

Seasonality matters: how cyclical changes trigger drivers of acute malnutrition in Chad's Sila Province

A FEINSTEIN INTERNATIONAL CENTER BRIEF 

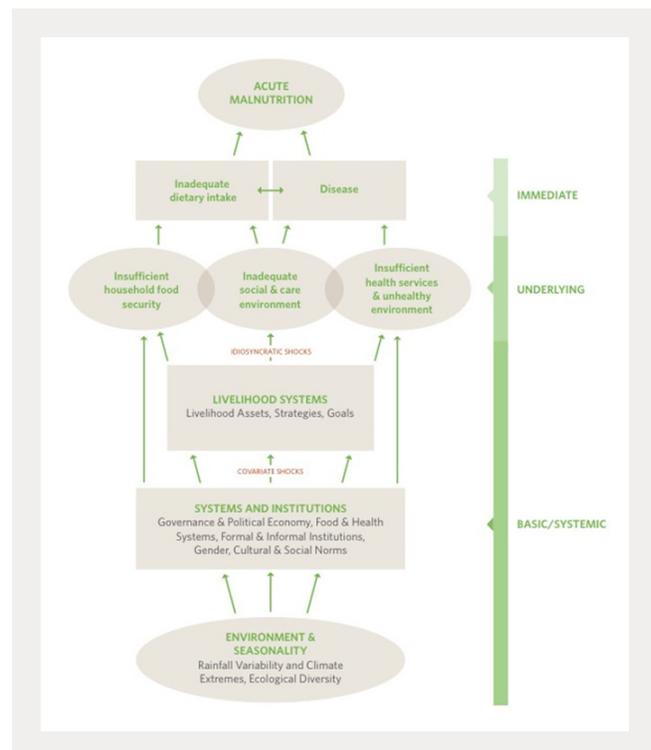
Anastasia Marshak, Gwenaëlle Luc, Anne Radday, and Helen Young

A prevalence of global acute malnutrition (GAM) above 15 percent is one of the main indicators of a humanitarian crisis. Yet GAM rates often persist above this emergency threshold beyond the acute phase of a crisis, even when assistance is provided.¹ A recent adaptation of the UNICEF Conceptual Framework for Acute Malnutrition adapted for dryland environments highlights a key gap in our understanding of the basic drivers: environment and seasonality, systems and institutions, and livelihoods.² The study identified “environment and seasonality” as a key trigger of the underlying and immediate drivers, mediated through livelihoods and institutions (see Figure 1).

This briefing paper sets out how seasonal changes in rainfall, temperature, and vegetation, mediated through livelihoods, trigger the underlying and immediate drivers of acute malnutrition in eight villages in the Sila Province of eastern Chad. This research reveals a nuanced and complex seasonal pattern of wasting characterized by two different sized peaks with likely different drivers; a primary and larger peak at the start of the rains and a secondary smaller peak prior to the harvest. As well as exploring the basic, immediate, and underlying drivers of acute malnutrition in Chad's Sila Province, this briefing paper offers recommendations for programming and evaluation that are grounded in a seasonal perspective.

This research was undertaken in collaboration between Tufts University and Concern Worldwide. The data described in this brief comes from a mixed methods study, using both qualitative interviews

Figure 1: Drivers of acute malnutrition in Africa's drylands³



and quantitative longitudinal data collection. Concern collected data on children 6-59 months across 89 households for 23 months (May 2018 – March 2020) in the Sila Province of Chad with in-depth qualitative work carried out in August 2018 and May/June 2019. For the full report, detailed description of methods, and instrument please see <https://fic.tufts.edu/research-item/seasonality-of-malnutrition-in-eastern-chad/>.

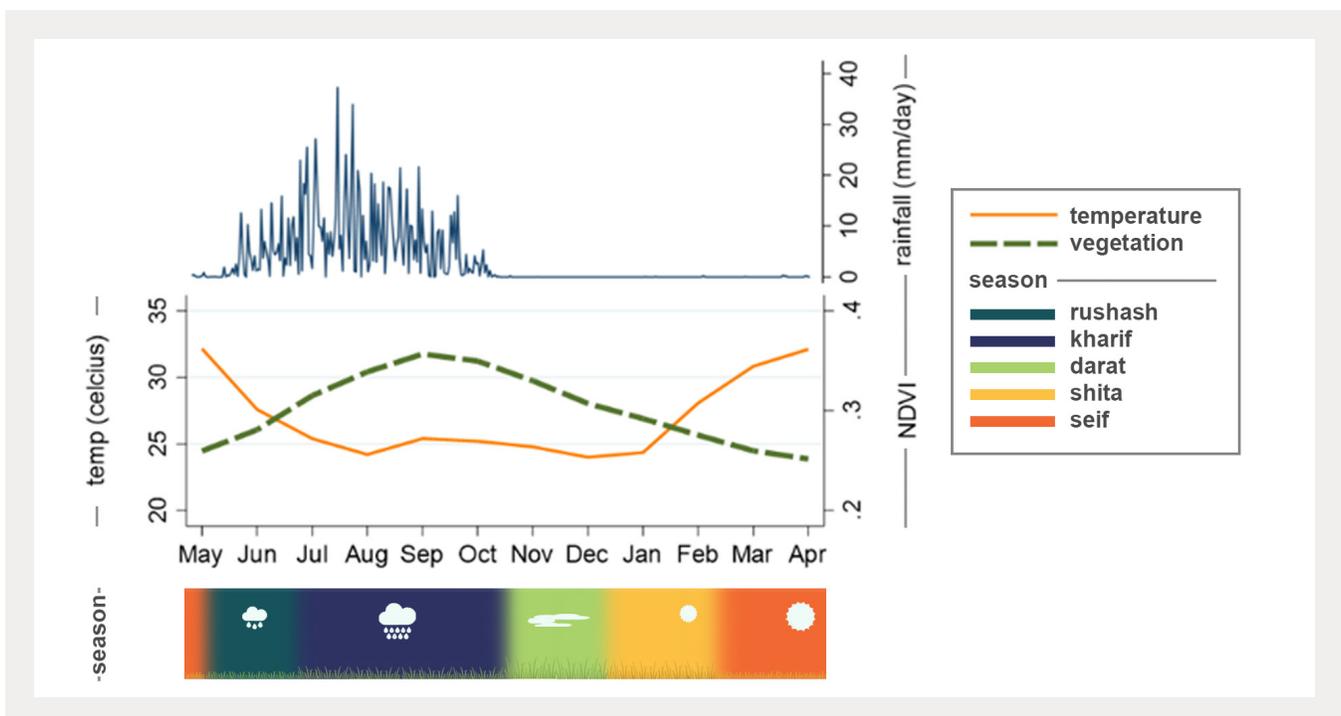
Seasonality is more complex than rainy vs dry seasons

