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Measuring the Resilience of Livelihoods in Darfur: The Income Streams Index

TAADOUD II PROGRAM

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Caption: Cards depicting livelihood activities used during Income Streams Index (ISI) interviews. Illustrations by Darah Hafiz Abdalla.

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Executive Summary

This report summarizes the major learning points of a three-year panel study (August 2018 to September 2021) on livelihood resilience in three very different areas in Darfur. Through this final report, we answer the research question as posed in the protocol:

> *How do investments in different livelihood activities relate to the various phases or aspects of resilient livelihoods? [These phases include] proactive mitigation against potential shocks (reducing sensitivity and exposure), adaptation while experiencing a shock (both to protect livelihoods and to continue to support households) and building or rebuilding livelihoods after a shock.*

Livelihoods are the way people accumulate and use their assets to meet their needs and wants. They are central to people's resilience. Livelihoods are structured with potential shocks in mind, to reduce exposure to these shocks and to mitigate their impact (DFID 1999). People attempt to maximize the benefit they can extract out of their livelihood system while simultaneously reducing risks to their lives and livelihoods. People use their livelihood strategies to try to build assets of all types, in part to support themselves generally. Just as importantly, they are also working to accumulate certain types of assets specifically to draw upon to pay expenses resulting from a shock, or to cover their basic needs during a crisis that may affect immediate income.

Within a particular livelihood system, different elements are constantly changing: the economy, institutions, political systems, norms, demographics, even climate. As the system changes, livelihood strategies of individual households also change to continually maximize benefits while reducing risks (Fitzpatrick, Satti, and Ahmed 2021). Where possible, people try to influence these systems to benefit themselves and their livelihoods.

This study provides evidence that people's responses to mitigate impact or to cope during a shock depends more on the household's level of engagement in various livelihood activities than it does on the nature of the shock. Nevertheless, certain aspects of shocks, such as predictability and urgency of the need to respond, do have an important influence.

By definition, that people use livelihoods to support themselves and their ability to continue to do so in the face of shocks is a reflection of their resilience (DFID 2011). A major finding of this study is that people both protect their livelihoods in the face of shocks and strategically use assets, skills, and other resources associated with their livelihood strategies as responses to shocks in ways that have the least negative impact on their strategies. **The way people respond to shocks strongly reflects their livelihood specializations[1] and, very importantly, how successful they have been in those specializations.**

This study collected the data used in this report while developing the Income Streams Index (ISI) score. This score is based on a weighted combination of the proportion of a household's time and resources invested in the most-preferred activities, and the proportion of their income derived from those activities. The study participants' preference for certain activities was calculated from a weighting exercise with participants at baseline. Their preferences, they explained, were based on maximizing relative benefits while minimizing relative risk associated with the activities they were able to engage in. These activities were organized into four different categories or "tiers" based on the preference weights provided by the study participants.

The ISI score was sensitive enough to reflect the relationship between a household's level of engagement in preferred livelihood activities and the ability of a household to absorb the impact of a shock or to avoid resorting to less-favorable responses to a shock. This finding confirms the

1 A livelihood specialization is a particular set of skills and assets that permits a household to do certain activities especially well. This study sample included three livelihood specializations: cultivation (farming), pastoralism/agro-pastoralism, and nomadic/mobile pastoralism.

population's initial description of resilience during the Taadoud I Scoping Study, in terms of which activities they were able to engage in at critical moments in relation to shocks and recovery from shocks (Fitzpatrick and Young 2016). Although the ISI score and food security measures tracked pretty closely through most of the study period, as the entire system became increasingly stressed by COVID-19, insecurity, and ever-worsening hyperinflation, and as food aid entered the picture, the two measures diverged. Food security scores reflect the ability of the household to meet their immediate food needs, but not the ability of the household to leverage resources when challenged by a shock. Households with a higher ISI score were more likely to simply absorb the impact of shock or to respond to it in a more positive way, regardless of their food insecurity scores. **In these times of prolonged stress, the ISI score was a better predictor than food security of people's ability to cope with shocks.**

Households were most intensely focused on cultivation and livestock herding (the most-preferred activities) during the exceptional rains leading to the bumper harvest in 2018. After years of struggling, households used their surplus production to invest in their preferred activities: livestock and cultivation. Farmers used the surplus to expand their primary activity (cultivation) but also to purchase small livestock, mostly as a resilience strategy. Small livestock provided an asset that generally maintained its value, and which could be easily sold to pay the expenses associated with a shock. Pastoralists also invested in their primary activity (their herds), often focusing on large livestock for the long-term income, while they also expanded cultivation to increase the productivity of the herds. Pastoralists invested in small livestock to provide a means to cover daily expenses and as a ready source of cash to pay for expenses following a shock.

These investments highlighted the role and importance of small livestock, especially goats, in Darfurian resilience strategies, especially for the most vulnerable households with few other assets and poor income opportunities. **The value of small livestock as a response to shocks remained throughout the three years, though farming households rarely invested beyond a herd of three or four animals**. Few shocks required more funds than could be provided by that number of goats. As goats were not generally an income strategy, rather a shock response strategy, beyond three or four animals, the cost of care and maintenance exceeded their intermittent benefit.

With improved security and transportation infrastructure during the first year of the study, long unsatisfied urban demand for fresh, perishable vegetables reached new areas of rural Darfur. At the same time, households that settled in many of the study areas are cultivating rainfed land that previous residents had cultivated prior to the conflict. As these previous residents could not cultivate as much grain as previously, many capitalized on the increased access to urban fresh vegetable markets by investing in irrigated vegetable production. This type of land is typically very limited (and was not available in the Central Darfur sampled locality), but with mechanized water pumps, the area that could be irrigated was significantly increased. Not only did vegetable cultivation provide additional income to make up for the lost access to rainfed land, but during the dry season it also provided a positive occupation (as opposed to negative occupations such as charcoal production) during a season when household labor was freed from the heavy demands of rainfed cultivation.

Over the three-year period of this study, households continued to invest heavily in the preferred activities, but gains were undercut by inflation that accelerated into hyperinflation that reached 350% during the latter part of the study period. COVID-19 pandemic policies and increased insecurity in West Darfur limited market access to major urban areas and reduced the profitability of many of the more-preferred supplemental activities (most of which were commercial in nature). A previous trend toward cash crops reversed as households returned to grain cultivation to reduce food purchases. Even though selling prices for grain improved, households reported trying to use grain less as a source of income and where possible supplementing income with labor and collection of firewood.

In general, the ISI scores indicated that at baseline (2018) the especially good rains allowed households to build up their livelihood strategies so that they have withstood a multitude of idiosyncratic shocks as well as the major covariate shocks of the general economic situation, COVID-19 containment measures, and, in some areas, insecurity. Nevertheless, toward the end of the study period (2021), these protracted shocks were beginning to erode livelihood strategies, with some households resuming negative strategies. The need to use negative coping strategies was partly reduced by food aid in some areas. Although there are many details that differ greatly by livelihood specialization or state, the general concepts and trends over time were similar across the three study areas.

Reflections on the ISI score as a resilience measurement tool

The ISI score is a weighted composite of three different components: income, time use, and expenditure. The three components reflect the reality that the benefits (income) derived from specific activities or portfolios of activities do not always come at the same time that a household invests their time and resources (through expenditures). Over the entire three years of the study, the total ISI score was a better predictor of how people responded to shocks than any one of the ISI component scores alone or the food security measures.

