building of water channels in 12 communities that had not constructed water channels (could be conducted as food for asset activities)
3	Raising compound/housing units in 68 villages (see the Housing Design Report for recommendations on how to raise buildings/compounds and required materials)
4	Reinforcing housing units in 68 villages (see Housing Design Report for advice on recommended construction methods and materials)

[3] See Annex 1 for village names
[4] See Annex 1 for village names
[5] NGO locations not known at the time of the study so villages could not be identified
[6] NGO locations not known at the time of the study so villages could not be identified

Flood Vulnerability LOW

Representing 43 villages (15,390 HH) across 4 of the counties assessed. Based on: (1) preparedness methods used by the communities and (2) the support the communities recommended, the following 2 activities have been identified:

No.	Activity
1	Raising compound/housing units in 43 villages (see Housing Design Report for recommendations on how to raise buildings/compounds and required materials)
2	Reinforcing housing units in 43 villages (see Housing Design Report for advice on recommended construction methods and materials)

Activities to Be Carried Out During a Flood Event

The following activities are intended to be carried out during a flood event. Using the information found in Tables 10 and 11, mitigation activities were developed for High and Moderate classifications of the FVI – it is assumed that Low FVI classifications would not need prioritized assistance.

Table 10: Mitigation Methods Used by Communities (Number of Communities)

FVI	Displacement	Change in livelihood	Shelter reconstruction	Reconstruction water channel	Reconstruction of dykes	Raising compound
High	6	0	2	6	7	2
Moderate	9	1	16	22	28	5
Low	24	22	32	20	19	6
Grand total	**39**	**23**	**50**	**48**	**54**	**13**

Table 11: Support Requested During Floods (Proportion of Communities Assessed)

FVI	DRR	Food	NFI	Shelter	WASH	Grand Total
High	50.00%	18.75%	6.25%	25.00%	0.00%	100.00%
Moderate	21.05%	50.88%	12.28%	14.04%	1.75%	100.00%
Low	14.29%	69.05%	4.76%	11.90%	0.00%	100.00%
Grand Total	**22.61%**	**53.04%**	**8.70%**	**14.78%**	**0.87%**	**100.00%**

Flood Vulnerability HIGH

Representing 24 villages (8,338 HH) across 4 of the counties assessed. Based on: (1) preparedness methods; (2) mitigation methods used by the communities; and (3) the support the communities recommended, the following 5 activities have been identified:

#	Activity
1	Distribution of shelter materials for affected villages
2	Distribution of NFI kits for affected households
3	Rebuilding/maintenance of dykes in 24 communities that need to reconstruct dykes (could be conducted as food for asset activities)[7]
4	Rebuilding/maintenance of water channels in 24 communities that need to reconstruct water channels (could be conducted as food for asset activities)[8]
5	Raising compound/housing units in all 24 villages (see the Housing Design Report for recommendations on how to raise buildings/compounds and required materials)
6	Reinforcing housing units in all 24 villages (see Housing Design Report for advice on recommended construction methods and materials)

Flood Vulnerability MEDIUM

Representing 68 villages (27,597 HH) across 4 of the counties assessed. Based on: (1) preparedness methods; (2) mitigation methods used by the communities; and (3) the support the communities recommended, the following 4 activities have been identified:

#	Activities
1	Rebuilding/maintenance of dykes in communities that need to reconstructed dykes (could be conducted as food for asset activities)
2	Rebuilding/maintenance of water channels in communities that need to reconstructed water channels (could be conducted as food for asset activities)
3	Maintenance and raising of compound/housing units in 68 villages (see the Housing Design Report for recommendations on how to raise shelter/compounds and required materials)
4	Reinforcing housing units in 68 villages (see Housing Design Report for advice on recommended construction methods and materials)

[7] See Annex 1 for village names
[8] See Annex 1 for village names

ANNEXES

Annex 1: List of Communities Assessed with FVI Classification

Tong South County	
Village	FVI score
Aguka	Moderate
Genanyuon	Moderate
Kombania	Moderate
Mabior yar	Moderate
Madol	Moderate
Maper	Moderate
Moragoor	Moderate
Wanh_Alel	Moderate
Warcuei	Moderate
Warwut	Moderate
Abar	Low
Madhal	Low
Majok	Low
Piok koi	Low
Waratit	Low

Tong North County	
Village	FVI score
Gumeer	High
Ageeny	Moderate
Aricdeng	Moderate
Athieng poul	Moderate
Guac_Awan	Moderate
Jur-ciek	Moderate
Managul	Moderate
Marial abuok	Moderate
Rual malith	Moderate
Apuor	Low
Bundir	Low
Kondok	Low
Lil-keet	Low
Majok	Low
Mariik	Low
Panthiou	Low
Roor-kou	Low

Gogrial East County	
Village	FVI score
Manyiel	Very high
Nyang	Very high
Panroor	Very high
Puoth-kuel	Very high
Buk Agok	High
Abyei	Moderate
Bulic	Moderate
Chueicirar	Moderate
Hal ajak	Moderate
Lang	Moderate
Liet Chan	Moderate
Majok amal	Moderate
Mayom chol	Moderate
Pathuon	Moderate
Roorcol	Moderate
Rumjual	Moderate
Toch	Moderate
Wun_Liet	Moderate
Wunchuei	Moderate
Yiikadoor	Moderate
Agagal	Low
Agor	Low
Alabek	Low
Anapriang	Low
Bolich	Low
Kual _kou	Low
Lil_Athian	Low
Mading akot	Low
Maluth	Low
Mangok	Low
Pagoot	Low
Panhomaker	Low
Roor mayom	Low
Tit Agok	Low
Tuong Adoor	Low
War Nyang	Low

Gogrial West County	
Village	**FVI score**
Rumdhol	High
Panrang	High
Makuac payum	Moderate
Majakkou	Moderate
Wet-buol	Moderate
Malek	Moderate
Lake_Yangyom	Moderate
War_Mabwoit	Moderate
Maper agal	Moderate
Nyinlir	Moderate
Milo	Moderate
Achierchok	Moderate
Tiit majak	Moderate
Adutbul	Moderate
Arany piny	Low
Ridic village	Low
Makuei village	Low
Powang	Low
Cuom-lual	Low
Adeer	Low
Thur	Low
Majok	Low
Kar-ajak	Low
Mayen_Pajok	Low
Adun	Low
Totin	Low
Kuajok	Low

Twic County	
Village	**FVI score**
Rumajing	Very high
Toch yoou	Very high
Achol khor	Very high
Manoor akol	Very high
Abei	Very high
Audhap	High
Mayne-guotjuol	High
Ayen	High
Mayen haal	High
Wuncum	High
Makuei-yuou	High
Mangok Amuol	High
Ahot	High
Mayen	High
Mathiang aheer	High
Audhur	High
Managok	Moderate
Panyimo	Moderate
Achakoi	Moderate
Liil	Moderate
Mangok Pannot	Moderate
Ayikou	Moderate
Lien village	Moderate
Aweei village	Moderate
Manyiel	Moderate
Liil 1	Moderate
Pakot	Moderate

Twic County	
Village	**FVI score**
Toch tiit	Moderate
Awany	Moderate
Akoc deng bol	Moderate
Machar agep	Moderate
Mayen- jang	Moderate
Wang lath	Moderate
Gomguoi	Moderate
Muolbang	Moderate
Long aheer	Moderate
Nyanaluel	Moderate
Gok/kueth dhiac	Moderate
Guok village	Moderate
Majok noon	"-"
Pan tiok	"-"
Adindaw	"-"
Fan_Agork	"-"
Muor	"-"
Man-nyuar	"-"
Aweng	"-"
Aluel village	"-"
Wunchum	"-"
Apapping village	"-"
Matdiar	"-"
Akoc	"-"
Akok village	"-"
Akec piny	"-"
Rum Akoon	"-"
Pajaka	"-"

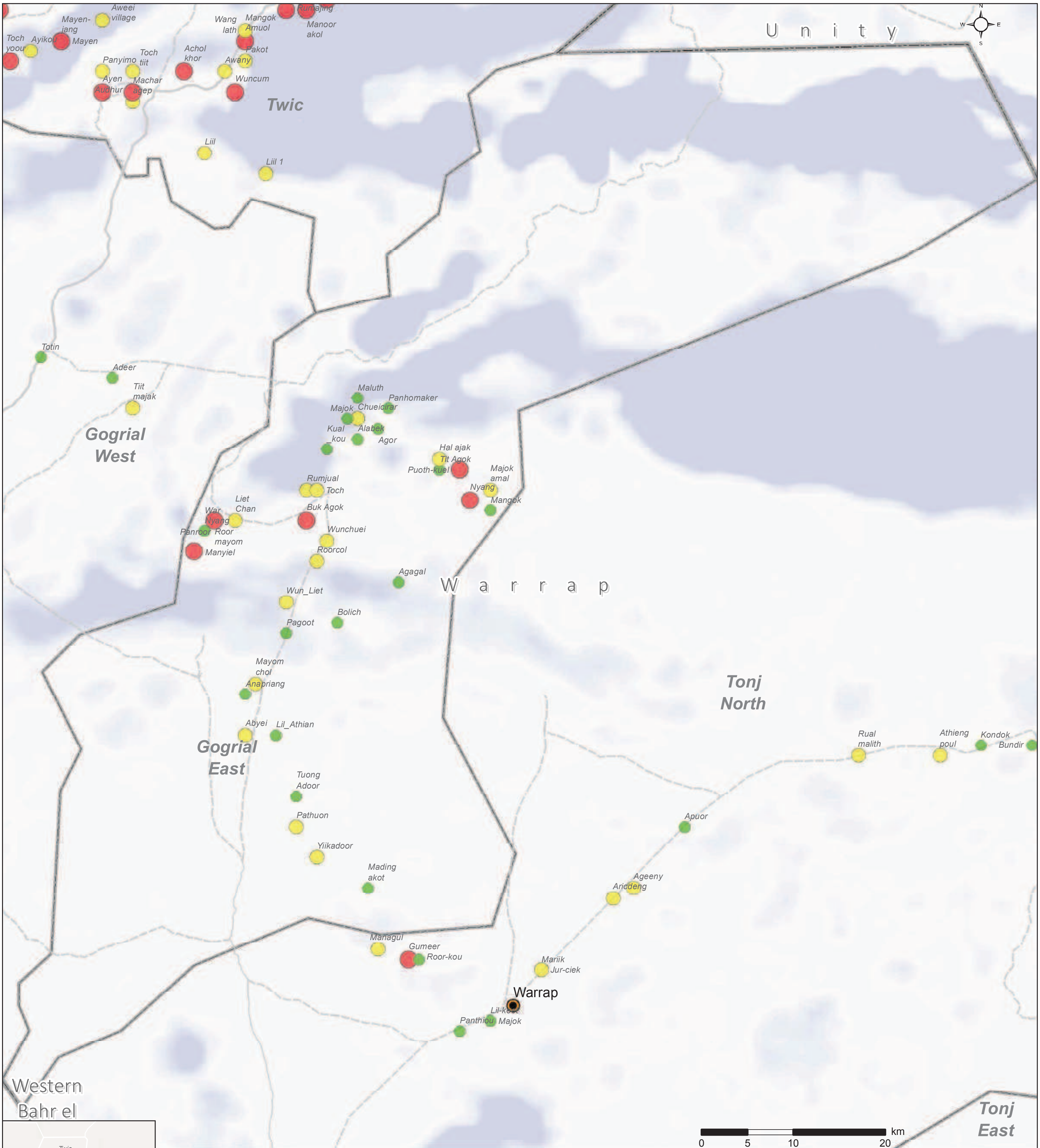
Annex 2: Maps of Communities Assessed with FVI Classification