Dryland contexts such as Chad (like much of the Sahel) are defined by their climatic variability between and within years. While we have a good snapshot of how nutrition outcomes change from year to year, primarily through the availability of data from annual standardized monitoring and assessment of relief and transition—or SMART—surveys, our understanding of *seasonal* changes in nutrition outcomes is often limited by our incomplete knowledge of the seasons themselves. Frequently, seasons in dryland contexts are described as either “dry” or “wet/rainy” or as either “pre-harvest” or “post-harvest”. However, local perspectives point to a much more complex conception of seasonality, one that encompasses the critical relationship between changes in rainfall, temperature, and vegetation on the one hand, and, on the other, human activities that ultimately form the basis of underlying and immediate drivers of acute malnutrition.

Communities in Chad distinguish between five seasons (see Figure 2), beginning with *rushash*,

the intermittent rainfall prior to the rainy season. *Rushash* is an extremely short season, usually lasting 3-5 weeks sometime between late April and early June. *Rushash* is followed by the rainy season. *Kharif* corresponds to declining temperatures and more consistent rainfall that usually lasts through the end of September. As the rains subside after *kharif* comes another short season—*darat*—when seasonal rivers are full but starting to dry out and vegetation has reached its peak. *Darat* is followed by *shita*, the cool dry season, usually around January and February. As temperatures begin to climb, access to surface water declines and vegetation is at its lowest. This is the period of *seif*, the hot dry season. *Seif* is then interrupted by the start of the rains and we are back at *rushash*. It is worth noting that while calendar months are often assigned to these seasons the precise dates are extremely variable. What is far more important than the calendar month is the corresponding changes in precipitation, temperature, and vegetation.

Figure 2: Seasons and area-averaged rainfall, temperature and vegetation⁴ (May 2018-April 2020) in Chad’s Sila Province



Basic drivers

This section explores the seasonality of the basic—or systemic—drivers of acute malnutrition with a specific focus on livelihoods, the livelihood-related mobility of humans and animals, and conflict (both marital and farmer-herder). Livelihood activities in drylands are ecologically adapted to their environment, with communities taking advantage of the seasonal changes in natural resources. However, most dryland ecosystems are characterized by climatic differences over a small area,⁵ which means that even with communities that are close to each other their respective activities may differ depending on, for example, soil types and the presence or absence of a seasonal river.⁶

Rushash

In Sila Province, *rushash* (May/June) is a critical period for crop cultivation and livestock activities, with most households practicing a mix of both. *Rushash* is therefore one of the busiest periods of the year, particularly for women, across all communities.

As the first rains come, field preparation begins with men doing the ploughing and women the seeding and weeding. Most households do not have land near their villages and have to travel several kilometers from the community. Women often move with their children to temporary settlements called *damkoutch* (Photo 1a), where they stay from *rushash* to *darat*. This allows them to save time on the daily commute and also to protect their crops from animals.

Farmers plant millet in *rushash* at the first, second, or third rainfall (usually around June) depending on the quantity of rain, the quality of the soil, and proximity to livestock migration routes. Generally, farmers with more fertile soil can plant just before the first rain, while those planting in clay soil have to wait until the third rain to give time for the water to penetrate sufficiently. Depending on the timing of the rains and their attitude to risk, food insecure households may plant millet and other crops earlier, irrespective of soil type. If the risk pays off, such households will produce an earlier harvest and improve their food security, but if their crop fails, they will have already used up a large portion of their seeds and will have a reduced yield that year.

Rushash also signals the return of thousands of livestock from medium- and long-distance migration. *Rushash* and later *darat* are the only two seasons when male herders with a large number of cattle and camels return to be near the community and then only for a short time (from one week to a month). During these periods, entire families will move together with their small and large ruminants to a *diyar* (Photo 1b), a temporary settlement between 2 and 10 kilometers away from the main settlement. Going to *diyar* is fairly new and linked with pastoralist communities becoming more sedentary. The household usually stay in the *diyar* for between one and three weeks with their animals. If there are insufficient stocks of stems and hay to feed the livestock, men will leave the *diyar* with the animals

Photo 1: Damkoutch (left), diyar (middle), and makhalaf (right)



sooner to find pasture in areas where the rains have already come and the grass has begun to grow.

The combination of returning livestock and high-intensity farming activities can contribute to conflict in *rushash*, especially as pressure on natural resources (water and pasture) increases. One such conflict occurred near Goz Beida in May 2019 over crop residues between pastoralists migrating with their herds and a primarily farming community, resulting in numerous deaths.

Kharif

As the rains start in earnest in *kharif* (July-September), farmers begin to sow cash crops such as sesame and peanuts and around September women do the second weeding. Because *kharif* is also the time when food stocks are at their lowest, women from households with limited resources need to find additional sources of income. Women will often seek employment on the plots of wealthier households, where they plough, weed, sow seed, and thresh. The need for additional income affects how much time and energy women can put into their own plots. For example, duration of stay at the *damkoutch* is strongly related to household vulnerability. Women from poorer households only stay in the *damkoutch* for short periods of intense agricultural work, returning to the community in search of other income opportunities. On the other hand, households who own livestock have more access to income during *kharif* as they can trade in milk and other livestock-based products, stay longer in a *diyar* or *damkoutch*.

Some of those interviewed for this research noted that the pressure resulting from the combination of diminishing grain stocks and increased agricultural workload sometimes led to significant marital strife during *kharif*. As this is the time women are in the greatest need of additional financial support from their husbands, there are multiple opportunities for marital conflict.

The availability of pasture during *kharif* also affects animal mobility. For households who stay at the *diyar*, after about July the animals will be brought to an encampment for cattle and herders (mostly men) called *makhalaf* (Photo 1c), located two to eight kilometers from the village in a non-cultivated zone

for the duration of *kharif*. Few women will stay in the *makhalaf* because they are working in their fields; however, they will need to go back and forth from the village to the *makhalaf* in order to milk the animals for the family's consumption and for sale.