Like similar indexes, the ISI score itself varies by season, location, and even livelihood specialization. As such, **the ISI score is more appropriately used for comparisons of populations over time to monitor trends than it is for comparisons between specializations or contexts.** The data that are collected to build the ISI are incredibly rich in detail, and the data allow certain comparisons of specific aspects between groups and contexts. Year-on-year comparisons of the ISI score in the same season detect major, general trends in livelihoods and resilience. **Most rural livelihoods, though, have a strong seasonal component, and scores at different points in a specialization's annual cycle of activities can shed light on different aspects of their livelihoods and the resilience of those livelihoods.**

Since we have used responses to shocks as a comparison measure of resilience, we might ask why anyone should make the effort to construct an index at all instead of simply tracking how households are responding to shocks. As noted above, a large amount of very informative data are incorporated, and the ISI index does not depend on experiencing a shock to see how the household responds. These data on their own provide insights into changes over time that are not shock dependent and so would not be revealed by simply tracking responses to shocks. **The ISI data helped us to understand how the ability to engage in the more-preferred activities is associated with changes in the context and the role that different activities play in a strategy.** For example, the activities that were second in preference, like donkey cart rentals or petty commerce (Tier 2), were not often used as a resilience strategy (i.e., households were not diversifying their activities to diversify risk). Rather, people invested in these secondary activities when they could not expand their preferred (Tier 1) activities, either due to limitations in opportunity (for example, limited land for cultivation) or because their preferred activities were already so extensive that additional direct investment gave lower marginal gains than investment in a supplementary activity. These are all dynamics that emerge only when looking at how households combine activities and how they draw benefits from them.

The interviews used in this study contained more elements than needed to calculate an ISI score in order to see how the ISI score behaved in relation to other measures. They were, therefore, more demanding and time-consuming than the interviews that would be used for program monitoring and evaluation. The basic data to calculate the ISI score are fairly simple and quick to gather, but the data produced require an understanding of livelihoods and the context to fully understand and analyze. **If the intention is to closely examine the data, rather than simply use the ISI score as a stand-alone summary measure of resilience, then it is worth the effort to gather and interpret the data necessary for the ISI score.** If the team lacks the expertise, willingness, or resources to examine the data to understand the underlying dynamics or the team just wants to monitor one component of resilience, then a simple survey of shocks (even if just idiosyncratic

shocks) and associated responses may be more appropriate, categorizing the responses by their potential negative longer-term impacts.

Key takeaways

1. Cultivation and livestock rearing are the most-preferred activities, central to livelihood strategies and the economy of Darfur, and even to the whole of the Sudan.

a. More engagement in these activities predicted better outcomes and responses to shocks, a major aspect of resilience.

b. The poorest farmers lacked access to key livelihood resources, either appropriate land or labor and sometimes both.

c. Those activities most favored after livestock and cultivation, such as donkey cart rentals or petty commerce (Tier 2 activities), vary widely, require significant investment in capital, and have limited scalability. People mostly engaged in these activities as a way to *supplement* income earned from the most-preferred activities and rarely as a means of diversifying income to spread risk.

2. A household's response to a shock was best predicted by factors associated with their livelihood specialization and their level of engagement in livestock or cultivation activities, rather than by household composition or the shock itself.

a. Farmers were more likely to sell agricultural produce or seek agricultural labor as a response to a shock. Pastoralists were more likely to sell an animal or to seek support from their networks in response to a shock.

b. The exception was that sudden shocks that required a relatively large, urgent expenditure were more likely to result in the sale of an asset, very often a goat, regardless of livelihood specialization or the number of those assets owned.

c. Households with the most engagement in the more-preferred activities (especially among farmers) were the most likely to simply absorb the shock and were sometimes able to cover shock-related expenses from their usual income.

d. Pastoralists with the least engagement in their preferred activities were less likely to sell large animals (they only sold smaller animals) or to seek support from their networks. Farmers with low engagement in cultivation or livestock rearing were more likely to resort to agricultural labor, the collection of natural resources (firewood, grasses), or making charcoal.

3. Goats played a unique role in livelihoods and resilience.

a. Farmers seldom reared goats as a source of income for daily expenses; rather goats served more often to store wealth in a form that could be easily turned into cash in response to a shock.

b. All livelihood specializations used the sale of goats as a common response to shocks, often with the aim of protecting assets more central to the livelihood strategy (for example, grain for farmers; more commercially viable livestock for pastoralists).

c. Farming specialists seldom sought to own more than a few goats. They only kept enough goats so that sales of goats produced would cover the cost of the goats' maintenance and the cost of most shocks. Goats are the one type of livestock that women could consistently own throughout the study population. Women could usually sell goats they own without consulting their husbands, allowing women to respond quickly to idiosyncratic shocks when the husband was not present. Nevertheless, even farming women rarely sold goats except in response to a shock.

4. Successive years of good rain bolstered recovery from the conflict by supporting production of both livestock and crops, but these gains have been eroded by nation-wide and local covariate shocks.

a. Households experience far more idiosyncratic shocks than covariate shocks, and these do eat away at gains in livelihoods. But because these shocks only affect a few households at a time, they do not compromise the system in which livelihoods function, facilitating faster or more complete recovery.

b. Covariate shocks, especially at the national, and even global, level undermine the effectiveness of livelihood strategies and

support from others. These shocks, especially when protracted, affect the very systems and institutions these households use in their livelihood and coping strategies.

c. Spiraling hyperinflation and reduced market access during the COVID-19 pandemic-related lockdowns have changed the dynamics, preferences, incentives, and disincentives within the livelihood system, thus changing the system itself, possibly only temporarily. Market-based activities that were previously very lucrative became less lucrative as purchasing power and market access were both reduced. As food prices rose, household's own production, especially grain crops, became more valued as a source of food as opposed to primarily a source of income—and the pendulum shifted back from cash crops to food grain crops.

d. Where food aid was made available, households consumed the food aid. This protected assets (like grain or livestock) that might otherwise have been sold to pay for food and allowed households to pay for other cash needs.

e. Cash-based activities like the savings groups spontaneously shifted from keeping capital as cash to asset-based activities like communal investment in livestock to counter the effects of inflation. While this protected the value of the capital held by the savings groups and even provided some returns to investors, it reduced the ability of the group to respond to individual households' shock-related needs.

6. The ISI score was a better predictor for a household's ability to cope with and recover from a shock than other indicators such as food security, household composition, or the nature of a shock.

a. The ISI score evaluates the resilience of a household's livelihood strategy and predicts the household's ability to absorb or respond to shocks without having to resort to strategies that harmed the environment or their own ability to generate future income.

b. This ISI score as a measure of resilience may be helpful in tracking trends in resilience and recovery from covariate shocks but is generally less sensitive to moderate idiosyncratic shocks.

c. The ISI score has proven a useful population measure that compares one point in time with another within the same population, but it is less appropriate for comparing one population with another who may have different strategies or a different context.

d. The data from which the ISI score is derived provide detailed information, which allows for comparisons on how different populations structure their livelihood strategies and potentially highlights inequalities and vulnerabilities within populations.

e. Food security was only loosely correlated with the ISI score and differed by livelihood specialization. They are clearly different, though related, concepts.

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Although this study was led by the Feinstein International Center, Friedman School of Nutrition Science and Policy at Tufts University, it was implemented through the combined effort of multiple members of the Taadoud consortium, including Catholic Relief Services (CRS), Norwegian Church Aid (NCA), Oxfam USA, and the Catholic Agency for Overseas Development (CAFOD).

The vision and support of Hamid Mohammed Adam of CRS was especially crucial to the initiation and continuation of the study through a very difficult period. Mohammed Ahmed Adduma Musa provided consistent, thoughtful, timely support on many important details. Helen Young provided irreplaceable insights and leadership throughout. Anne Radday provided numerous types of support that were not always visible but ensured the study remained on track.

Three teams collected data over the three-year period. Three individuals managing these teams stood out as leaders: Abdelmohsin Elsami Elrayah (Team Leader West Darfur), El-Fary Mohammed Ibrahim (Team Leader North Darfur), and Nasraldin Mohamed Abaker (Team Leader Central Darfur). These gentlemen demonstrated commitment and stamina, organizing the logistics, communicating with community leaders, maintaining data quality throughout, cleaning data, and often translating, scanning, and transmitting the data to Tufts, all under very difficult conditions.

Throughout the political, economic, and public health crises that occurred during the three-year period of this study, Hassan Alattar Satti Osman, the Tufts Research Manager, provided critical support directly to the teams collecting the data even under these momentous, disruptive events. The remote management forced on this study by the events were overcome only with Hassan's stalwart support, and Tufts is very grateful he is a member of our team.