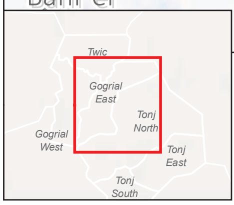
ShelterCluster.org
Coordinating Humanitarian Shelter

SOUTH SUDAN - Warrap State - Gogrial East

Vulnerability to floods of assessed villages

For humanitarian use only
Production date : 01 November 2013





FVI
- No data
- Low
- Moderate
- High

Flood Index
- High : 402
- Low : 0

Road
- Primary
- Secondary
- Tertiary

Data sources: County, State, Country Borders and rivers: UNOCHA, Innudation data: UNOSAT

Coordinate System: WGS84
Contact: reach.mapping@impact-initiatives.org

Note: Data, designations and boundaries contained on this map are not warranted to be error-free and do not imply acceptance by the REACH partners, associated, donors mentioned on this map.

CHF The Common Humanitarian Fund South Sudan

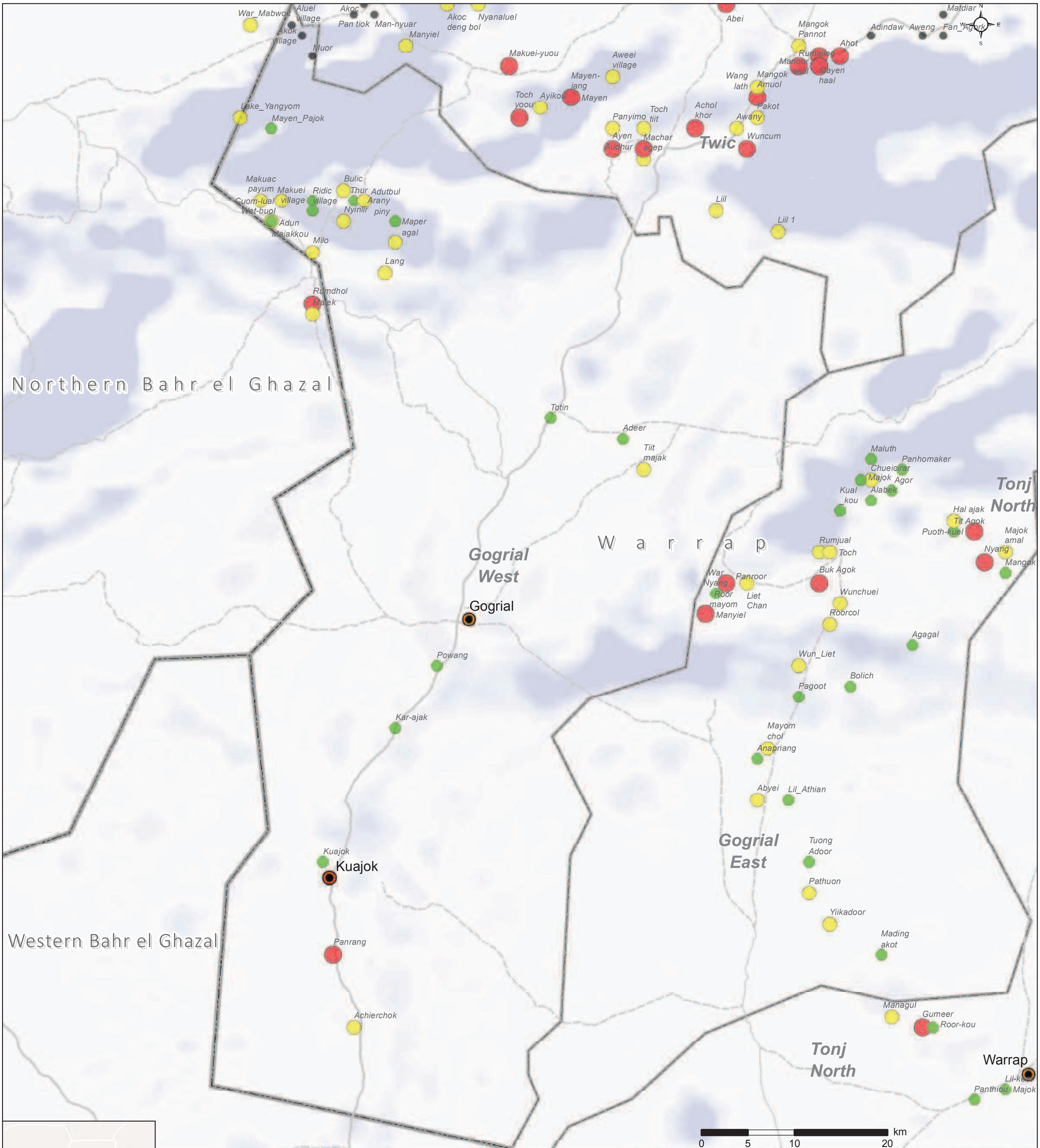
REACH An initiative of IMPACT Initiatives ACTED and UNOSAT

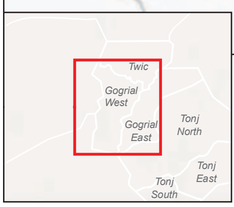
For humanitarian use only
Production date : 01 November 2013

ShelterCluster.org
Coordinating Humanitarian Shelter

SOUTH SUDAN - Warrap State - Gogrial West

Vulnerability to floods of assessed villages





FVI
- No data
- Low
- Moderate
- High

Flood Index
- High : 402
- Low : 0

Road
- Primary
- Secondary
- Tertiary

Data sources: County, State, Country Borders and rivers: UNOCHA, Innudation data: UNOSAT

Coordinate System: WGS84
Contact: reach.mapping@impact-initiatives.org

Note: Data, designations and boundaries contained on this map are not warranted to error-free and do not imply acceptance by the REACH partners, associated, donors mentioned on this map.

CHF The Common Humanitarian Fund South Sudan

REACH An initiative of IMPACT Initiatives ACTED and UNOSAT

SOUTH SUDAN - Warrap State - Tonj East

Vulnerability to floods of assessed villages

For humanitarian use only
Production date : 01 November 2013

FVI
- No data
- Low
- Moderate
- High

Flood Index
High : 402
Low : 0

Road
- Primary
- Secondary
- Tertiary

Data sources: County, State, Country Borders and rivers: UNOCHA, Inundation data: UNOSAT

Coordinate System: WGS84
Contact: reach.mapping@impact-initiatives.org

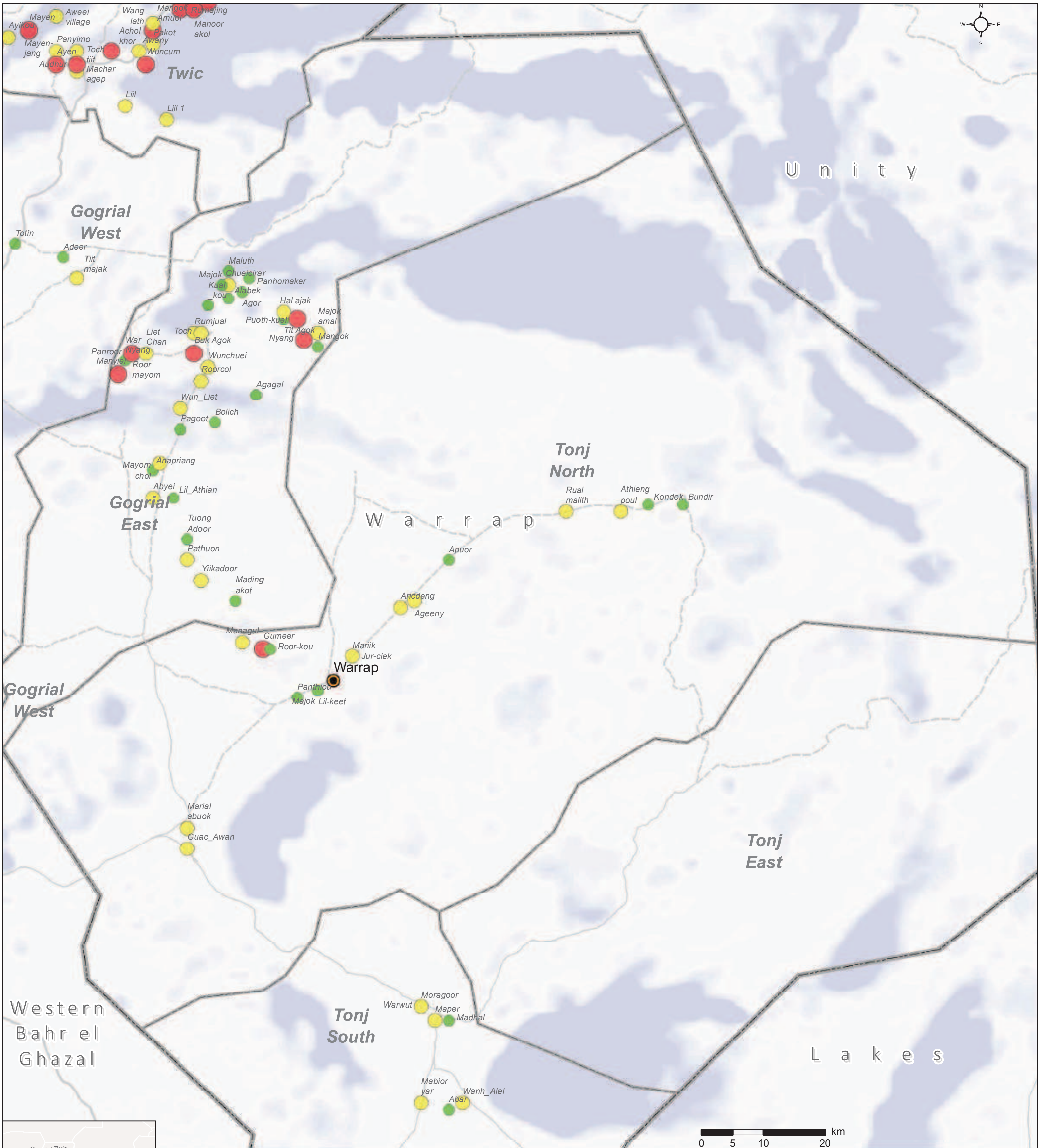
Note: Data, designations and boundaries contained on this map are not warranted to error-free and do not imply acceptance by the REACH partners, associated, donors mentioned on this map.