Darat

By *darat* (November/December) the rains have mostly stopped, and the seasonal rivers will begin to dry out. Harvesting occurs at this time as does the return, for approximately a month, of medium-sized and large livestock herds to take advantage of the resulting crop residues. *Darat* is therefore the second time in the year after *rushash* when large herds are present near Goz Beida in Sila Province. As with *rushash*, the proximity of large herds of livestock to crops increases during *darat* and so does the opportunity for conflict.

Decisions on timing for long-distance livestock migration are made by the Sila Province's sultan together with district heads and village chiefs. They give dates and signals for long-distance herds to return in *darat*. For long-distance livestock mobility, the regional governor and district heads are responsible for the timing of *talaaga*, the traditional signal for animals to eat crop residues at the end of the harvest.

For women who have left the *damkoutch* to look for additional income opportunities, *darat* is also when women return to the temporary *diyar* settlement in order to harvest. At the same time, whole households who both raise livestock and grow crops will return to the *diyar* with their herds and stay there until crop residues run out.

Shita

In *shita* (January/February), water and pasture resources are no longer sufficient, so medium-sized and large livestock herds will start migrating south or east for about 20 to 50 kilometers. While most crop-growing activities have by now ended, households with access to sufficient land and seasonal rivers can derive additional income from growing vegetables in the fertile soil near the seasonal rivers that have yet to entirely dry up. Sales from these market gardens provide an additional important source of income at this time. However, as the practice of market

gardening increases, access to water points for migrating herds is reduced, creating an additional and growing source of conflict.

Seif

During *seif* (March/April), the hot dry season, there is little presence of livestock in the communities,

except for calves, or animals that are sick or milking. Nor is there any cultivation work. Some households with cash crops or access to market gardens can take advantage of increasing prices for produce at this time.

Underlying drivers

This section explores the seasonality of the key underlying drivers of acute malnutrition: food security, care practices, utilization of health services, and the hygiene environment. The measured and observed seasonality of these underlying drivers is directly related to the seasonality of livelihoods and of animal and household mobility described above, which in turn is driven by seasonal changes in precipitation, temperature, and vegetation.

Rushash

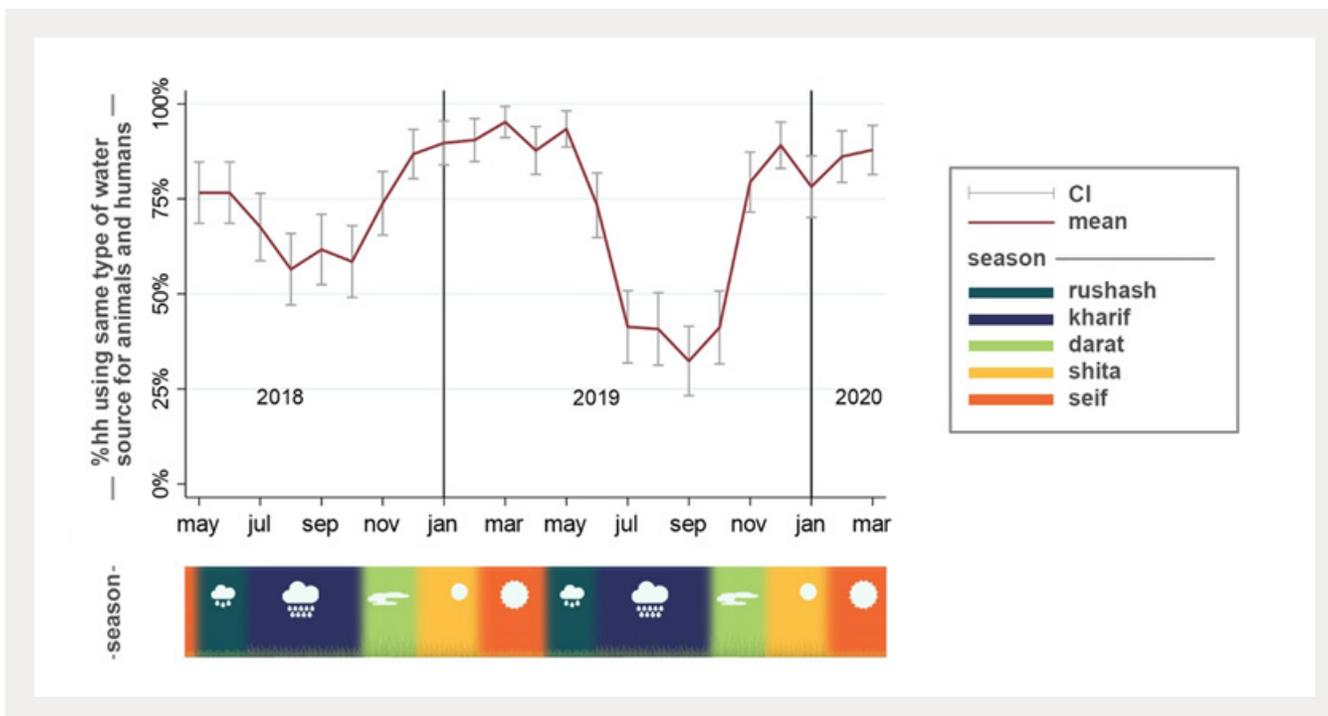
The first rains have a transformative effect on the Goz Beida area of Sila Province, particularly in relation to water access, sharing of water points between animals and humans, and resulting water quality. Gradually, during the first three rains, *hits*—deep wells dug in the dry beds of seasonal rivers—collapse and households begin to mainly rely on *machiches*—shallower wells dug into the banks

of riverbeds—or surface water that forms in small shallow ponds. Contamination levels (measured in colonies of coliform bacteria)⁷ vary greatly between different *hits* and *machiches*, but on average, these traditional water sources are more contaminated than more modern boreholes. However, boreholes, a source of potable water, were reported to not always be available during *rushash* as they break down in *seif* due to increased use and tend not to be repaired until income begins to flow in the community, usually at the end of *kharif*. A dramatic transformation was observed at the few still-viable *hits* just after the first rain in May 2019. Uses and users of the few remaining *hits* are radically different just one day apart: thousands of cattle and their male herders were replaced by women from nearby villages who used the well for collecting water and doing laundry (Photo 2).