And finally, this study would not have been possible without the 360 households who cheerfully gave their time and insights to make this possible. We hope through this report and others your contributions will serve your families and communities through better programming.

Thank you all,
Merry Fitzpatrick

Glossary of Terms

Covariate shock – a shock to which many households are exposed, usually almost simultaneously though perhaps not equally; for example floods, pestilence, inflation, or drought

Farmer – a household whose historic livelihood specialization prioritizes cultivation, with limited engagement in animal rearing

Food security – "when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. Based on this definition, four food security dimensions can be identified: food availability, economic and physical access to food, food utilization, and stability over time" (FAO et al. 2017, 107).

Idiosyncratic shock – a shock that affects one individual household, for example an illness or theft

Income stream activity – a specific activity designed to return more material or financial returns than were invested (for example rain-fed cultivation)

Livelihood specialization – the activities a household depends on to meet the greatest portion of their needs and for which the household has specialized knowledge or skills. For example, mobile animal herding, cultivation, mineral mining, or trade

Nomad – a household whose historic livelihood specialization depended on mobile livestock herding, across long distances, the routes of which were variable, even if the household and herd are no longer mobile

Pastoralist – a household whose historic livelihood specialization depended on livestock herding, but within Taadoud implies a permanent homestead and limited herd mobility, if any

Preference – for the purposes of this study, preference is applied to income streams activities. It is the relative desire a household has to participate in a particular income stream activity as a significant contribution to the household's livelihood strategy.

Resilience – "the ability of countries, communities and household to manage change by maintaining or transforming living standards in the face of shocks or stresses without compromising their long-term prospects" (DFID 2014, 8).

Shock – an event, trend, or dynamic that negatively affects a household's livelihood or well-being

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Part I. Introduction and Background

Resilience is, by nature, a dynamic construct of the ability to withstand and recover from a shock. We cannot truly observe, much less measure, resilience directly. But a measure that reflects key characteristics of resilience would make understanding and influencing resilience much easier. Most measures of resilience either use livelihood outcomes as proxies such as food security, wealth, social capital, or expenses, or they combine such factors into an index to predict how resilient a household will be to a shock.

Over the past seven years, the Feinstein International Center, Friedman School of Nutrition Science and Policy at Tufts University has been working in partnership with the Taadoud I and II consortiums in Darfur, Sudan to generate evidence and promote learning regarding the resilience of livelihoods in Darfur. The Income Streams Index (ISI) emerged from this research as a measure that captures certain aspects of resilience. It uses an entirely new paradigm based on the livelihood strategies themselves rather than on indirect constructs like food security, or outcomes of livelihood activities, such as herd size. During Taadoud II, the research further refined the ISI as a potential real-time measure of resilience. The underlying aim of this portion of the Taadoud operational research (OR) was specifically to inform the Taadoud program teams about resilience-related dynamics and opportunities to improve resilience programming while also building more generalizable lessons about resilience. As this evidence has been generated, it has been shared with the Taadoud II implementing partners. This report presents findings from the ISI that are likely to have the most influence on future resilience programming in similar environments.

The specific research question pertaining to the ISI is:

> *How do investments in different livelihood activities relate to the various phases or aspects of resilient livelihoods? [These phases include] proactive mitigation against potential shocks (reducing sensitivity and exposure), adaptation while experiencing a shock (both to protect livelihoods and to continue to support households), and building or rebuilding livelihoods after a shock.*

This research uses a longitudinal panel study design; that is, we conducted the same interview with the same households eight different times over three years. The study purposively selected areas in West, Central, and North Darfur to represent contexts, populations, and experiences that were as diverse as possible. In each area, the study samples residents who specialize in cultivation (referred to as "farmers" in this report) and residents who specialize in animal herding ("pastoralists").

The past four years (2018–2022) in Darfur have been eventful, affecting the ability to carry out the study, but more importantly, affecting the people living in Darfur. Collecting long-term longitudinal data is seldom attempted because it is vulnerable to events that can block data collection. However, long-term data are critical to understanding how shocks affect households at different times during the year. During 2020 and 2021 in particular, we faced three major blocks to data collection: the COVID-19 pandemic, partner organization staff changes, and insecurity.

In March 2020, all Feinstein-led face-to-face research was paused due to the COVID-19 pandemic. We unsuccessfully attempted to collect data over the telephone. The North and Central Darfur populations do not have regular telephone connectivity. A small, unrepresentative proportion of the West Darfur sample did have periodic access to a telephone network. Therefore, the West Darfur team made a laudable attempt to conduct a modified version of the ISI interview by telephone, but the results were not usable. During the research pause,

we missed two rounds of data collection. We were able to get a waiver from the Tufts Integrative Safety Committee to allow resumption of face-to-face research late in 2020, and the teams collected data in early 2021. The final round in August 2021 provide d an additional year-on-year comparison with the baseline (August 2018) and August 2019 rounds.

Using the longitudinal study design, we were able to monitor how individual households' investment and divestment in livelihood activities changed as households experienced shocks, and how these dynamics were reflected in the ISI scores of those households. In addition to thousands of shocks affecting only one or a few households at a time (idiosyncratic shocks), the COVID-19 pandemic and hyperinflation provide extended simultaneous covariate shocks by which to learn how the ISI relates to household responses.

The ISI initially evolved out of observations that, when asked about issues related to resilience, Darfurians consistently referred to the impact of shocks on their livelihood activities and the institutions they depend on, not to factors humanitarian agencies tend to use as proxies for resilience, such as food security. Darfurians described their responses to shocks in terms of changes they made to the mix of livelihood activities they engaged in to support their households and to regain a stable income and food source. The order of preference for individual livelihood activities at all phases of resilience was consistent across households within livelihood specializations (farming or herding) and differed little between specializations. For example, cultivation and livestock rearing were most favored, while the collection of natural resources like firewood or grass was always a very low priority. This observation led to a simple index used in the Taadoud I research to capture, visualize, and communicate the annual experiences of the population from 2000 to 2015, as recalled in 2015. Though an approximation, this initial version of the index clearly reflected trends associated with major shocks affecting the population (covariate shocks) but could not detect the impact of shocks affecting individual households (**idiosyncratic shocks**) within a year. During Taadoud II, we tested whether a refined version of the ISI would allow real-time measurement of resilience and provide information on how households are affected by and respond to specific shocks.

This report provides the major conclusions up front for our users and then presents the evidence supporting those conclusions in the following sections for those who wish to have more information about the data.

1. Major conclusions, with associated recommendations

1. Cultivation and livestock rearing are the most-preferred activities, central to livelihood strategies and the economy of Darfur, and even to the whole of the Sudan.

a. More household engagement in cultivation and livestock-rearing activities predicted better outcomes and responses to shocks.

b. The poorest farmers lacked access to either appropriate land or labor and sometimes both. The simple provision of seeds and tools, both of which may be easily borrowed, is unlikely to improve their situation. Pastoralists need a minimum herd size for the herd to provide income beyond the expense of their maintenance. Otherwise, the cost of maintaining the herd becomes a burden on the pastoralist, and their best option may be to sell the herd (Blewett 1995; Fratkin, Roth, and Nathan 1999). This is why many pastoralists with smaller herds combine their herds (Sulieman and Young 2019).

c. Those activities most favored after livestock and cultivation such as donkey cart rentals or petty commerce (Tier 2 activities) vary widely, require significant investment in capital, and have limited scalability; for example, petty commerce, providing animal treatment, or renting out a donkey cart. These were mostly engaged as a supplement when additional investment in the most-preferred activities was so fully engaged that more investment would not produce much increase in income. These Tier 2 activities were rarely used as a means of diversifying income.

Program recommendations:

1) To improve resilience, **focus most program activities on improving returns and reducing risk associated with cultivation and livestock rearing** (Tier 1) activities. For example, promote the integrated management of natural resources (INRM) in such a way that water is sustainably available for livelihoods as well as domestic use while also taking into account how land use around a water source is affected. Or possibly support institutions upon which livelihoods and conflict resolution depend.