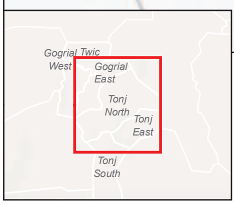
ShelterCluster.org
Coordinating Humanitarian Shelter

SOUTH SUDAN - Warrap State - Tonj North

Vulnerability to floods of assessed villages

For humanitarian use only
Production date : 01 November 2013





FVI
- No data
- Low
- Moderate
- High

Flood Index
- High : 402
- Low : 0

Road
- Primary
- Secondary
- Tertiary

Data sources: County, State, Country Borders and rivers: UNOCHA, Inundation data: UNOSAT

Coordinate System: WGS84
Contact: reach.mapping@impact-initiatives.org

Note: Data, designations and boundaries contained on this map are not warranted to error-free and do not imply acceptance by the REACH partners, associated, donors mentioned on this map.

The Common Humanitarian Fund South Sudan

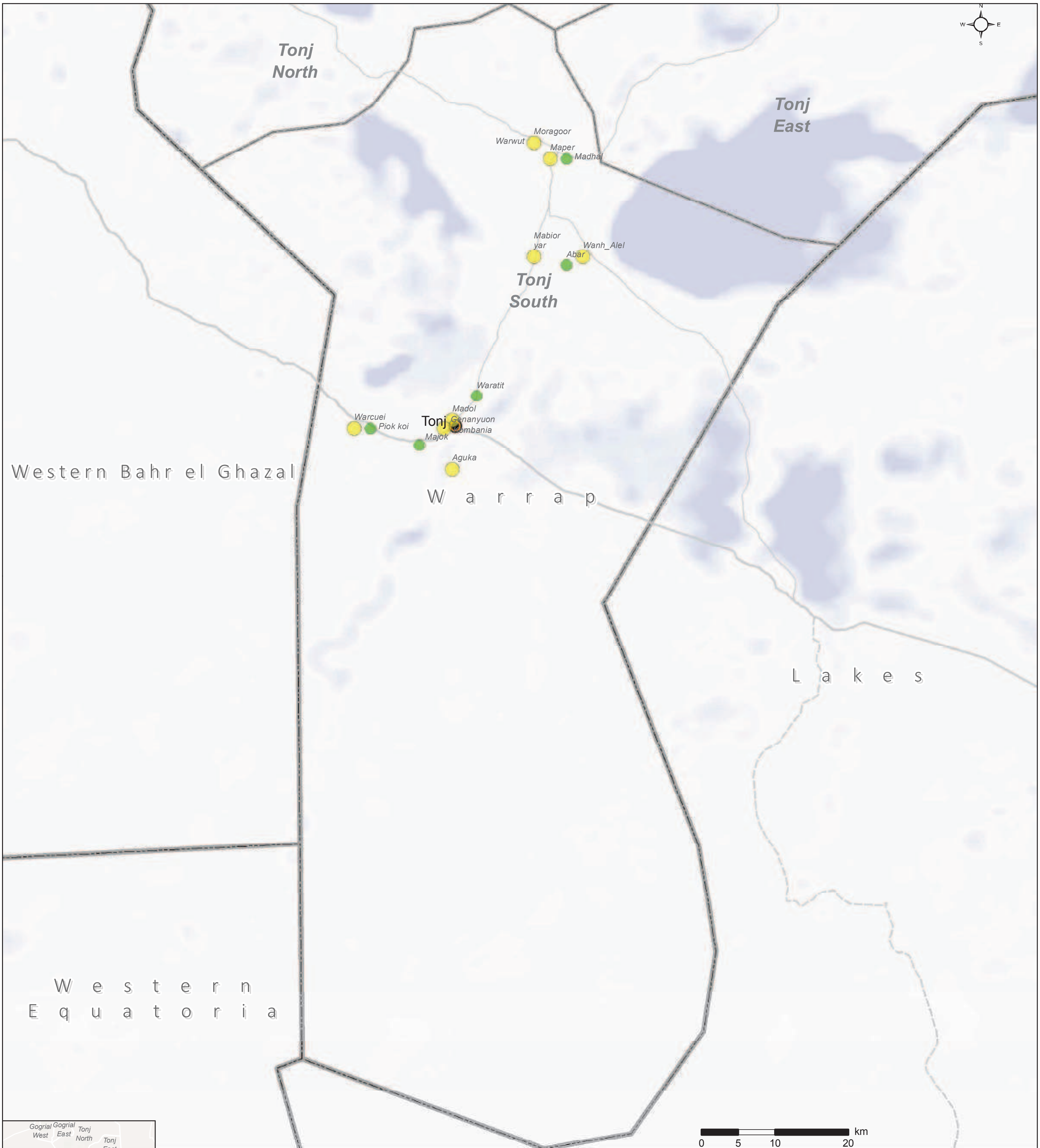
REACH An initiative of IMPACT Initiatives ACTED and UNOSAT

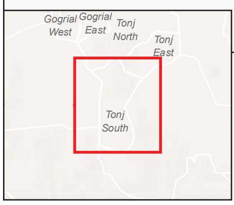
ShelterCluster.org
Coordinating Humanitarian Shelter

SOUTH SUDAN - Warrap State - Tonj South

Vulnerability to floods of assessed villages

For humanitarian use only
Production date : 01 November 2013





FVI
- No data
- Low
- Moderate
- High

Flood Index
High : 402
Low : 0

Road
- Primary
- Secondary
- Tertiary

Data sources: County, State, Country Borders and rivers: UNOCHA, Inundation data: UNOSAT

Coordinate System: WGS84
Contact: reach.mapping@impact-initiatives.org

Note: Data, designations and boundaries contained on this map are not warranted to error-free and do not imply acceptance by the REACH partners, associated, donors mentioned on this map.

CHF The Common Humanitarian Fund South Sudan

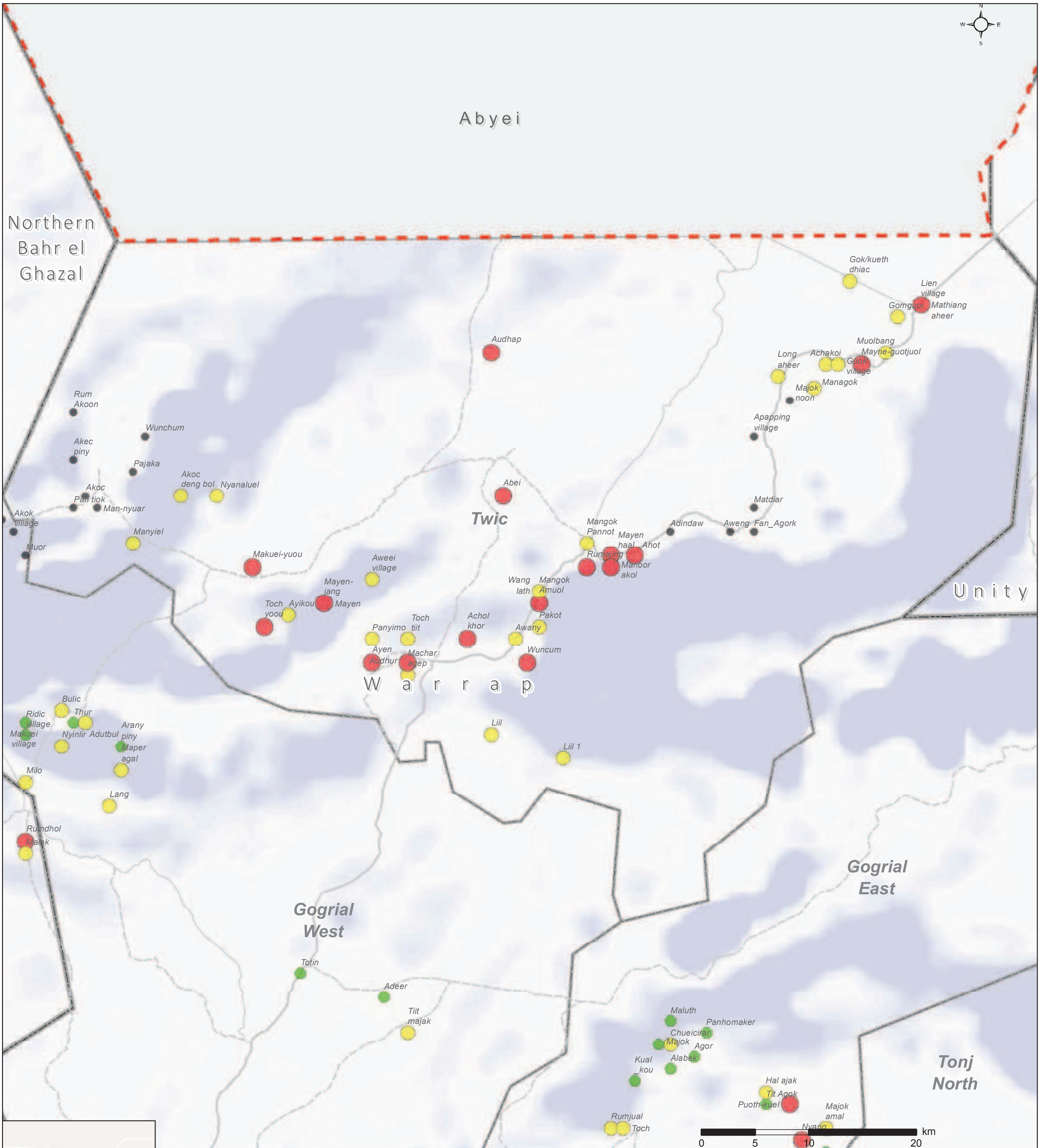
REACH An initiative of IMPACT Initiatives ACTED and UNOSAT