Photo 2: The same *hit* right after the first rain in 2019: one day apart



Figure 3: Households with water resources shared by animals and humans by month and season in Chad's Sila Province (n=2405)



As medium-sized and large herds begin to return with the first rains, the pressure on the limited water sources—remaining *hits*, newly dug *machiches*, and ponds of surface water—rises significantly. The increased shared use between animals and humans is most apparent during *rushash* (Figure 3). Several of those interviewed for this research pointed out that while shared use between animals and humans is also high during *seif*, the sheer number of animals in *rushash* creates unparalleled pressure on water sources.

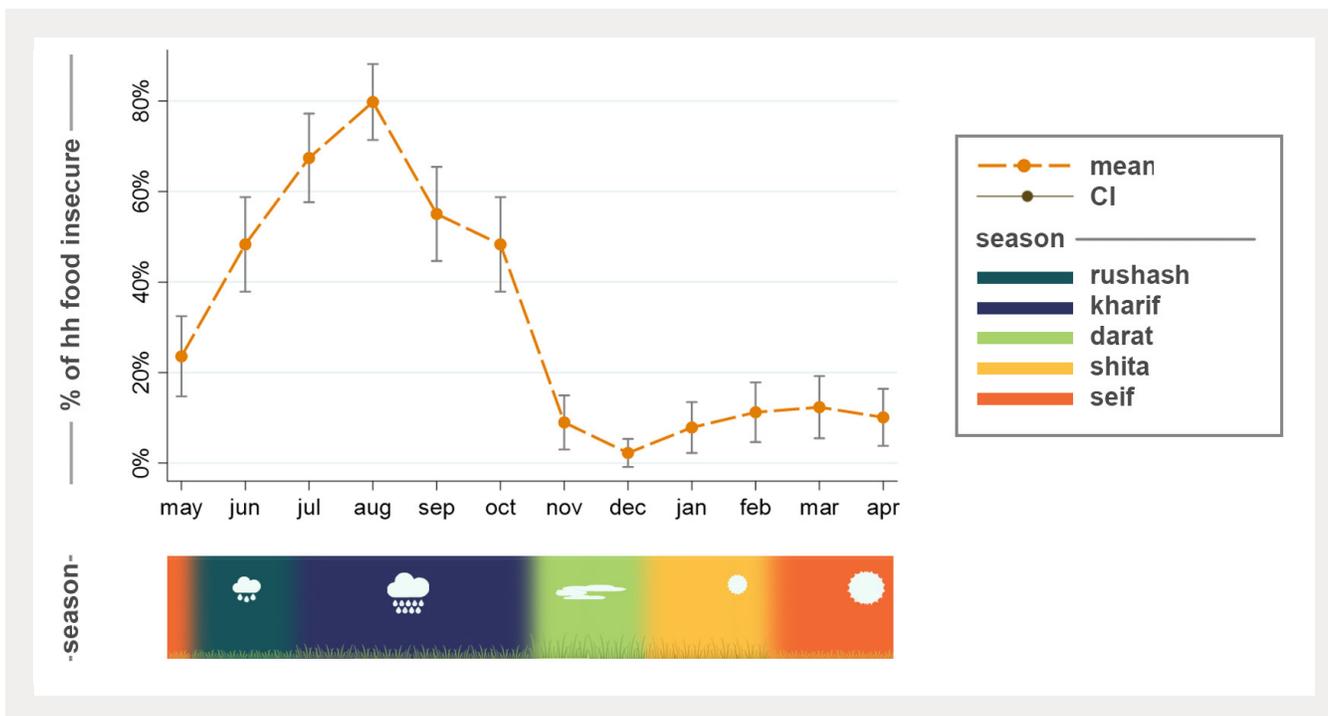
Communities regard the surface water during the first three rains as being of poor quality for both animals and humans. In fact, this perception is accurate because the first rains wash animal cadavers and fecal matter into the riverbeds and ponds. Previous research has found associations between the start of the rains/warmer temperatures and peaks in a) total dissolved solids, an indicator of potential health risks,⁸ b) *Cryptosporidium*, a parasite that can cause respiratory and gastrointestinal illness⁹ and c) bacterial intestinal infections.¹⁰ Despite the acknowledged risk by the communities, surface water is more accessible and timesaving for

women who are busy with planting at this time of the year and is therefore most likely to be utilized.

The focal point for veterinary services in Goz Beida explained that animals are most vulnerable to diseases during *rushash* due to the destruction of pasture by the first rains and the high contamination of surface water. Community members noted that livestock are sicker at the end of *shita* and the beginning of *rushash*. (One said: “the first rains fall on dirty soil and the water becomes contaminated”; another explained that at this time of year the animals “are tired and hungry from the dry season”.) Sick and weak animals are brought closer to homes so households can more easily take care of them, increasing the risk of disease transmission from animals to humans.

In general, women reported the high workload and lack of income during *rushash* and *kharif* means they cannot focus on good hygiene, nor do they have the time or resources to clean the containers used to store and transport water. The problem is exacerbated for women who stay in a *damkoutch* or *diyar*, as they have neither access to clean water

Figure 4: Household food insecurity (2017 food security data using MAHFP) by month and season in Chad's Sila Province (n=1970)



nor the time necessary to properly boil it. It is important to note that women showed a high level of awareness of *how* to keep their containers clean and to maintain basic human hygiene; they simply did not have the time or income at this time of year for these activities.

In general, women reported having less time to feed and care for children during periods of high workloads, such as *rushash*. They reported leaving children with older siblings or grandparents, preparing one meal in the morning that the children could eat while the mother worked. For women working in the *damkoutch* or *diyar*, they would frequently have to leave the younger children under a tree in the care of older siblings near the fields.