2) Support for the poorest of any specialization requires **additional consultation on a community case-by-case basis rather than simple provision of basic assets.**

3) Do not invest in complementary (Tier 2) activities as a resilience strategy. Instead, **invest limited resources in Tier 2 activities as a way to improve the productivity of cultivation and livestock rearing** or to add value to the production from these activities. These activities will provide a service supporting Tier 1 activities. This may mean targeting individuals who are more likely to succeed and who will need the least support in these activities rather than those who are neediest.

2. A household's response to a shock was best predicted by factors associated with their livelihood specialization and their level of engagement in livestock or cultivation activities, rather than by household composition or the shock itself.

a. Farmers were more likely to sell agricultural produce or do agricultural labor as a response to a shock. Pastoralists were more likely to sell an animal or to seek support from their networks in response to a shock.

b. The exception was that sudden shocks that required a relatively large, urgent expenditure were more likely to result in the sale of an asset, very often a goat, regardless of livelihood specialization or engagement in these activities.

c. Households with the most engagement in the more-preferred activities (especially among farmers) were the most likely to simply absorb the shock and were sometimes able to cover shock-related expenses from their usual income.

d. Pastoralists with the least engagement in their preferred activities were less likely to sell large animals (they only sold smaller animals) or to seek support from their networks. Farmers with low engagement in the preferred activities were more likely to resort to agricultural labor or the collection of natural resources (firewood, grasses), or making charcoal.

Program recommendations:

1) To improve resilience, **focus on support to household's engagement in preferred activities.** This may take multiple forms, as long as the outcome is increased income from cultivation and livestock rearing. Examples are improving access to financial capital in the midst of hyperinflation, improving access to local natural resources, developing skills related to livelihood specializations, and supporting select Tier 2 activities that target the value chains of the preferred activities. Promoting greater long-term security will increase productivity of all, possibly through safe grazing areas for both pastoralists and herders, secure livestock corridors, support to accepted local conflict resolution mechanisms, and the encouragement of joint resilience or production activities that include multiple livelihood specializations.

2) When supporting livestock and cultivation, consider the unique barriers faced by the poorest and use creative, low-resource avenues to overcoming these barriers.

3. Goats played a unique role in livelihoods and resilience.

a. Goats were seldom used as a source of income for daily expenses. Rather, they served more often to store wealth in a form that could be easily turned into cash in response to a shock.

b. All livelihood specializations used the sale of goats as a common response to shocks, often with the aim of protecting assets more central to the livelihood strategy (for example, grain for farmers; more commercially viable livestock for pastoralists).

c. Farming specialists seldom sought to own more than a few goats. They only kept enough goats so that sales of goats produced would cover the cost of the goats' maintenance and the cost of most shocks. Goats are the one type of livestock that women could consistently own throughout the study population, and women could usually sell goats they own without consulting their husbands, allowing women to respond quickly to idiosyncratic shocks when the husband was not present.

Program recommendations:

1) Support the acquisition and maintenance of goats to provide a resilience cushion for those who are not the neediest or the wealthiest.

4. Successive years of good rain bolstered recovery from the conflict by supporting production of both livestock and cultivation, but these gains have been eroded by nation-wide and local covariate shocks.

a. Households experience far more idiosyncratic shocks than covariate shocks, and these do eat away at gains in livelihoods. But because these shocks only affect a few households at a time, they do not compromise the system in which livelihoods function. Even if these idiosyncratic shocks set them back, people can usually count on support from others and continue with their livelihood strategies as an avenue to recovery.

b. Covariate shocks, especially at the national, and even global level undermine the effectiveness of livelihood strategies and support from others. These shocks, especially when protracted, affect the very systems and institutions households use to manage their strategies.

c. Spiraling hyperinflation and reduced market access during the COVID-19 pandemic-related lockdowns have changed the dynamics, preferences, incentives, and disincentives within the livelihood system, thus changing the system itself, possibly only temporarily. The pandemic-related containment measures closed some markets and prevented traders from moving, causing livestock owners to seek alternative markets and increase dependence on off-season sales in small markets when they needed cash instead of more strategic sales at livestock markets that would have brought a better price and would have been timed for better herd management. Market-based activities that were previously very lucrative (like irrigated vegetable cultivation, cash crops, butcheries, bakeries, etc.) became less lucrative as purchasing power and market access were both affected, pushing households to increase lower-preference activities like collection of firewood or charcoal production. As food prices rose, a household's own production, especially of grain crops, became more valued as a source of food as opposed to primarily a source of income—and the pendulum shifted back from cash crops to food grain crops.

d. Where food aid was made available, households consumed the food aid. This protected assets (like grain or livestock) that might otherwise have been sold to pay for food and allowed households to pay for other cash needs. Food aid, therefore, had a positive impact on households' overall resilience and livelihood strategies in addition to having a positive impact on their food security.

e. Cash-based activities like the savings groups spontaneously shifted from keeping capital as cash to asset-based activities like communal investment in livestock to counter the effects of inflation. While this shift protected the value of the capital held by the savings groups and even provided some returns to investors, it reduced the ability of the group to respond to individual households' shock-related needs.

Program recommendations:

1) Explore any new opportunities and risks that have emerged with hyperinflation and changes to the security and political situations. Look for skills, resources, or services that the program can provide to facilitate the adaptation of livelihoods to unstable markets.

2) Identify those adaptations that have financial or social barriers that may further marginalize the poorest and provide support to overcome them.

5. The ISI score was a better predictor for a household's ability to cope with and recover from a shock than other indicators such as food security, household composition, or the nature of a shock.

a. The ISI score evaluates the resilience of a household's livelihood strategy and predicts their ability to absorb or respond to shocks without having to resort to strategies that harmed their environment or their own ability to generate future income.

b. The ISI score as a measure of resilience may be helpful in tracking trends in resilience and recovery from major covariate shocks but is generally less sensitive to moderate idiosyncratic shocks.

c. The ISI score has proven a useful population measure comparing one point in time with another within the same population but is less appropriate for comparing one population with another.

d. The data from which the ISI score is derived provide significant detailed information, which does allow for comparisons on how different populations structure their livelihood strategies and potentially highlights inequalities and vulnerabilities within populations.

e. Food security was only loosely associated with the ISI score and differed by livelihood specialization. They are clearly different, though related, concepts.

Program recommendations:

1) The ISI score could be a useful tool to monitor changes to livelihood strategies and the general resilience of populations, and to guide program design when the details of the information are examined alongside the overall score. If just the overall score is used as a stand-alone measure, it is not an effective tool. Although the data collection would not be a heavy burden, the analysis may require more skill, nuance, and effort than many teams are able or willing to invest.

2) If a stand-alone measure without further nuance or detail is desired, then a simple survey of household responses to shocks would be more appropriate.

1.1 Summary discussion of major findings

People use livelihoods to support themselves, and their ability to continue to do so in the face of shocks is a reflection of their resilience (DFID 2011). A major finding of this study is that people both protect their livelihoods in the face of shocks, and strategically use assets, skills, and other resources associated with their livelihood strategies as responses to shocks in ways that have the least negative impact on their strategies. **The way people respond to shocks depends heavily on their livelihood specialization and, very importantly, how successful they have been in those specializations.** For example, a farmer is more likely to sell produce in response to a shock while a pastoralist is more likely to sell livestock. At the same time, within livelihood specializations, those who are less wholly engaged in the most-preferred (high-profit, low-risk, scalable) activities are more likely to resort to alternative, often negative, strategies, either because they do not have nonproductive assets to liquidate or because they are trying to protect their assets to ensure better future livelihood outcomes. The most-successful households (those with the highest engagement in the most-preferred activities) are more likely to report no response at all or the sale of a ready asset such as grain or livestock.