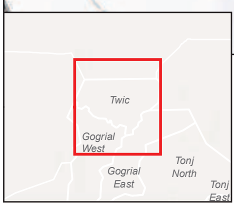
ShelterCluster.org
Coordinating Humanitarian Shelter

SOUTH SUDAN - Warrap State - Twic County

Vulnerability to floods of assessed villages

For humanitarian use only
Production date : 01 November 2013





FVI
- No data
- Low
- Moderate
- High

Flood Index
- High : 402
- Low : 0

Road
- Primary
- Secondary
- Tertiary

Data sources: County, State, Country Borders and rivers: UNOCHA, Innudation data: UNOSAT

Coordinate System: WGS84
Contact: reach.mapping@impact-initiatives.org

Note: Data, designations and boundaries contained on this map are not warranted to error-free and do not imply acceptance by the REACH partners, associated, donors mentioned on this map.

CHF The Common Humanitarian Fund South Sudan

REACH An initiative of IMPACT Initiatives ACTED and UNOSAT

ACTED SHELTER CONSULTANCY

planningAlliance

Warrap Region, South Sudan
October 2013

Contents

1.0 Introduction

After South Sudan gained independence in July 2011, the international community contributed generously to the South Sudan consolidated appeal (CAP) to meet the needs of the most vulnerable people. In February 2012 the South Sudan Common Humanitarian Fund (CHF) was established to finance projects in the CAP. One of the key CAP priorities for the cluster of Non Food Item / Emergency Shelter (NFI/ES) is to 'adjust its shelter support to provide more adequate shelter'. It is through this cluster that a program to improve living conditions with adequate shelter can be implemented.

As an active member of the NFI & ES cluster, ACTED is working the Warrap region of South Sudan with Impact Initiatives through the REACH initiative[1] and has undertaken extensive long term flood mapping to locate communities that are vulnerable to flooding based on historical satellite mapping as well as key informant interviews and complemented with field mapping and verification. This work is near completion with the next step to provide communities with plan to cope with future flooding. Improved shelter designs that can mitigate damage from future flooding are part of this plan to cope with future flooding.

planningAlliance has been contracted by ACTED to provide shelter consulting services in the Warrap State, where the flood mapping took place. After community consultations, shelter and material assessments, climatic analysis, planningAlliance provides recommendations to improve shelter designs and outline methods for delivering a successful shelter project that will be able to reduce the risks of flooding as well as provides a sustainable solution that responds to cultural, contextual and climatic issues. It was highly recommended by ACTED that the solution should be one that uses local materials and can be implemented by the communities with limited inputs from the government and/or international community.

The results of this shelter project will be submitted to the NFI & ES cluster coordinators and members for further dissemination and to inform coordination and humanitarian planning.

[1] REACH is a joint initiatives between ACTED, IMPACT initiatives and UNOSAT. For more information: http://www.reach-initiatives.org

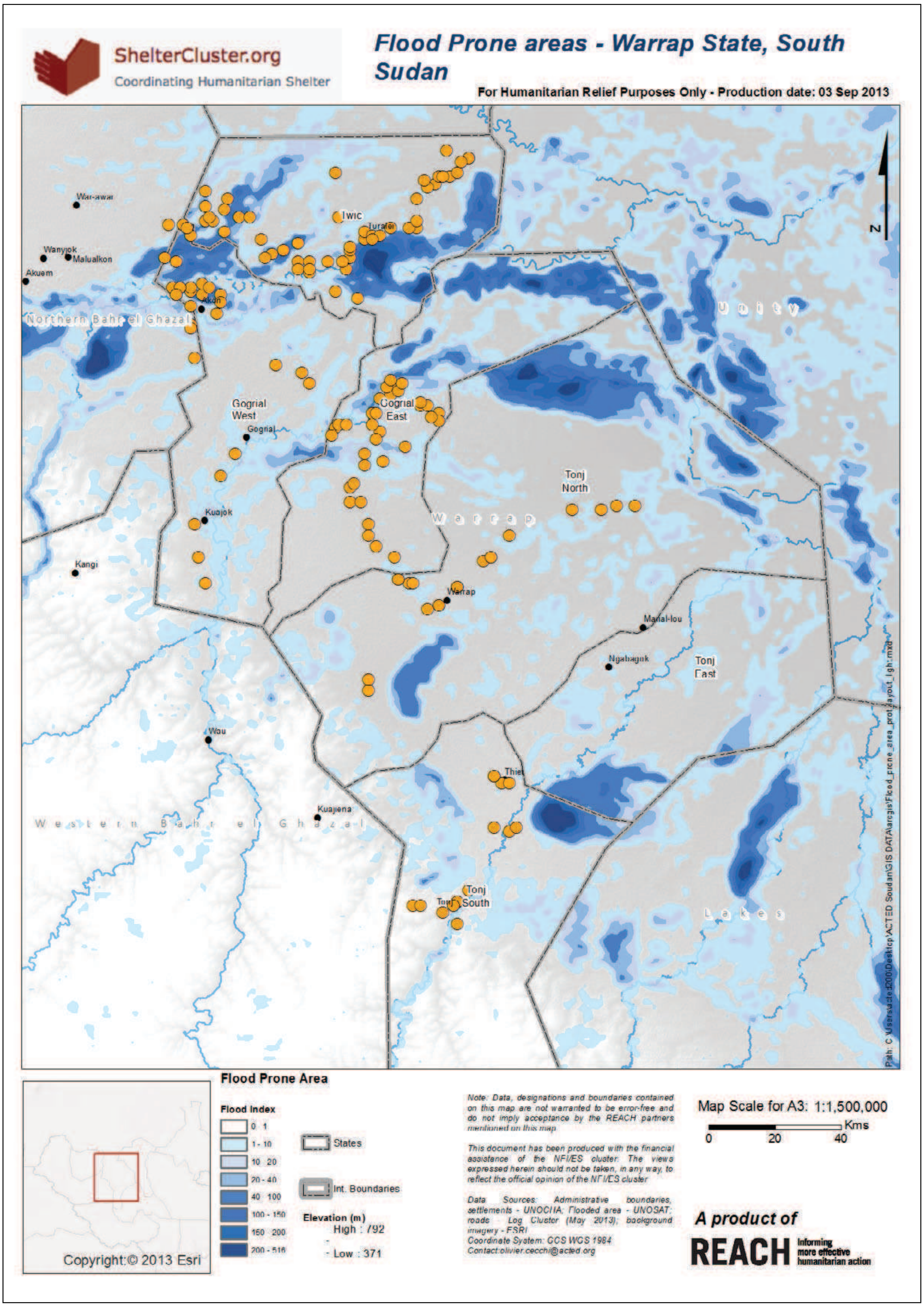


Figure 1
Flood Mapping showing assessed villages that are prone to flooding

3.0 Research/ Consultation/ Analysis

3.1 Climate and Climate Change

South Sudan's climate fits within the Köppen Classification of Aw - Tropical Savanna Climate. This classification is also known as tropical wet and dry climate due to the pronounced wet and dry seasons, with dry the driest months having less than 60mm of precipitation and the wettest months reaching 200mm of precipitation.

The climate can be broken down into a rainy season of high humidity and a drier season with little to no rainfall. Most rain falls between May and October with no rain between December and February. On average each month experiences about 10 days of precipitation. Flooding is reported to take place from August to December

Daily average temperatures remain high throughout the year with a daily mean temperature of 28 degrees Celsius and Average high of 35 degrees Celsius. Average low temperatures most likely occur at night and are significantly lower than Average highs and daily means, leading to significant diurnal temperature difference that could be as high as 18 degrees Celsius.

Climate data for Wau, Western Bahr el Ghazal, most likely derived from satellites has been used as it is the closest available to the affected region. Wau is located at 437 meters above sea level at a latitude 7 degrees, 42 minutes north of the equator and a longitude 28 degrees, one minute east of the Prime Meridian. Climate data is taken from www.weatherbase.com and represents 38 years of recorded weather. http://www.weatherbase.com/weather/weatherall.php3?s=8826&

In addition to standard climate data, South Sudan has been impacted by a number of extreme weather events that include heavy thunder and rain storms, accompanied by strong winds during the rainy season and heavy dust storms in the northern parts of the country as well as dry spells and drought. (WMO presentation on South Sudan Meteorological Service)

The Intergovernmental Panel on Climate Change (IPCC) predicts that temperature warming in Africa is very likely to be greater than the global average. "There is likely to be an increase in annual mean rainfall in East Africa" (IPCC 2007, p.850) as well the number of extremely wet seasons is predicted to increase to roughly 20% (i.e., 1 in 5 of the seasons are extremely wet, as compared to 1 in 20 in the control period in the late 20th century). (IPCC 2007, p.871) The IPCC report also notes that there will be increased variability in the climate.