Kharif

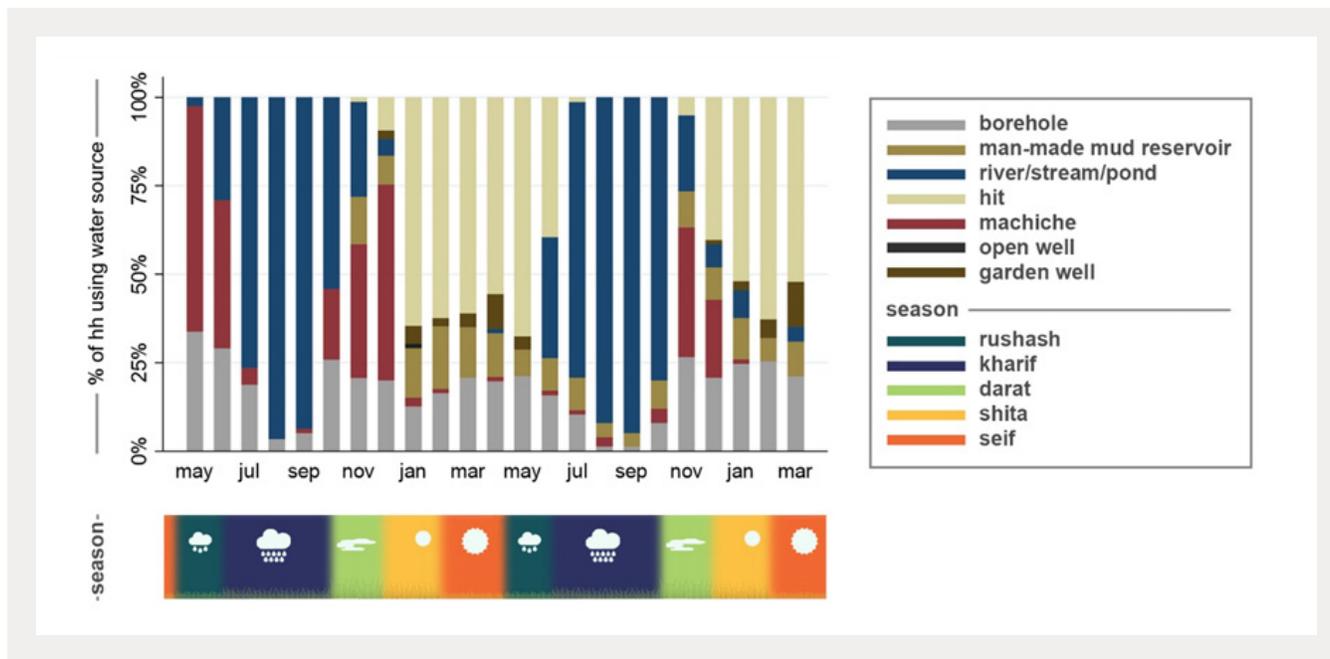
As the seasonal rivers fill during *kharif* (July-September), access to water increases. The high availability of water results in *kharif* being the period when animals and humans are least likely to share the same water source (see Figure 2 above). The increased access to water was reported to lead to

improved hygiene practices including more frequent washing of children, clothes, dishes, and water storage and transport containers. However, women still noted that heavy workloads were a significant barrier to these practices in *kharif*.

While the rainy season has the major benefit of increasing access to water, it also has a negative effect on health-seeking behavior. People reported that during *kharif* health centers can become inaccessible for villages isolated by floods. The seasonal moves to *damkoutch* or *diyar* also means that the distance to health centers increases. Furthermore, incomes are particularly stretched during *kharif*, except for households who can trade in animal-based products. The lack of access to financial resources, coupled with the high workload, further hinders utilization of health centers.

For most households, *kharif* is also the period of greatest food insecurity,¹¹ which was shown to rise rapidly throughout *kharif*, peaking in August (see Figure 4). While this period corresponds to greater production of income-generating animal milk, *kharif* is also when food stocks begin to run out and cereal

Figure 5: Type of water source used by livestock, month, and season in Chad's Sila Province (n=1832)



prices increase. A dramatic improvement in food security does not occur until households begin to harvest in *darat* (November).

Darat

The harvest period—*darat* (November/December)—is associated with the highest level of food security, with fewer than 10 percent of households reporting that they did not have enough to eat. With the harvest also comes greater access to income, which is reflected in a few other drivers. Importantly, we see an increase in reported borehole use, which is associated with the cleanest water for household consumption. People reported that boreholes tend to break down during *seif*, as there is a high demand during that time. Boreholes are then usually not fixed until after or towards the end of *kharif*, when communities can afford to pay for repairs. However, *darat* is also a period of intense agricultural work that requires women to return to the *damkoutch* and bring animals to the *diyar*. For these households, therefore, access to water is limited by what is available in these temporary encampments, which is usually surface water or water in *machiches*.

Darat is also the period when medium-sized and large herds of livestock return to the Goz Beida area to take advantage of the availability of crop residues in the fields. Seasonal rivers also start to dry out and so returning animals are more likely to get water from the *machiches* (see Figure 5), which are also used by people. Thus, sharing of water sources by animals and humans once again dramatically increases during *darat*.

Shita

Shita is the cool, dry season right after harvest (January/February). This period is associated with high food security and access to additional vegetables for households who have market gardens. While water resources are beginning to disappear, with households switching from using shallow *machiches* to using the deeper *hits*, water is still more available than during the hot and dry *seif* season and during *rushash*. The drying-up of the seasonal rivers is directly correlated with increased sharing of water sources between animals and humans, although the total number of livestock present is significantly lower as animals continue to migrate out of Goz Beida in search of better water access and pasture.

Seif

While *shita* is marked by generally good food security and some water access, community members describe *seif* as a period of greater hardship, particularly in relation to decreasing water access. This has a direct effect on hygiene practices: during *seif*, women and children usually bathe only once or twice a week due to limited

water availability. Households were also more likely to report having a separate storage and transport container for water during *seif* and going into *rushash*, likely relating to the need for longer storage times, which risk worsening water quality because of the natural growth of microbes. This threat to health may be exacerbated by recontamination resulting from the abovementioned poor hygiene practices.