The ISI score was sensitive enough to reflect the relationship between a household's level of engagement in preferred livelihood activities and the ability of a household to absorb the impact of a shock or to avoid resorting to less-favorable responses to a shock. This finding confirms the population's initial description of resilience during the Taadoud I Scoping Study, in terms of which activities they were able to engage in at critical moments in relation to shocks and recovery from shocks (Fitzpatrick and Young 2016). Although the ISI score and food security measures tracked pretty closely through most of the study period, as the entire system became increasingly stressed by COVID-19, insecurity, and ever-worsening hyperinflation, and as food aid entered the picture, the two measures diverged. Food security scores reflect the ability of the household to meet their immediate food needs but not the ability of the

household to leverage resources when challenged by a shock. Households with a higher ISI score were more likely to simply absorb the impact of shock or to respond to it in a more positive way, regardless of their food insecurity score. **In these times of prolonged stress, the ISI score was a better predictor than food security of people's ability to cope with shocks.** Households were most intensely focused on cultivation and livestock herding (the most-preferred activities) during the exceptional rains leading to the bumper harvest in 2018. After years of struggling, households used their surplus production to invest in their preferred activities: livestock and cultivation. Farmers used the surplus to expand their primary activity (cultivation) but also to purchase small livestock, mostly as a resilience strategy. Small livestock provided an asset that generally maintained its value and that could be easily sold to pay the expenses associated with a shock. Pastoralists also invested in their herds, often focusing on large livestock for the long-term income, and expanded cultivation to increase the productivity of the herds by using the grain cultivated to feed the herd and the household, preventing the sale of additional animals to pay for grain. Pastoralists invested in small livestock as a means to cover daily expenses and as a ready source of cash to pay for expenses following a shock.

These investments highlighted the role and importance of small livestock, especially goats, in Darfurian resilience strategies, especially for the most-vulnerable households with few other assets and poor income opportunities. **The value of small livestock as a response to shocks remained throughout the three years, though farming households rarely invested beyond a herd of three or four animals.** Few shocks required more funds than could be provided by that number of goats. Because goats were not generally an income strategy, but were a shock response strategy, beyond three or four animals, the cost of care and maintenance exceeded their intermittent benefit.

With improved security and transportation infrastructure during the first year of the study, long-existing, unmet urban demand for fresh, perishable vegetables reached rural Darfur. The improved roads and security on the routes improved market access. Traders from the largest urban markets began to arrive in the production areas. For the first time, farmers could sell fresh, perishable vegetables directly to traders from these areas. At the same time, pastoralists who had settled in these areas during the conflict (primarily in West Darfur) had begun cultivating fields that previous residents had cultivated prior to the conflict, reducing overall availability of rainfed land for these residents. The increased opportunity to sell fresh vegetables, along with continued constraints to land suitable for rainfed cultivation, encouraged farming households to invest heavily in vegetable cultivation by purchasing pumps to increase the area that could be irrigated. Not only did vegetable cultivation provide additional income to make up for the lost access to rainfed land, but during the dry season it also provided a highly profitable activity at a time of year when household labor was freed from the demands of rainfed cultivation, a time when they otherwise might have resorted to collecting firewood or making charcoal. Over the three-year period, households continued to invest heavily in the preferred activities, but gains were undercut by inflation that accelerated into annual hyperinflation of up to 350% during the latter part of the study period. COVID-19 pandemic policies, and increased insecurity in West Darfur, limited market access to major urban areas and reduced the profitability of many Tier 2 activities (most of which were commercial in nature). A previous trend toward cash crops reversed as households returned to grain cultivation to reduce food purchases. Even though selling prices for grain improved, households reported trying to use grain less as a source of income and where possible supplementing with labor and collection of firewood.

In general, the ISI scores indicated that at baseline (2018) the especially good rains allowed households to build up their livelihood strategies so that they have withstood a multitude of idiosyncratic shocks as well as the major covariate shocks of the general economic situation, COVID-19 containment measures, and, in some areas, insecurity. Nevertheless, toward the end of the study period (2021), these protracted shocks were beginning to erode livelihood strategies, with some return to negative strategies. This was partly offset by food aid in some areas. Although there are many details that

differ greatly by livelihood specialization or state, the general concepts and trends over time were similar throughout.

1.2 Reflections on the ISI score as a resilience measurement tool

The ISI score is a weighted composite of three different components: income, time use, and expenditure. The three components reflect the reality that the benefits (income) derived from specific activities or portfolios of activities do not always come at the same time that a household invests their time and resources (through expenditures). Over the entire three years of the study, the total ISI score was a better predictor of how people responded to shocks than any one of the ISI component scores alone or the food security measures.

Like similar indexes, the ISI score itself varies by season, location, and even livelihood specialization. As such, **the ISI score is more appropriately used for comparisons of populations over time to monitor trends than it is for comparisons between specializations or contexts**. The data that are collected to build the ISI are incredibly rich in detail, and the data allow certain comparisons of specific aspects between groups and contexts. Year-on-year comparisons of the ISI score in the same season detect major, general trends in livelihoods and resilience. **Most rural livelihoods, though, have a strong seasonal component. Scores at different points in a specialization's annual cycle of activities can shed light on different aspects of their livelihoods and the resilience of those livelihoods.**

Since we have used responses to shocks as a comparison measure of resilience, we might ask why anyone should make the effort to construct an index at all instead of simply tracking how households are responding to shocks. As noted above, a large amount of very informative data are incorporated, and the ISI index does not depend on experiencing a shock to see how the household responds. These data on their own provide insights into changes over time that are not shock dependent and so would not be revealed by simply tracking responses to shocks. **The ISI data helped us to understand how the ability to engage in the more-preferred activities is associated with changes in the context and the role that different activities play in a strategy.** For example, the activities that were second in preference, like donkey cart rentals or petty commerce (Tier 2), were not often used as a resilience strategy (i.e., households were not diversifying their activities to diversify risk). Rather, people invested in these secondary activities when they could not expand their preferred (Tier 1) activities, either due to limitations in opportunity (for example, limited land for cultivation) or because their preferred activities were already so extensive that additional direct investment gave lower marginal gains than investment in a supplementary activity. These are all dynamics that emerge only when looking at how households combine activities and how they draw benefits from them.

The interviews used in this study contained more elements than needed to calculate an ISI score in order to see how the ISI score behaved in relation to other measures. They were, therefore, more demanding and time-consuming than the interviews that would be used for program monitoring and evaluation. The basic data to calculate the ISI score are fairly simple and quick to gather, but the data produced require an understanding of livelihoods and the context to fully understand and analyze. **If the intention is to closely examine the data, rather than simply use the ISI score as a stand-alone summary measure of resilience, then it is worth the effort to gather and interpret the data necessary for the ISI score.** If the team lacks the expertise, willingness, or resources to examine the data to understand the underlying dynamics or the team just wants to monitor one component of resilience, then a simple survey of shocks (even if just idiosyncratic shocks) and associated responses may be more appropriate, categorizing the responses by their potential negative longer-term impacts.