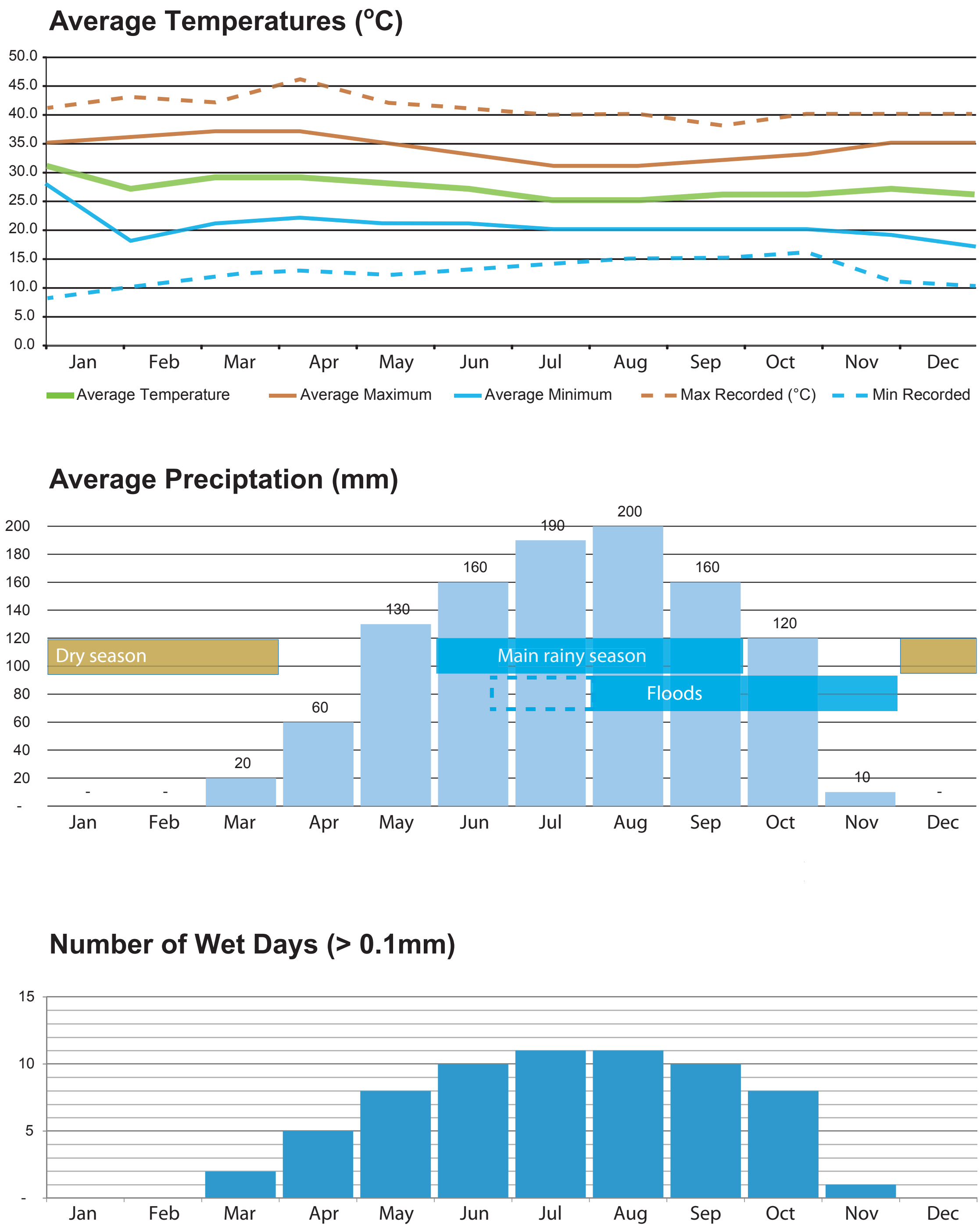


Figure 2
Climate for Wau (from www.weatherbase.com)

3.2 Climatic design

Understanding the climate is important part of the design process and one of the main methods in determining strategies for providing comfort and responding, in the context of South Sudan, to issues of heat, humidity and precipitation as well as extreme climatic events and changes in climate. Key climatic design strategies are:

Shade: With high values of solar radiation and high average temperatures; shade is paramount to shelter design where the effects of the sun can increase the risk of heat stress;

Thermal Mass: With both a hot, dry season and a hot, wet season strategies the employ thermal mass such as that found in bricks or mud will help maintain comfortable temperatures while allowing air flow through the shelter will help with comfort during periods of higher humidity;

Water Durability: With high levels of monthly rainfall and the known risk of flooding a strategy that is durable to water and keeps the floor of the home well above the flood line is key to reducing dampness and keeping people and belongings dry.

3.3 Community Consultation

Figure 4
Community consultation on improving shelters with village elders, women and youth

During the period of October 11th to 18th 2013 a number of villages within the Warrap State and Western Bahr el Ghazal (as one of the direct bordering states) were visited to benchmark existing shelters and review the extent and damage caused by flooding. At the same time meetings/ consultations were held with community members on the rebuilding of shelters. Meetings took place in a number of formats and ranged in size from approximately 50 people with a mix of gender and age groups to smaller meetings with individual households. Those consulted included people who had been physically displaced due to flooding as well as those whose conditions included discomfort due to ground moisture. All meetings were run by the shelter consultant and translated by ACTED field staff.

Villages visited and consulted include the following in Warrap State; Kang Lang, Lolnyiel, Majak, Nyieth, Gogrial, Panrang and in Western Bahr el Ghazal; Eastern Bank, Maleng and Mapel. Given the short time frame of the consultancy, meetings were organized without any notice and therefor only with available community members.

Community consultations were run as an open forum to discuss rebuilding their homes and how it could be improved to reduce damaged caused by flooding. The discussion was kept to solutions that the community could implement and lead to tools and training that could be provided to help improve construction techniques. Questions around resettlement and community planning to better use higher ground were raised and options for improved shelter design were discussed. The forum was left open to any other ideas regarding improving housing, community infrastructure and building back a community that is more resilient to flooding.

In almost all communities, meetings were held with those that were directly impacted with a loss of shelter and were therefore living in temporary settlements. These settlements were hosted by others on higher ground and where people waited for the flooding to recede before returning to their land. Although this was a very small sampling of the villages identified through flood mapping, there were a number of common points raised at both the community and household level. A summary of the key findings are listed here:

Key Findings from Community Consultation

- People have strong historical ties to their land and a sense of belonging to where they are staying. Even though it was flooded, their wish is to return. They also noted the possibility of finding better land is difficult;
- Communities feel that the roads have insufficient culverts and that new infrastructure (roads) have been the cause of increased flooding;
- Communities feel that raising the land and then building new homes on the higher ground was the best way to prepare for future flooding and one that they were willing to undertake as a community if provided with tools;
- Raising the floor level of the tukul was also a solution but only after land was raised;
- When asked about a raised house on stilts, the communities were open to the idea but again raising the land was a first priority and showed concern about obtaining materials;
- Wood poles for wall structure and roof supports may have been damaged in the floods and may need replacing;
- Communities agreed that the most vulnerable (elderly, disabled…) should be a priority in providing assistance;
- Nothing is currently being done to prepare for the rebuilding of their homes;
- Access between home and dry land during the flooded period was a concern and the solution suggested was improved boats.

Other findings from Community Consultation

A number of other issues were raised constantly by communities that are beyond the scope of this consultancy, however they are important in building back people's homes and are therefore noted here for information:

- The issue about access to food and food security was always a priority over shelter;
- The need for latrines to eliminate open defecation was raised by youth;
- Women expressed concern over a loss of kitchen utensils, in particular clay jugs;
- There is a need for mosquito nets, blankets and sleeping mats.

3.4 Existing Shelter Assessment


Image 1

The majority of households that have been affected by flooding are agro-pastoralists who also engage in farming activities, their existing main residence is made up of very basic sleeping shelters of minimal size. The main shelter, called a 'tukul', consists of a single room with a single entrance and rarely any windows. The predominant construction method is wattle and daub walls with a mud floor and thatch roof, although they may also be made of burnt and mud bricks as well as bamboo depending on availability. The tukul is either round or square in plan with the thatched grass roof supported by long poles from either bamboo or straight trees that rest on the walls or a series of wood columns (from large tree branches with a Y shape at the top).


Image 2

A household may have more than one tukul for sleeping and may also have tukuls or similar structures with one used for cooking and another for food storage. The size of tukuls varies by household ranging from approximately 3 metres to 6 meters in diameter, with much larger ones mainly used for keeping livestock safe at night.

Most of the daily activities take place outside in a flat open space that is central to the tukuls. This is where food is often prepared. It was observed that most households locate their tukuls near at least one large tree; this provides a shaded area this is highly used throughout the day.


Image 3

Many variations of the tukul exist based on availability of materials, the experience of those building the tukul and the number of people to help build (often based on how much food can be provided for the workers). A more detailed assessment of the different construction methods by village can be found in the flood mapping work carried out by the REACH Initiative. The following is an account of various tukuls assessed during the visits to the communities.

3.4.1 Extent of Damage by Flooding


Image 4

It is important to note that the extent to which households are affect by flooding varies greatly both in the level of damage but also the length of time in which a household is affected and must live in temporary conditions.

The images on the left depict the various levels encountered during the housing evaluation. From top to bottom; 1) shows a tukul faced with short term flooding that has caused minor damage, once the interior floor drys out the tukul is usable again. 2) long term flooding where the house is still standing, however it is likely that the submerged portion will have significant damage. 3) long term flooding where the walls have collapsed, the roof may still be reusable. 4) long term flooding where the entire house has collapsed and it is likely that all materials have been lost.

3.4.2 Housing Typologies

As with housing anywhere in the world, the tukul has many variations based on the availability of materials, wealth of the household and skills of those building the home. The following is a summary of variations in tukul design that were observed during the consultancy with a brief assessment of the materials and design.

The basic tukul is made from bamboo and may also have mud for a portion of the walls. This allows for good ventilation and for this reason these shelters are also used for cooking. The plan of this tukul is square. The 45 degree roof is a single thatched roof. The tukul is constructed directly on the ground, increasing the risk of damage by flooding.

The supporting structure of this tukul uses tree branches arranged in a circular plan before applying the mud walls to both the inside and outside. A more complex multi-layered bundled thatched roof provides better water resistance.
Note the water damage at the base of the mud walls. This was the most common tukul design in the villages visited.

Mud blocks and mortar are laid on a stone base to create a durable tukul. The thatched roof uses a slope greater than 45 degrees to increase water resistance. The metal door has been purchased for added security. The increased rigidity of the blocks allows this tukul to take a square plan shape.
Note that the stone base is only under the walls and that the floor is level with the outside ground. This tukul also features a window.

Burnt bricks are made in kilns that require large amounts of fire wood as fuel. The bricks are laid using a cement mortar or one made from a local soil with hardening properties. The walls are also parged with the same material.

This concrete tukul was an anomaly in that it was built to house workers in a government factory. Although this tukul was found in an area that did have any flooding, the concrete floor is substantially raised to reduce any impacts should flooding occur. A metal roof was installed at a low slope since the chance of leakage is reduced.