Immediate drivers

This section focuses on the seasonality of the immediate drivers of acute malnutrition: morbidity (illness/disease) and food intake (the quantity and quality of food consumption by children). While data on food *quantity* was not collected during the research for this paper, information related to the seasonality of food quality and milk availability was gathered. Figure 6 sets out the prevalence of leading illnesses reported across the research period.¹²

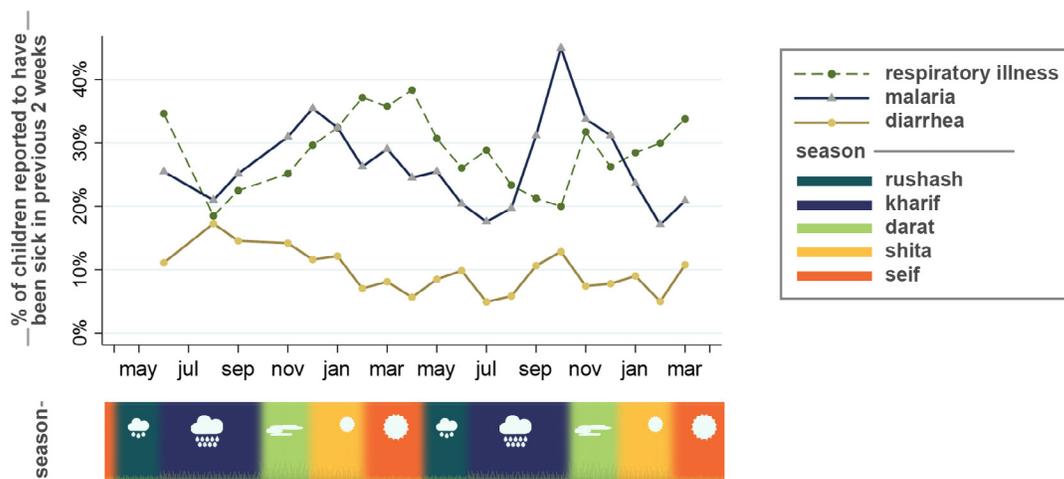
Rushash

The most common type of morbidity during *rushash* is respiratory illness. However, respiratory illness is generally on the decline during this season as rainfall

alleviates the dryness of *shita* and *seif*, with the main peak being in *seif*.

As described above, child-feeding practices are partially influenced by women's workloads. During *rushash* and *kharif* women reported not having enough time to prepare multiple daily meals or to consistently breastfeed. Instead, they might make a porridge in the morning that the child can eat throughout the day. In addition, another seasonal dimension was reported in regards to availability of breastmilk: as *rushash* and *kharif* correspond to lower household food security, women perceive that their breastmilk is of lower quality during these seasons and are accordingly less likely to breastfeed at all,

Figure 6: Morbidity among children, by type of illness, month, and season in the Sila Province of Chad (n=3400)



or are likely to breastfeed less frequently. Women also reported that early weaning of infants occurs during *rushash* and *kharif*. As men usually return from migration in advance of *darat* to help with harvesting, women reported an increase in sexual intercourse during *darat* and hence a peak of new births in *rushash* and *kharif*. Pregnancy was described as the number one reason why a child might be weaned early, not only off breastmilk, but also off their mother's physical attention and given to a grandparent or older sibling to take care of.

Kharif

Prevalence of diarrhea is fairly constant over the year, but peaks slightly at the end of *kharif*. Prevalence of malaria also starts to increase as the rainy season progresses, peaking around the end of *kharif*/beginning of *darat* (with a slight distinction across the two years of research). *Kharif* is also associated with a decrease in feeding and breastfeeding children (as in *rushash*) due to women's higher workload, a perception that the breastmilk is less nutritious due to the woman's lower food intake, and the seasonality of increased births during this period.

Access to animal milk is also extremely seasonal. Wealthier households and those with access to milk-producing livestock add dairy products to children's porridge during *kharif* and *darat*. Cow milk is mainly produced and sold during *kharif*. Access to milk is also dependent on arrangements with communities that have large herds. Milk is sold at market during *kharif* and may be exchanged or sold between

neighboring communities. For everyone else, *kharif* represents the period of lowest food diversity for children (and for that matter adults, too).

Darat

Darat is the peak period for malaria, as it corresponds to the end of the rainy season and a high presence of standing pools of water, ideal breeding grounds for mosquitoes. However, *darat* is also the best time of the year when it comes to dietary diversity as it is the harvest period. Women reported that in *darat* they frequently add crushed peanuts, sesame, goat milk, and oil to children's porridge.

Shita

During *shita*, we start seeing a decline in malaria, but also the beginning of an increase in respiratory illness corresponding to the increased dryness. Access to a diversity of food, including goat milk, is still high in *shita*, though it begins to decline during this period, except in wealthier households who have access to vegetables grown near a seasonal river at this time.

Seif

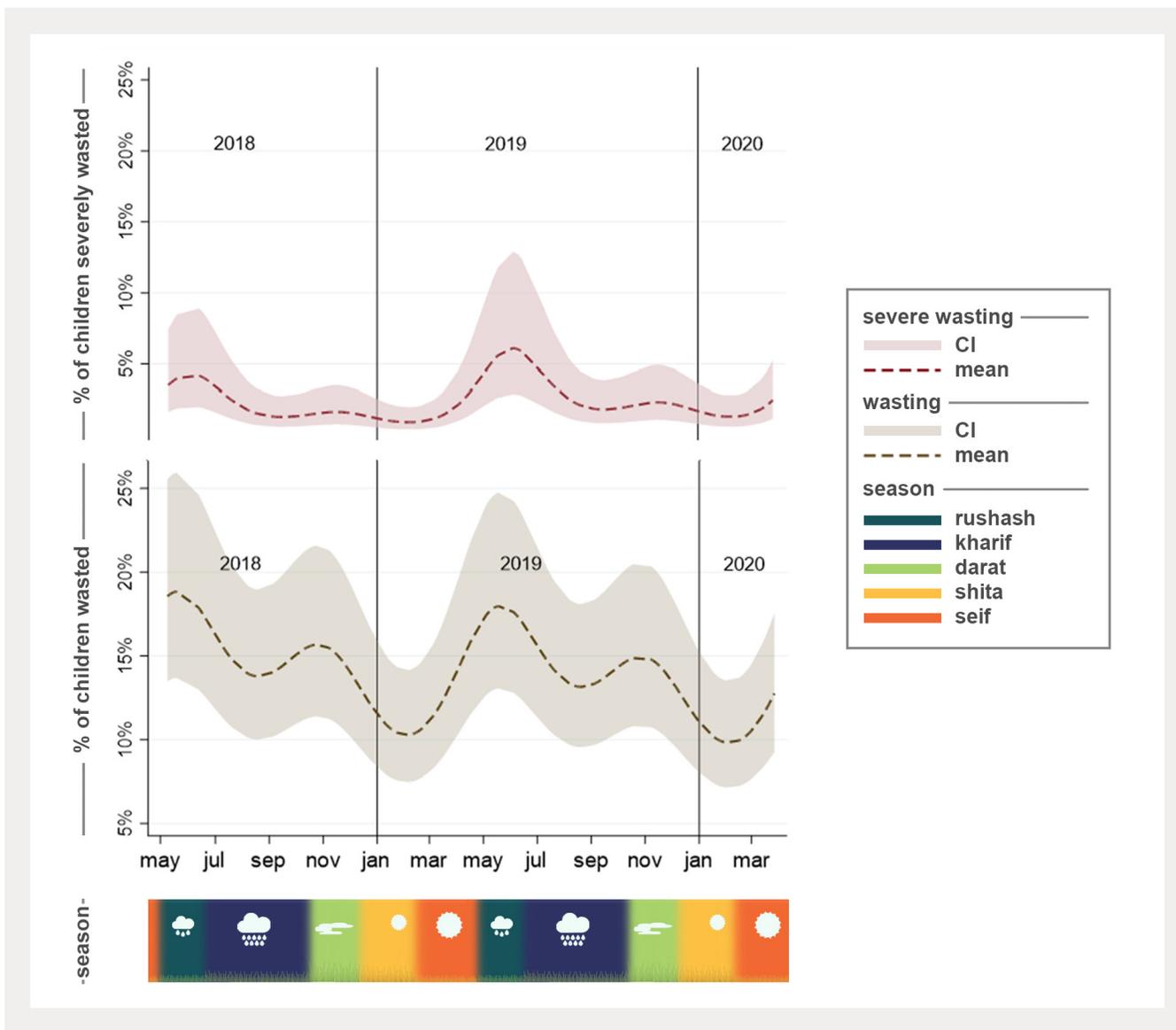
Prevalence of respiratory illness climbs dramatically during *seif*, with a peak corresponding to the end of *seif* and beginning of *rushash*. Similar to *shita*, *seif* is a period of declining quality and diversity in available food, but is still significantly better than what is described in *rushash* and *kharif*.