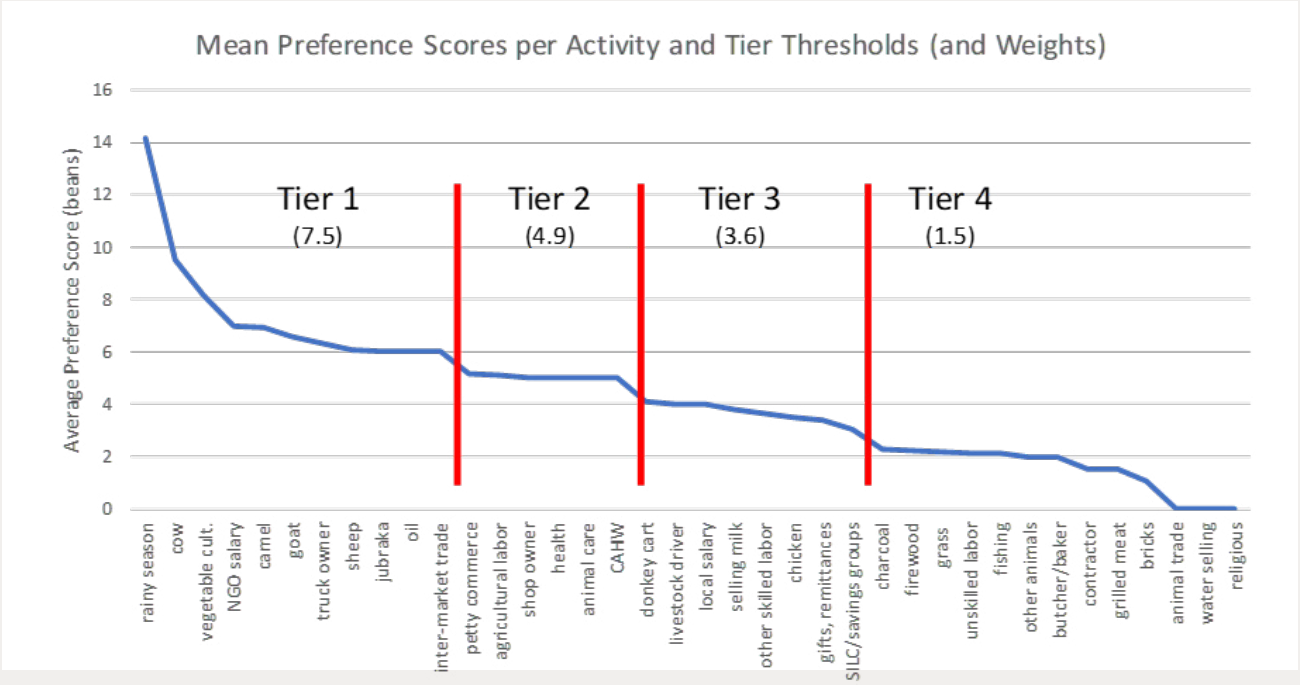
2. Background information

2.1 Methods summary

A summary of the methods is provided here, with a more detailed explanation in Annex B. This study is a panel study in which we conducted the same interviews eight times with the same households over a three-year period from August 2018 to September 2021. In each interview, households were asked to estimate the portion of their time spent on each livelihood activity and nonproductive time (time spent on activities that did not produce goods or income, like relaxation, fetching water for the household, attending school), their income from each activity, and their expenses. Households also reported shocks experienced, how they responded to those shocks, events that helped them to be more productive, and answered questions on measures of food security (sources of food and the Household Food Insecurity Access Scale (HFIAS)) (Coates, Swindale, and Bilinski 2007).

Additional information was asked at baseline that was not repeated in subsequent interviews. At baseline, participants listed and ranked their grandparents' major livelihood activities, then explained if and why their own current activities are different. They also weighted (using a set of 50 dried beans) the activities they preferred to engage in and why. Figure 1 summarizes the results of this weighting exercise. Using the natural cut-offs in preference, we divided the activities into four "tiers," with the most-preferred activities in Tier 1. The number in parenthesis below each tier label is the average weight of the activities in that tier.

Figure 1. Mean preference score histogram and thresholds for the division of activities into tiers[2]



2 Non-governmental organization (NGO), Community Animal Health Worker (CAHW), Savings and Internal Lending Communities (SILC). *Jubraka* are very small fields or vegetable gardens located immediately around the house.

The most-preferred activities, Tier 1 , relate to cultivation, animal rearing, and the higher end of trade-related opportunities. Tier 2 activities are generally commercial, provide a product or service, and have good returns but require a certain amount of capital or are related to livestock. All Tier 2 activities have limited potential for scaling up; for example, there are only a very limited number of people with a need or means to rent a donkey cart. Tier 3 activities generally require less initial investment, often providing a service on an ad-hoc basis. Tier 4, the least-preferred activities, are dominated by the more-extractive activities (charcoal production, and firewood, grass, or water collection) or low-paying, infrequent, and labor-intensive unskilled labor. Tier 4, surprisingly, also included more lucrative activities like butcher/baker and selling grilled meat due to their very limited demand.

Each ISI component score uses the average engagement (beans out of 50 beans for time, income, or expense) in activities, by tier multiplied by the preference weights for that tier of activities (as indicated in Figure 1).

The formulas for the time and income ISI scores are similar. For the expenditure score, expenditures that can be considered investments in income activities were counted positively, as a sign of investing or "engaging" in that activity. Beans on expenses that related to shocks such as human illness, animal illness, condolences for personal losses, or household expenses other than education were counted negatively. Education was not counted negatively because it was seen as a positive investment.

Time ISI score =
$(Preference_{Tier1}{}^{*}Time_{Tier1}) +$
$(Preference_{Tier2}{}^{*}Time_{Tier2}) +$
$(Preference_{Tier3}{}^{*}Time_{Tier3}) +$
$(Preference_{Tier4}{}^{*}Time_{Tier4})$

Income ISI score =
$(Preference_{Tier1}{}^{*}Income_{Tier1}) +$
$(Preference_{Tier2}{}^{*}Income_{Tier2}) +$
$(Preference_{Tier3}{}^{*}Income_{Tier3}) +$
$(Preference_{Tier4}{}^{*}Income_{Tier4})$

Expenditure ISI score =
$(Preference_{Tier1}{}^{*}Expense_{Tier1}) +$
$(Preference_{Tier2}{}^{*}Expense_{Tier2}) +$
$(Preference_{Tier3}{}^{*}Expense_{Tier3}) +$
$(Preference_{Tier4}{}^{*}Expense_{Tier4})-Expense_{shock}$

General ISI Score =
Time ISI + Income ISI + Expenditure ISI

2.2 Description of the sample

Brief descriptions of the three study contexts

Three areas (Habila, Zalingei, and El Fashir localities in West, Central, and North Darfur respectively) were purposively selected to represent very different contexts in order to make the results more generally applicable and to better understand which factors depended on the context and which were more universal. These are described in more detail in Annex C . Here we give only the briefest description.

Though all areas have been affected by conflict, Habila locality in West Darfur was the most heavily impacted by the conflict. It is considered highly productive, with relatively reliable rains for both cultivation and grazing, and good access to appropriate wadis to provide easily accessible water during the dry season for irrigated vegetables and livestock. Many nomadic pastoralist households settled at least some of their members in this area during the conflict.

The study villages in Zalingei locality, Central Darfur had rockier soil, slightly less reliable rainfall, and fewer wadis. Cultivating households had fewer barriers to accessing arable land than the samples from the other states, but the land was often far from the village, especially land appropriate for wadi cultivation. Fewer pastoralist groups settled in this area during the conflict, though many nomadic herds pass through the area in season, often lingering to graze for weeks at a time.

The study villages of El Fashir locality, North Darfur had the least reliable rainfall, and the least total rainfall, but had good access to wadis for irrigated vegetable cultivation in the dry season. Small livestock and vegetable farming formed a larger complement to rainfed cultivation for all

livelihood specializations, with smaller differences between those identifying as pastoralist and farming specialists. The area was relatively distant from any transhumant corridor (*murhal*) and had experienced less conflict than the other study areas.

Description of cultivating and pastoralist livelihood specializations

The economy of Darfur depends on a combination of cultivation and livestock, and all major livelihood strategies depend directly or indirectly on these two types of activities, though each activity may be used in different proportions in combination with other complementary activities. The data in this report describe how different populations combine these activities.

Specializing in certain activities allows households to make those activities much more productive. Through generation after generation, children learn from their parents' and grandparents' experiences, adding to their knowledge through formal training and their own experiences. A household specializing in cultivation, therefore, is likely to be more skilled in cultivation than a household specializing in pastoralism, with more strategies and networks for support when they face difficulties related to cultivation. For example, cultivating specialists are more likely to participate in agricultural labor or *nafir* (shared labor). They may have more ways to obtain seeds and other inputs when their own stores are insufficient. Likewise, households specializing in livestock will have more skills, networks, and support strategies related to livestock. Each specialization will use complementary activities, largely to bolster the productivity of their specialized activities.