The large high pitched roof of this tukul is supported on external wood posts external to the mud wall. The larger/higher roof potentially requires larger supports than just the wall. The external supports also have the potential to withstand water damage leaving the roof in place with only the walls requiring repair after a flood.

Found in only a few villages which were not affected by flooding is a tukul raised on large wood posts. The tukul construction is standard with the exception of the posts and floor supports that raise the tukul about 1 to 1.5 metres above the ground. Note the size and number of wood supports

Raising a portion of land on which to build the tukul was common practice, in a number of areas that did not report major flooding. The tukuls are arranged around the perimeter of the raised portion, this leaves the outer edge of the walls vulnerable to erosion from water.

Summary

A number of key observations were made during the review of existing shelter options that were common between villages. It was also apparent that there are a number of challenges in obtaining materials and labourers to assist with extensive land of shelter improvements. Key observations can be summarized as follows:

- Very few shelters have any resistance towards flooding, even when flood is a recurrent disaster in the area. Some had a threshold at the door however floors were still at the same level as the outside ground and were therefore saturated with water;
- Shelters raised on stilts require large a amounts of wood and could be better engineered;
- Materials are based on what is locally available. Main variations are in the type of sticks or bamboo that is used to support the mud;
- Although burnt bricks may be locally available, very few houses used them – most likely due to costs;
- Raising the ground provided a an exterior area out of the flood plain where a majority of the household activities could take place.

3.5 Materials and Availability

It can be generally said that the materials used in building housing is locally available and made from non-manufactured products with almost 97 percent of the surveyed tukuls having walls made from soil. The REACH Initiative also identifies that less than 5 percent of the 225 houses surveyed have steel roofing or concrete floors.

The methods of construction vary considerably throughout the region and from conversations are based on what can be found locally. It was also inferred that some people did purchase materials such as the long roof supports or metal doors. As vegetation and soil conditions vary considerable across the region, materials that may be common in one village may not be available in others or availability may be limited. A number of manufactured materials are typically available in the nearest commercial centers but appear to only available on a small scale, however by numerous suppliers but still carry significant costs. It should also be mentioned that although a number of materials can be found locally, they may be on land owned by others than the home owner and will carry a cost to use these materials. The following are materials assessed during the visit with comments as to their usefulness and availability.


Local mud - wall plaster


Small Sticks - form lath on which to apply mud


Large Branches - support roof structure


Support branches - support raised floor


Mud blocks - construction of walls


Burnt bricks - construction of walls


Murram soil - used to make mud blocks


Bamboo - walls or lath to support mud


Grass Thatch - main roofing materials


Metal Sheets - roofing


Concrete - support columns


Machine made blocks - walls


Plastic Sheets - roofing


Tires - alternative foundation material similar to a retaining wall

4.0 Shelter Solutions

4.1 Housing Design Solutions

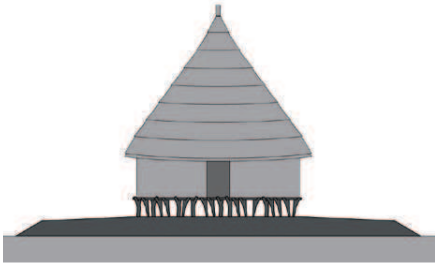
One of the key findings from the community consultation was the desire to raise one's land out of the flood levels; this was a priority above all other potential solutions. The assessment of the existing tukuls identified that a number of communities already had constructed shelters that were raised off the ground using larger wood members. The combination of raising the land and tukul forms the concept for a shelter solution that responds to future flooding.

A robust base that elevates the floor of the tukul above the flood plain is main consideration for protection against damages and the discomforts caused by flooding. The next consideration includes raising the land around the tukul to provide a place where cooking and other household activities can take place. The later consideration comes out of the community consultations and was one that the communities felt strongly about implementing. The concept of improving the base of the tukul is based on the assessment that the cause of failure was where the walls met the ground and that the discomfort people experienced was from moisture on the floor. The existing tukul design when placed on higher ground held together during the rains; however a number of minor improvements could improve overall durability. The concept is diagramed in Figure 5.

There are a number of methods in which to achieve a raised floor level, two of these that have the greatest potential to work in numerous villages and will be reviewed in detail with other options listed for further consideration. With varying material availability and soil qualities throughout Warrap State, a one-size-fits-all solution could prove difficult to implement. Rather a solution with flexibility that takes a systematic approach to community inputs, local materials, tools & training and testing that allows for adjustments to construction techniques will prove most successful in its implementation.

With a variety of methods for raising the floors levels is also a number of delivery methods and variations in cost that also need to be considered. The approaches discussed here take into account the full range from community lead with minimal input to importing materials that could be used to improve the quality of base on which to build a tukul.

Figure 5
Shelter concept to protect against flooding

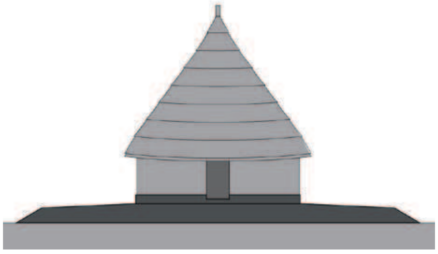


Elevated Platform Approach

The first method of raising the floor level, takes into account the existing concept of constructing the tukul on top of wood timbers imbedded in the ground to provide a raised platform (Figure 6). This method as currently implemented requires a considerable amount of wood to support the massive mud walls above. There is great potential to 'engineer' this construction method, provide bracing and achieve a more economical structure. In addition to providing a floor that is completely separated from ground water infiltration the design provides a shaded space below and increases protection from animals and rodents.

Raising the floor level on a stilts can be achieved using the more traditional approach of 'found' wood or achieve more economically with dimensional 'milled' lumber. Although wood is available depending on village, it may still need to purchased or proper permits obtained if taken from a forest. The variability in what can be found or purchased locally makes it difficult to engineer a solution and therefore each construction must be considered separately depending on the materials at hand as the methods currently used, one method is shown in Figure __. By using dimensional lumber the solution can be engineered to ensure a more economical use of materials. The use of wood still lends itself to a few problems beyond just procurement, mainly termites and wrought from sitting in water for prolonged periods and therefore very high quality timber would be required such as teak. It was noted that although many tukuls employed this technique, none were seen to be sitting directly in water or areas that experienced prolonged flooding. Due to the potential amount and quality of wood required to implement such a project on a large scale the environmental impacts on deforestation could be significant. If lesser quality wood is used the longevity of the solution is compromised and may not be easily repaired in the future. For these reasons this method is not recommended unless a particular village can prove it to be a sustainable solution.

Figure 6
Tukul raised on large wood members



Raised Foundation Approach
The second method of raising the floor is to provide a robust foundation or plinth that extends above the flood plane to provides a surface on which the tukul would be constructed. Key to this approach is ensuring that the construction can withstand the eroding effects of water and that is substantially above the flood plain so that water does not saturate the upper portion of the foundation. The foundation Plinth approach can be implemented by a number of construction methods that range from very simple compacted soil to a more robust concrete base. This method can be modified based on materials that are locally available and can also include potential for livelihood creation and lead to improved building practices.

In both cases the design needs to respond to the flooding conditions that have been experienced in the location where housing is to be built. Most often there are visual markers; such as water lines on the walls of the tukul, this level should be transferred to a marker (wooden stick) embedded in the ground with an additional height of 30 centimetres added to the level as a precaution for increases in future flooding. This level then becomes the minimum height for which the floor of the tukul can be located. Other levels to take into consideration are the level of roads which could potentially be a barrier to water flow and therefore increasing the height to meet these would also be suggested.

The following is a review of potential options with a comment on their strengths, weaknesses and the tools required to implement a raised foundation design.

Compacted Soil
The most basic method of creating the foundation is with compacted soil, this very much depends on the quality of soil nearby and the amount of compaction. This would be similar to the method used in building a road; murram soil is piled up and compacted. A flat area on top would provide for the base of the tukul and positive slope away from the tukul would ensure drainage. This method can be easily compromised without proper slopes or if the full floor of the tukul is not located on the highest ground. It also has the potential to erode over time.
Tools required: Wheel Barrow, shovel, tamper

Mud Blocks with Plaster Finish
A more substantial base can be created with mud blocks, the addition of plaster provides durability. Mud blocks can be produced locally depending on soil conditions and even provide a livelihood. Experience in mud bricks may already exist within some communities. This method will however require significant amounts of water to make the soil workable and therefore water sources should be taken into consideration. Once a number of blocks are ready, they would then be arranged and layered with mud mortar to form a foundation that extends above the high water line. The inside of the foundation would be filled with

compacted soil and a final top layer of bricks laid in place before applying a plaster coating. The production of bricks would require testing of soil and size to achieve blocks of sufficient quality. Potential methods to seal the foundation include a cow dung plaster, local soil plasters and cement plasters. All methods would need to be tested to ensure proper mixture and that the meet the objective of sealing the blocks from water damage. One potential issues with using mud and plasters is the amount of water required to make these materials workable and the need for cement to ensure the plaster can stand up to water. Grass, animal hair or other fibrous materials can be added to increase strength and durability.
Tools required: Wheel barrow, shovel, tamper, brick mould.

Compressed/Stabilized Earth Blocks
Compressed earth blocks can be made relatively inexpensively compared with cement blocks or burnt bricks and in most cases can use locally available soil. The cost of the compression mechanism can range from a simple wooden box with tamper to a fully mechanized machine with an engine. The advantages of this method are that less water is often required and stronger blocks can be produced. The blocks can also be designed in such a way that they can be dry stacked, not requiring mortar. Additives such as concrete or Anyway Soil Block increase the strength and durability of the compressed block such that a plaster finish may not be required, they can also broaden the range of usable soils. This method of producing blocks is currently being used in other parts of South Sudan.
Tools required: Wheel barrow, shovel, block compression machine.

Burnt Bricks
Burnt bricks are manufactured by a number of communities and provide a base that is durable against water depending on their quality. Detailed mapping of brick production could be used to support local livelihoods. Consideration should be given to the amount of bricks required and the amount of fuel (wood) and water required to make bricks. It is recommended that this method only be used to support local livelihoods and that new factories not be set up unless they are done using alternative fuel sources.