Acute malnutrition is highly seasonal, with two annual peaks and multiple seasonal drivers

The research for this paper identified two peaks of wasting and severe wasting (see Figure 7) in Sila Province. The highest peak was in *rushash* (May) and the secondary peak was at the end of *kharif*/beginning of *darat* (October), with a decline in wasting prevalence during *kharif* (June through

September). The lowest level of wasting was observed during *shita* (January/February). A recent seasonal analysis of 20 years of SMART data found a similar seasonal pattern with two peaks of wasting during *rushash* and prior to *darat* across the Sahel more broadly.¹³

Figure 7: Predicted prevalence of severe wasting (top) and wasting (bottom) by Month and Season in Sila Province, Chad (n=2558)



Outside of this study and a separate analysis of nutrition survey data carried out by Tufts and the Food and Agriculture Organization of the UN,¹⁴ this “twin peak” seasonal pattern in wasting has not been generally identified in other studies. Instead the predominant narrative around the seasonality of wasting is that it peaks once during the rainy season—also referred to as the “hunger gap” or “lean season”—due to a combination of decreased food security and greater disease burden, particularly malaria. However, in the light of the seasonal patterns related to drivers (see Table 1), the presence

of two annual peaks—during *rushash* and prior to *darat*, with an improvement in wasting during *kharif*—is far less surprising.

The *rushash* peak of wasting corresponds to the time of year when: water access is the most limited; cadavers and fecal matter are washed in with the first rains; animals and humans are more likely to share the same source of water; and the presence of large ruminants begins to increase, putting added pressure on water sources. This season is also identified as the one when animals are the most

likely to be sick. These challenges likely result in increased water contamination, particularly from cattle possibly introducing *Cryptosporidium parvum* into water sources. This parasite can cause intestinal disease in children, reducing their ability to absorb nutrients.

In addition, *rushash* is associated with an increased workload for women; preparing fields for planting leaves less time to care for and breastfeed children. Moreover, lack of access to agricultural land near the communities means many women move to temporary settlements during *rushash* and *kharif*, leaving their children in their care of grandparents or older siblings and thereby more likely to consume water instead of breastmilk just when water

sources could be most contaminated. On the other hand, the wasting peak immediately prior to *darat* corresponds to the period of lowest food security and a greater burden of malaria. This second, smaller peak amongst children in Sila likely reflects the more traditional thinking that food intake and morbidity (particularly malaria) are the main drivers of child wasting. Malaria is often associated with the wet season, rather than the period immediately after the rains, perhaps because of a prevailing binary understanding seasonality (i.e. rainy versus dry season). When research looks at more frequent data collection, the evidence base for a peak of malaria immediately *after* the rainy season is more apparent.¹⁵

Table 1: Basic, immediate, and underlying drivers of acute malnutrition, by season in Sila Province, Chad

			<i>rushash</i>	<i>kharif</i>	<i>darat</i>	<i>shita</i>	<i>seif</i>
Basic Drivers	Environment	Rainfall					
		Temperature					
		Vegetation					
	Livelihoods	Livestock close to communities					
		Farmer-herder conflict					
		Women's workload					
		Women in <i>damkoutch</i> or <i>diyar</i>					
Underlying drivers	Food insecurity	Food insecurity					
	Inadequate social and care environment	Less time with children					
		Poor hygiene behaviors					
	Insufficient health services and unhealth environment	Poor health seeking behavior					
		Poor water access					
		Sharing water with animals					
		Animal disease					
Immediate Drivers	Food intake	Poor milk access					
		Reduced breastfeeding					
	Morbidity	Malaria					
		Respiratory illness					
		Diarrhea					
Acute Malnutrition							

Note: darker colors indicate a driver is a greater problem during the season, compared to lighter colors. Blank cells indicate the driver was not identified by either qualitative or quantitative data.

Implications for practitioners, policymakers, and researchers

The research conducted for this study indicates a nuanced and complex pattern of seasonality of child wasting with different seasonal drivers. An improved understanding of the seasonality of acute malnutrition and its different seasonal drivers, rooted in local knowledge and longitudinal data collection, could go a long way in improving program impact, as well as the ability to measure progress. Programs that address the appropriate seasonal driver as well as timelier outreach and treatment services could help prevent the observed seasonal peaks in acute malnutrition. In this section, we set out some recommendations for program design and evaluation.