This study uses specialization labels as they are used by the Taadoud program: "farmer" for those historically specializing in cultivation, though they often have some livestock; and "pastoralist" for those households that historically specialized in livestock rearing, though they are primarily settled and heavily invested in cultivation. "Agro-pastoralist" would be a more accurate label. "Nomads" are pastoralists who historically owned large herds that must migrate long distances, either with or without all members of the household. As livelihood strategies change to respond to new opportunities and risks, the labels do not always accurately reflect the activities. For example, of those households in Central Darfur who self-identified as "nomadic," few still have large migrating herds, and they had taken on a sedentary life at least one generation ago. On the other hand, many who self-identified as "pastoralist" in West Darfur were in reality still largely nomadic though they had recently settled part of their household in the Habila area to cultivate in order to provide grain for the herds. For political reasons, they chose to identify with the agro-pastoralists who settled in the area prior to the recent conflict.

Description of the study sample

The sample included a fairly even spread of farmer and pastoralist households across specialization and state, though nomads are under-represented (Table 1). Nomadic pastoralist households that migrate through the study areas are not specifically targeted by the Taadoud program, and therefore the partner teams had difficulty identifying and engaging them. The nomadic pastoralists, who are present only seasonally, require time and multiple interactions with staff and enumerators to build the trust necessary to interview with reliable results. The data include full data for 20 nomad households in Central Darfur, and only two rounds of data for the 10 nomadic households in West Darfur.

The nomad households in Central Darfur had either settled or had very reduced herds and migration. On the other hand, many of the households identified as pastoralists in West Darfur depended on migrating herds (often camels), but most households members no longer moved with the herd. Because of the small sample of nomads and the confounding with sedentary pastoralists, the two samples are combined for most analyses.

There were few significant demographic differences between the groups with the exception that households (HH) in North Darfur were significantly larger, especially the North Darfur pastoralists (Table 2). In the analyses, these factors did not have a significant impact on the outcomes measured.

Table 1. Sampling by catchment and specialization

Catchment area	Locality	Villages	Households registered		
			Farmer	Pastoralist	Nomad
CRS-WD-H-6 CRS-WD-H-4	Habila	Baktel Reda, Damre Deliso, Eyior, Simbila Andanabero, Sala	61	60	10[1]
NCA- CD-Z.8	Zalingei	committees of men and women separately	56[1]	55[2]	20
OX-ND-EL-1	El Fasher	usually solely women	50	50	

1 Ten nomad households were added after the baseline.
2 Sixty households were selected, but four farmer households were not available. Later one of these was dropped as too old and infirm to understand the consent process.
3 Sixty pastoralist households were selected: one refused during the consent process, one had only young members present, three were not available.

Table 2. Description of the sample population registered at baseline

	Total members % (n)			Household size		Members 15 years and older	Contributing individuals per household[1]		Dependent/ contributor ratio	
	Females % (n)	Total people	Total HHs	Mean	SE		Mean	SE	Mean	SE
West Darfur										
Farmers	44.6% (139)	312	59	5.31	0.37	170	3.27	0.34	2.10	0.19
Pastoralists	51.3% (177)	345	60	5.68	0.30	167	3.05	0.22	2.36	0.24
Central Darfur										
Farmers	51.2% (147)	287	52	4.75	0.35	187	3.21	0.27	1.91	0.18
Pastoralists	51.4% (162)	315	55	5.05	0.32	169	2.69	0.19	2.27	0.17
Nomads	48.9% (44)	90	15	5.80	0.56	56	3.73	0.41	1.74	0.28
North Darfur										
Farmers	51.4% (180)	350	49	6.61	0.39	199	4.57	0.35	1.75	0.11
Pastoralists	48.6% (176)	362	46	7.46	0.36	204	4.63	0.35	2.02	0.15
Total sample	**49.7% (1025)**	**2061**	**336**	**5.76**	**0.14**	**1152**	**3.52**	**0.12**	**2.07**	**0.07**

1 Some contributing members were outside the household, i.e., they were not dependent on or physically located with the household but were providing regular assistance to the household.

Table 3. Total numbers of interviews by period, month, and season

Month	Season	Period 0 (baseline)	1	2	3	4	5	6	7	Total
August	Pre/early harvest	62	0	0	0	165	0	0	2	**229**
September		229	0	0	0	147	0	0	311	**687**
October		50	0	0	0	0	0	0	1	**51**
November	Post-harvest/ early dry/herd moving south	0	130	0	0	0	0	0	0	**130**
December		0	184	0	0	0	0	173	0	**357**
January		0	11	0	0	0	273	39	0	**323**
February	Late cool dry	0	0	293	0	0	57	0	0	**350**
March		0	0	38	0	0	0	0	0	**38**
April		0	0	3	0	0	0	0	0	**3**
May	Early rains/ herds moving north	0	0	0	325	0	0	0	0	**325**
June		0	0	0	0	0	0	0	0	**0**
July		0	0	0	0	0	0	0	0	**0**
Total		**341**	**325**	**334**	**325**	**312**	**330**	**212**	**314**	**2,493**

Note:
Periods 0, 4, and 7 = aug sep early oct - pre/early harvest
Periods 1, 6 = nov, dec, early jan - post harvest/early dry/animals arriving
Periods 2, 5 = late jan, feb, mar - late dry/cool
Period 3 = may - early rains/animals departing

The original study design was to repeat interviews four times per year. This pattern was roughly followed for the first six rounds (baseline to Period 5) (Table 3). At that point, the pandemic stopped the data collection until a waiver was obtained and the partners agreed to two additional rounds of data collection. This pattern allowed for two to three rounds of data collection per season, except during the early rains when there is only one round of data collection. The original study design was to repeat interviews four times per year. This pattern was roughly followed for the first six rounds (baseline to Period 5) (Table 3). At that point, the pandemic stopped the data collection until a waiver was obtained and the partners agreed to two additional rounds of data collection. This pattern allowed for two to three rounds of data collection per season, except during the early rains when there is only one round of data collection.

For a panel study covering three years, there was surprisingly little real loss to follow-up, though many households missed one or two periods over the course of the study (Table 4). A total of 361 households were initially registered and interviewed. Due to interviewer error, 20 of

Table 4. Interview data by livelihood specialization, state, and period

	Period								
	0 (baseline)	1	2	3	4	5	6	7	Total
West Darfur									
Farmer	60	57	57	58	56	56	39	59	**442**
Pastoralist	60	57	57	57	55	57	25	59	**427**
Nomad				9		8			**17**
Total	120	114	114	124	111	121	64	118	**886**
Central Darfur									
Farmer	53	52	47	41	43	49	18	40	**343**
Pastoralist	54	43	53	41	40	44	22	40	**337**
Nomad	15	17	20	20	18	18	10	20	**138**
Total	122	112	120	102	101	111	50	100	**818**
North Darfur									
Farmer	48	45	46	45	46	44	44	43	**361**
Pastoralist	51	54	54	54	54	54	54	53	**428**
Total	99	99	100	99	100	98	98	96	**789**
All states	0	0	0	0	0	0	0	0	**0**
Farmer	161	154	150	144	145	149	101	142	**1,146**
Pastoralist	165	154	164	152	149	155	101	152	**1,192**
Nomad	15	17	20	29	18	26	10	20	**155**
Total	**341**	**325**	**334**	**325**	**312**	**330**	**212**	**314**	**2,493**

these initial interviews were discarded but these households were retained in subsequent periods. A few households registered and interviewed at baseline (Period 0) declined to interview in the subsequent rounds. Most loss to follow-up was due to the death of the interviewee or to the household moving out of the area. As can be seen by the somewhat erratic size of the sample from period to period, there was some movement in and out of the area as households either migrated seasonally for labor or were simply unavailable during one round of interviews but present at the next. In Period 6, insecurity in West Darfur and staffing issues in Central Darfur reduced the number of households visited. The final round of data collection (Period 7) included 87% of the households interviewed at baseline, a loss of 13% over three years. This relatively high retention is likely due to multiple factors, including: interviewers went to the homes of the interviewees; they built up a rapport over time with the interviewees; and the participatory, tactile nature of the interview made it more enjoyable for the interviewee.