Discarded Tires
Discarded tires can be stacked to form a durable base that would provide good resistance against water damage. Although this not currently done locally and is a less traditional method of providing a foundation it has been used in a number of countries for retaining walls. The availability of used tires would need to be confirmed but the concept holds great

Figure 7
Tukuls located on ground that has been raised

potential for using an often discarded material. The relatively low automobile use may inhibit finding the required amount of tires. Once the tires have been arranged to form a foundation, the inner portion would need to be filled with soil and compacted.
Tools required: Wheel barrow, shovel, tamper.

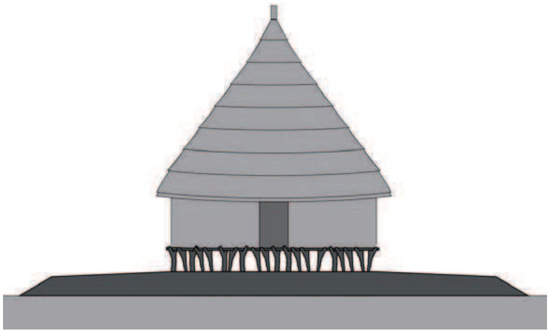
All methods will still rely on soil to be placed within the foundation walls and compacted thus requiring at a minimum; a wheelbarrow, shovel and tamper. The methods identify five potential ways for providing a durable foundation on which to support the construction of a new tukul. A number of other options could also prove to be viable and should be explored if other materials are available. The size of the base should be coordinated with the size and design of the tukul to be constructed on top including the placement of any poles to support the roof.

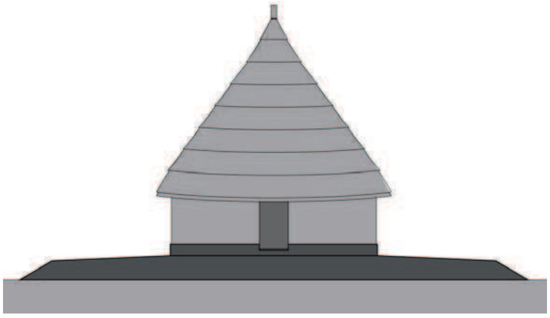
One other method that is more of a temporary solution is to isolate the floor from the ground inside the tukul. This could be done using wood, bamboo or other locally available materials that could provide a raised surface and are less permeable to water. This method would be most appropriate were flooding is minimal. It would still require repair of exterior walls once flooding subsides.

The proposed method for constructing the new tukul will also need to consider the availability of local materials and building practices. The recommended tukul design uses mud bricks or compressed earth blocks to create a durable and inexpensive home. This however will depend on the availability of good soil for brick making. The primary objective is to improve shelters for sleeping, however considerations to also include kitchen areas, food storage structures, latrines and animal shelters should also be taken into consideration.

As no national housing standards was available and the current ministry of housing and infrastructures has yet to begin work towards improving housing in rural areas, a conceptual design for new tukul takes into account common sizes that were approximated during the field visits with SPHERE standards to determine an appropriate size for a new tukul based on an average household size of six as determined from flood mapping survey (data inputs from demo_Popu_Pop / demo_Popu_HH_num). The minimum new house size should be based on the SPHERE standard of minimum area of 3.5 square metres per person and the average household size to provide an area of approximately 21 square metres. As many households often live between more than one shelter, a total area based on number of people could be distributed between the desired number of shelters.

4.2 Comparison of approaches





Elevated Platform

Strengths
- A technique currently used,
- Uses less 'material' to raise the house,
- Requires less water for construction,
- Less labour intensive,
- Uses renewable wood materials,
- Provides increased safety from small animals,
- Could be engineered with milled timber to provide more economical use of wood.

Weaknesses
- Wood may not be locally available and may have to be purchased,
- Large amount of wood is required and may have to be imported, and could have a significant environmental impact,
- Mud walls are heavy and not as suitable on a raised platform,
- Long term durability is reduced through wrought or termites.

Raised Foundation

Strengths
- Provides a robust base for long-term durability,
- Can be implemented by a number of methods depending on material availability,
- Construction method is less technical.

Weaknesses
- Large amounts of water are needed,
- Foundation method is more labour intensive,
- Good soils for making foundations may not be available,

Summary

Both options are viable, however in order for the solution to be of low environmental impact the availability of quality wood that can resist termites and a proper management of the resource must be taken into consideration before using an elevated platform approach from wood. Upon visiting a few sample communities the raised foundation option is likely to be widely implemented based on material availability and skills needed to work with various materials. A design for a raised foundation is therefore provided in this report as a starting point to implement a rebuilding of the

4.3 Detailed Drawings

The following pages are drawings for the mud blocks with plaster foundation. This basic foundation design can be adapted to use compressed blocks or burnt bricks and may not require the use of a plaster finish on the sides, however it is still recommended to plaster the floor to lower the probability of dampness. The design of the tukul on top of the foundation is one method of construction and is shown for reference only.

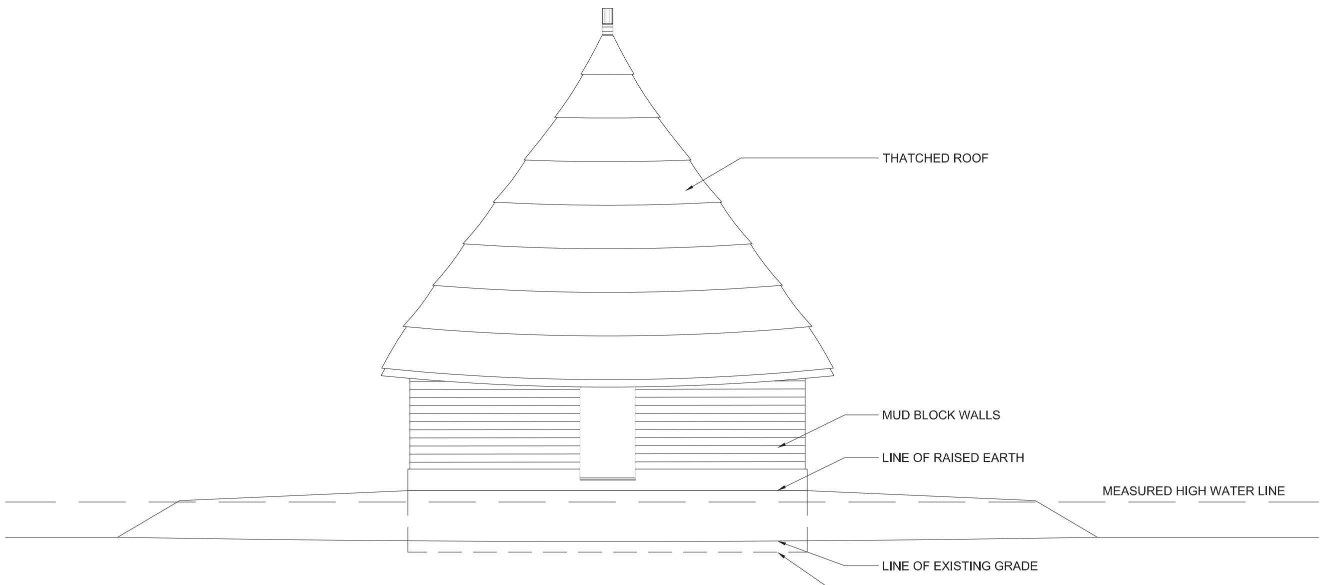
Materials Required:
Foundation

- Blocks (mud with stabilizer)
- Plaster
- Soil as fill

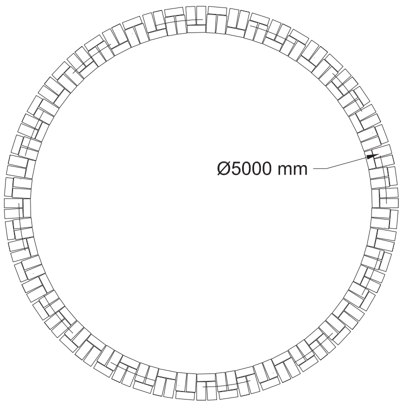
Notes:
-Footings should be at least 28 cm thick with a minimum width that is 33 percent greater that the wall width.
-Final finished grade should not extend more than 20 cm below finished floor.
-Detailed block sizes will need to be worked out through testing to achieve maximum strength and durability.

Tukul (as per local standards or improved with techniques similar to foundation)

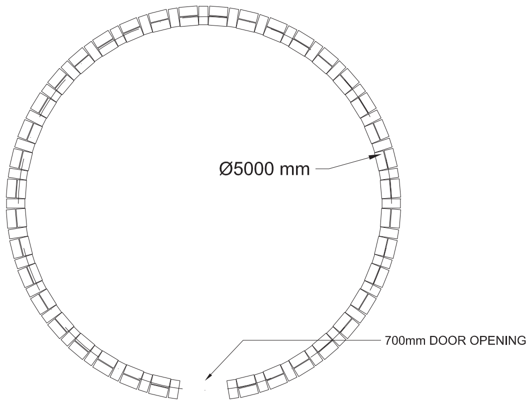
- Blocks (mud with stabilizer)
- Long wood poles for roof supports
- Grass thatch for roofing
- Branches to form base of roof supports



ELEVATION



FOUNDATION WALL PLAN



TYPICAL WALL PLAN

PROJECT: South Sudan
ACTED Shelter Consultancy

CONSULTANT: planningAlliance
110 ADEALAIDE STREET EAST, 3RD FLOOR
TORONTO, ONTARIO M5C 1K9
T 416 593 5933 F 416 583 1550