Invest in formative research with an eye towards seasonality

Where programs aim to have a longer-term sustainable impact, it is essential to first invest in formative research,¹⁶ such as a contextual analysis, to identify seasonal patterns of wasting and associated drivers. Seasonality serves as a trigger of the underlying drivers (food security, care practices, hygiene environment, and health access) and the immediate drivers (food intake and disease) of acute malnutrition, mediated through institutions and livelihoods. It is therefore critical for researchers and organizations to try to understand this seasonality prior to program design through participatory qualitative methods (i.e. listening to communities) and multiple quantitative observations within the course of one year (longitudinal data) that are grounded in local understanding.

Tailor programs and messaging to seasons

Programs aimed at preventing acute malnutrition need to be multi-sectoral—addressing not only the many different underlying and immediate drivers, but also the appropriate driver at the right time. Such an approach is already common in programming around agriculture, such as climate smart activities or the prepositioning of seeds and tools in advance of the planting and harvesting seasons. A seasonal mindset is far less common for other sectors, such as water, hygiene, and sanitation (WASH); gender; and health and nutrition. However, the research for this paper identified two differently-sized wasting peaks within

the course of one year, with very different drivers. Thus, while prior to *darat* wasting might correspond to low food security given that the season comes right before the harvest, the *rushash* peak suggests infectious disease and water contamination are key drivers then. A seasonal programmatic mindset would foster greater efficiency and integration across programs as it would allow organizations to focus on specific drivers at specific times of the year. Moreover, tailoring different programs and messaging to specific times of year—rather than encouraging households to address all risk all the time – might make the adoption of those messages more manageable for households.

- **Water management and hygiene**
In the Sila Province (and most likely in the Sahel drylands more generally) programs and messaging related to WASH should focus on *seif* and *rushash*, when water access diminishes and the risk of contamination increases. Messaging during *rushash* should emphasize the dangers of contaminated water sources during the first weeks of rain, not just for consumption but also for children’s play. Support for boreholes would also be most relevant at this time of year, but would be highly inefficient during *kharif* as households have sufficient access to multiple water sources at this time, when there also appears to be a lesser risk of water contamination.
- **Food security, childcare, and feeding**
Messaging around exclusive breastfeeding should be adapted to give extra emphasis on *rushash*, given the higher risk of infants consuming contaminated water. An important consideration around breastfeeding messaging is the reported increase in births that might be occurring during *rushash* and *kharif*. Programs around improving food security and dietary intake would be most effective during *kharif* in order to prevent the second peak of wasting.
- **Outreach and support for women and children in *damkoutch* and *diyar***
Additional consideration should be made for women and children who are not in their communities, but rather in the *damkoutch* or

diyar. Women and children in these temporary settlements would not benefit from a functioning borehole or other interventions put in place at the village level. During *rushash* and *kharif*, programs need to consider how to bring messaging and services around water, feeding practices, care practices, and health services to the temporary settlements.

Monitor and evaluate key outcomes by season

All data collection should be designed and analyzed with a view to the specific drivers of acute malnutrition associated with that season. For example, nutrition surveys should be carried out during *rushash* and *darat*, when the risk of wasting is greatest. This has implications for the timing of SMART surveys, for routine monitoring, and for

the evaluation of interventions aimed at preventing wasting. Similarly, programs that address the drivers of acute malnutrition should be evaluated at the appropriate time of year. Without a more focused monitoring and evaluation data collection scheme the impact of programs and interventions run the risk of being under- or over-estimated.

The encouraging news is that during *shita* wasting prevalence drops to near the 2025 SDG target, a finding that corresponds to the lack of reported drivers during this season in either the qualitative or quantitative research (Table 1). If programs and policies properly address the identified drivers of acute malnutrition, it is therefore reasonable to assume that the SDG wasting targets can be attained in Chad across the entire year.

- 1 H. Young and A. Marshak. 2017. "Persistent Global Acute Malnutrition." Feinstein International Center, Tufts University.
- 2 H. Young. 2020. "Nutrition in Africa's drylands: A conceptual framework for addressing acute malnutrition." Feinstein International Center, Tufts University.
- 3 Adapted from: H. Young. 2020. Op. cit.
- 4 Expressed here using the normalized difference vegetation index (NDVI), which uses remote sensing data to show whether an observed area contains live green vegetation as well as the health of that vegetation. The spectrum of NDVIs ranges from -1.0 to +1.0, with dense vegetation generating positive values.
- 5 C. Hutchinson and S. Hermann. 2008. *The Future of Arid Lands - Revisited: A Review of 50 Years of Drylands Research*. Paris: UNESCO Publishing.
- 6 This paper does not attempt to provide an exhaustive account of all drivers across all seasons; only issues raised during respondent interviews or captured in quantitative survey data are covered.
- 7 Coliform bacteria are present in the feces of all warm-blooded animals, including humans. While unlikely to cause illness themselves, their presence in water is a strong indicator of contamination by other, disease-causing organisms.
- 8 A. V. Kulinkina, et al. 2016. "Seasonality of water quality and diarrheal disease counts in urban and rural settings in south India." *Scientific Reports*. 6: 20521.
- 9 J. S. Jagai, et al. 2012. "Seasonality of rotavirus in South Asia: a meta-analysis approach assessing associations with temperature, precipitation, and vegetation index." *PLoS One* 7(5): e38168.
- 10 L. A. Kelly-Hope. 2008. "Temporal trends and climatic factors associated with bacterial enteric diseases in Vietnam, 1991-2001." *Environmental Health Perspectives* 116(1): 7-12.
- 11 Measured using the Months of Adequate Household Food Provisioning indicator.
- 12 Respondents were asked about morbidity during the two weeks prior to each interview. This data was not independently confirmed by the researchers.
- 13 FAO and Tufts. 2019. "Twin peaks: the seasonality of acute malnutrition, conflict, and environmental factors in Chad, South Sudan, and the Sudan." Rome and Boston: Food and Agricultural Organization.
- 14 Ibid.
- 15 M. Toure et al. 2016. "Seasonality and shift in age-specific malaria prevalence and incidence in Binko and Carriere villages close to the lake in Selingue, Mali." *Malaria Journal*. 15: 219.
- 16 The US Centers for Disease Control and Prevention defines formative research as "the process by which researchers or public health practitioners define a community of interest, determine how to access that community, and describe the attributes of the community that are relevant to a specific public health issue."

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