DRAWING TITLE : Shelter Drawings

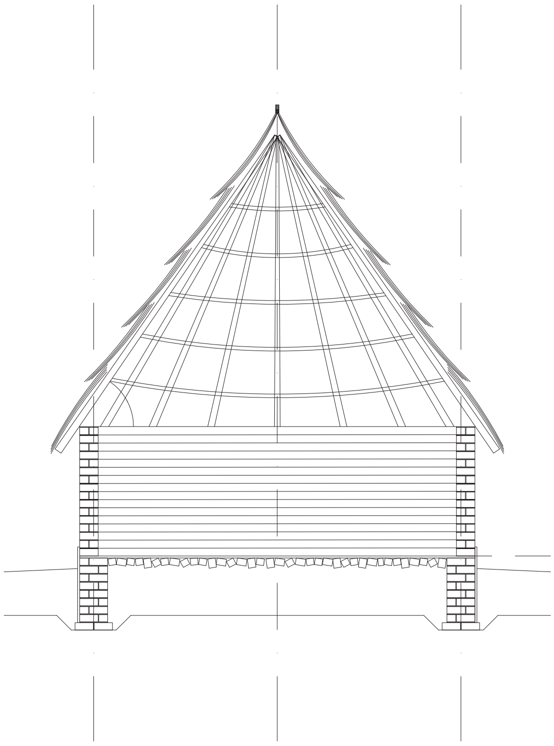
DATE: 24 OCT 13

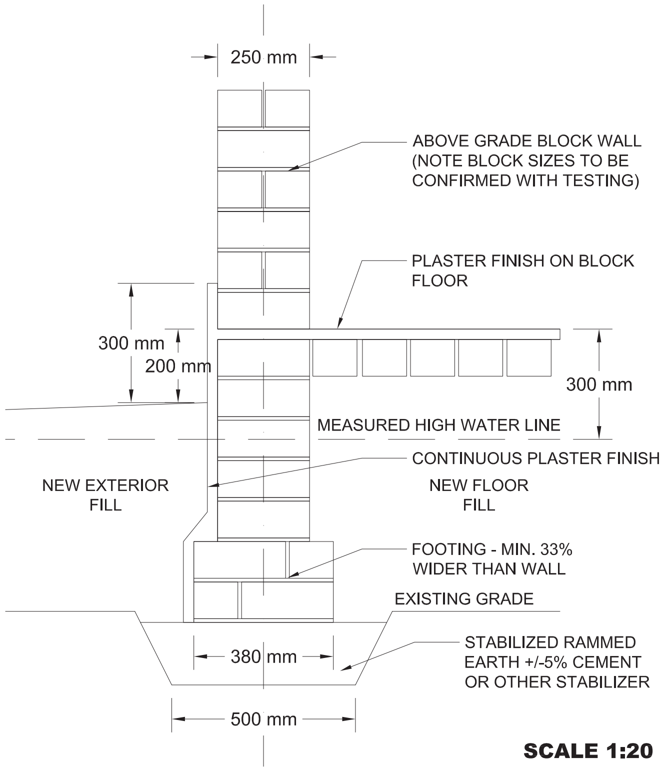
ISSUED:

SCALE: 1:50

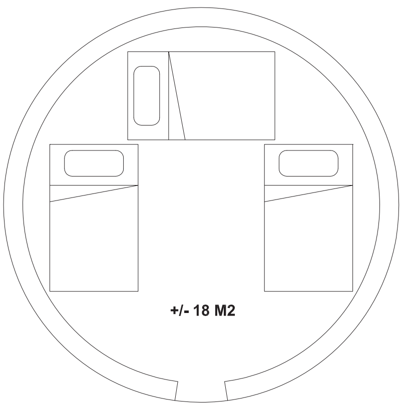
PROJ. NO: 11329

SHEET NO : A1

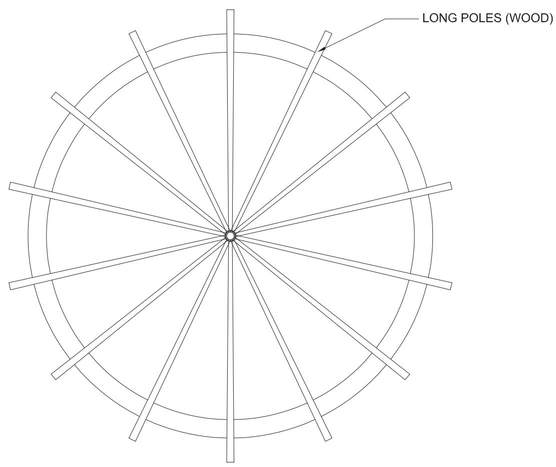




SCALE 1:20



INTERIOR LAYOUT PLAN



ROOF PLAN

PROJECT: South Sudan
ACTED Shelter Consultancy

CONSULTANT: planningAlliance
110 ADEALAIDE STREET EAST, 3RD FLOOR
TORONTO, ONTARIO M5C 1K9
T 416 593 5933 F 416 583 1550

DRAWING TITLE : Shelter Drawings

DATE: 24 OCT 13
ISSUED:

SCALE: 1:50
SHEET NO : A2
PROJ. NO: 11329

4.4 Implementation Concept Note

This section summarizes one possible approach to implementing a program to rebuild homes that were affected by flooding in the Warrap Region. The solution is one that works with local communities and as much as possible uses local resources and the capacities. The approach is intended to work closely with the community and national person's knowledgeable in construction in order to work towards a larger implementation. The recommendation is to undertake a pilot project with one or more communities to fully understand the environmental implications and how to best implement a shelter project at a larger scale.

The implementation can be broken down into three phases that relate to work requiring a Shelter Expert to be on the ground. It is anticipated that the full project would take 10 months to implement before being expanded to the larger scale. Before a design or approach can be finalized a project budget and the available assistance from ACTED needs to be established.

Phase One - Pre-Construction (3 weeks, December)

1. Support staff should be identified and communities selected for implementation prior to shelter expert arriving.
2. Community Consultation (+/- 10 meetings)
    - The community should be consulted on the program to improve shelters against future flooding as a very first step. This is to ensure that the community is willing to participate and to help them realize the extent of effort that is needed complete the undertaking.
    - A housing committee should be formed who will oversee the implementation of the program at the community level, provide training and take responsibility for progress and managing tools.
    - All households that wish to participate should be identified and the location of their shelters identified. This list should be posted in the community with the corresponding mapping.
    - Existing materials should be documented.
3. Damage Assessment
    - The extent of damage should be noted including any materials that are reusable or required.
    - A marker should be placed securely in the ground with extent of flooding recorded using a painted line. This can be based on visible water damage and confirmed with the household.
4. Materials Assessment and Procurement
    - Identify material availability, soil quality, existing livelihoods and skills in construction of housing.
    - From the various methods listed for creating a durable foundation, one should be selected with the community for implementation based on material availability.
    - Determine method for improving water resistance to foundation based on availability or funding for outside materials.
    - Once the method for construction has been decided, materials should be stockpiled.

- A coordinated plan should be made as to where soil can be obtained with the objective to also improve drainage and create water storage areas that can be used for livestock and watering of crops. Review a larger water management plan.
- Materials and tools required for block making should be distributed.
- Block making should begin as soon as possible followed by testing for strength and durability with larger scale production.
- A prototype foundation should be constructed and tested; this may be done by the support staff with guidance from the shelter expert.
- Identify locations and methods for improved latrine design that works under flooded conditions - critical for health.
- Set training and construction schedule, outline procurement required for phase two.

Phase Two - Construction (4 weeks, January-February)

1. Review initial performance of blocks and foundation.
2. Materials and tools required for construction should be distributed.
3. Location of new tukuls is to be marked out on the ground, circumferences drawn using a string and footing depth established based on soil conditions.
4. Construction of new foundation
    - Construction should be used as a method of training key community members to undertake work with the greater community.
    - Begin with digging the foundations and laying the spread footing. (see illustrative drawings for potential foundation design)
    - Once a height of 30 centimetres above the water line has been reach the foundation can be capped and sealed with the plaster.
    - Once the foundation is completed the land around is ready to be raised. Ensure it slopes away from the tukul.
5. Construction of Tukul above foundation
    - The method of constructing the new tukul may be left to the individual household, however they should be encouraged to use high quality materials and construction methods as used in the foundation.

Phase Three - Assessment and large scale implementation (2-3 weeks, October/November)

1. Review of foundation designs for durability and resistance to flooding
2. Provide recommendations for modifications are required and begin larger scale implementation with support staff and ACTED field staff.

Other Considerations

There are a number of considerations in implementing this construction project that include:

- The amount of water that may be required for a specific construction method should be coordinated with periods of the year when weather conditions are ideal and water quantities still abundant as not to use drinking water for construction.
- Construction projects should seek to improve local construction knowledge and building techniques and create livelihood opportunities that will last beyond the lifespan of the project.
- Other housing improvements should also be considered including extending the roof line

further from the walls to ensure the walls are well protected from rains and adding a threshold to the entry doors to ensure runoff water does not enter the tukul.

- Raised lands should be planted, particularly around the perimeter with soil binding vegetation. This should also include the provision for one or more larger shade trees that could also be one that produces fruit.
- Shoring the edges of the raised land with timber, bamboo, rocks etc. should be done till vegetation is established.
- Land rights should be discussed with the individual households and confirmed with the community to ensure the efforts of building the new tukul are long-term.

Implementation of a program to improve shelter designs as outlined in this report should be carried out by someone with a construction related background who has experience working with similar shelter projects.

Costs
Shelter Expert
-Professional Fees (approximately $35,000 USD)
-International Flights
-Accommodation, transportation and other logistics costs while in country

National shelter staff and logistical support staff
-Salary or hourly fees

Foundation construction
-Tools: Wheel barrows, shovels, tampers, block molds (quantity as required)
-Soil stabilizers (as required)

Tukul Construction
-Long poles (as required)

5.0 Further Recommendations

From the field assessments there were a number of other findings outside the scope of the shelter consultancy that could be form programs that run in parallel or prior to the implementation of a shelter program. These recommendations are listed here for consideration only.

The cause of the flooding needs to be further studied to understand how the area drains and the implication of raised roads on the drainage pattern. Although flooding poses many challenges the water it brings is essential for survival in this region. It is therefore recommended that a regional water management study take place to provide a strategy where by water from the rainy season can be managed as a resource and extend its use beyond the rainy season.

A majority of households affected by flooding are located on lands that are vulnerable to flooding, this is potentially due to a shortage of higher ground. With natural population growth as well as potential influx into the region it is expected that the population will grow. Similar to the regional water management strategy a regional growth plan should take place to understand natural growth rates and influx and then identify how villages can grow and where this should take place to ensure access to suitable lands for housing, pastures, agriculture and livelihoods, with minimal negative impacts from flooding.

Any shelter solution should be a coordinated effort with health, food security, water, sanitation and livelihoods to ensure the solution being implemented is a sustainable one and that communities will not abandon their houses because other basic needs cannot be met.

The importance of a coordinated effort with water and sanitation is to ensure that the effects of flooding do not cause health problems from open defecation, over flowing latrines or contaminated water sources. Latrines should take a similar approach and be located on higher ground or employ a raised plinth and a covered and sealed pit to ensure containment of excrement.

www.planningAlliance.ca