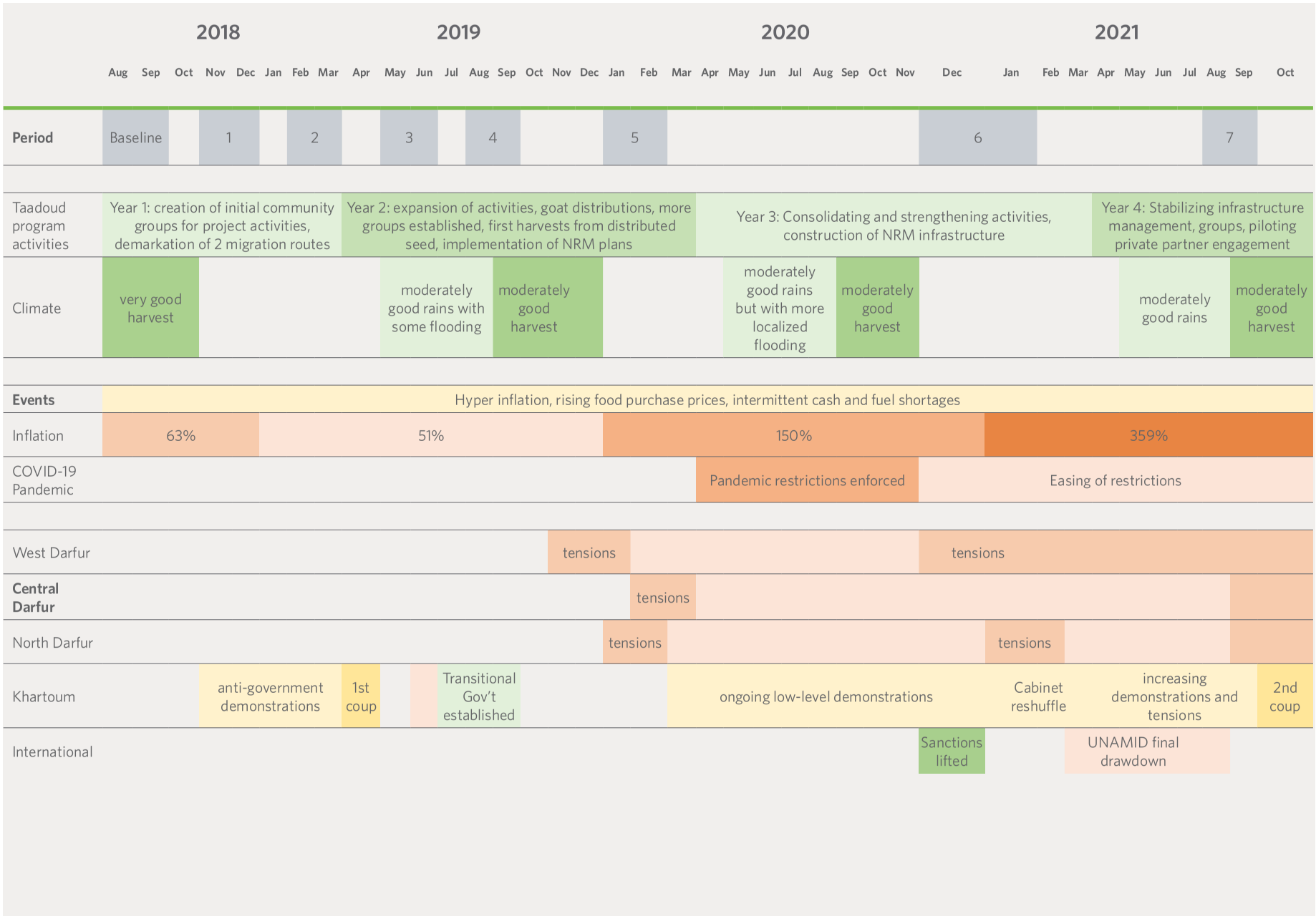
2.3 Timeline of events by period

Taadoud II activities began in earnest in April 2018, consolidating and maturing through 2021, and winding down in late 2021 and early 2022. The baseline for this study was conducted four months into the program, when the population had as yet felt little impact from project activities. The final round of data collection came after the completion of most activities. The study therefore captures the period over which the vast majority of the program activities were implemented, though it is hoped that the benefits from those activities will continue to accrue and further improve the lives of the population.

During the 37 months covered by the study, the study population was affected not only by the Taadoud activities, but by numerous events happening at the individual household, community, national, and even global, levels. As this study evaluates changes in livelihoods over time, it is useful to keep in mind the timing of the events affecting them.

Table 5 provides an overall timeline of major events and program activities in relation to the rounds of data collection. Rains and production were relatively good throughout, with a bumper harvest and good grazing for livestock at the start of the study, for those who were able to plant or who had livestock. Some localized flooding and ill-timed rains in 2019 and 2020 reduced harvests, but they were still generally good, as was the 2021 harvest. Restrictions to reduce transmission of COVID-19 exacerbated an already crippled economy. Inflation was already very high at the start of the study, worsening considerably in 2020 and 2021. Along with a declining economic situation, security and government instability throughout the study complicated any potential for a response, while the tenuous national governance situation inhibited the much-needed influx of aid after US sanctions were lifted in December 2020.

Table 5. Timeline of Taadoud II program activities and changes in the context affecting livelihoods



Part II. Evidence

Part II of this report presents the evidence that led to the findings listed in Section 1, "Major conclusions, with associated recommendations." To make the data more accessible to the reader, this section will provide the results of analyses in tables and graphs with just enough narrative to explain the important points of each.

3. General

3.1 Transformation of livelihoods across generations

Livelihood strategies have changed considerably in Darfur over the past two generations, reflecting the tremendous changes in the livelihood system itself (Fitzpatrick, Satti, and Ahmed 2021). To gain a rough idea of past livelihood strategies, a subset of 225 interviewees were asked at baseline to list their grandparents' major livelihood activities (if they remembered them) and to rank each of their grandparents' activity's relative importance to their grandparents' livelihood strategies.

One consistent pattern seen in Table 6 is that most participants' grandparents, regardless of specialization, also cultivated grain. The current generation of participants whose grandparents owned camels also currently own camels, though interviewees explained that instead of a herd of camels, many now just own one or two camels, either for transportation or social reasons associated with their identity rather than as a livelihood activity. A major difference from grandparents was the drastic reduction in cattle and sheep ownership among farmers, from about 25% of the grandparents to about 3% of the current generation. Most explained that previously more land was available for grazing, so it was easier to maintain cattle. Many also cited past major droughts when their grandparents or parents lost too many cattle to maintain a migrating herd and the household settled, unable to rebuild their herds.

Current Darfur livelihoods are heavily dependent on the market. Cash is required for many services, which requires a market for producers to convert their production into cash. The Period 6 data collection occurred while travel was restricted due to the COVID-19 pandemic and market access was

Table 6. Respondents grandparents' activities, with perceived preference weight (0–5)

	Farmers		Pastoralists	
	Mean preference	Households	Mean preference	Households
Rainfed cultivation	1.0	102	1.5	93
Goat	2.1	70	2.0	83
Cow	1.4	28	1.3	76
Sheep	1.8	29	2.2	61
Irrigated vegetables	0.7	77	1.1	44
Petty commerce	0.5	51	0.4	37
Camel	0.0	0	2.5	22
Chicken	1.2	45	1.6	50
Labor	0.6	44	0.0	0
Shop owner	0.9	15	1.8	8
Skilled work	0.2	18	0.4	7
Grass collection	0.6	30	0.4	16
Firewood collection	0.1	25	0.6	15
Selling milk	1.8	4	1.3	16
Charcoal	0.0	0	0.6	10
Donkey cart	0.0	0	0.4	24
Total households		110		115

Note: Darker red indicates lower preference or fewer households whose grandparents engaged in an activity. Darker green indicates higher preference or more households.

severely limited. Households reported this as a major shock to their livelihood strategies. But the grandparents' livelihoods were more subsistence and less market based. Similar to the current generation, most (70%) of the farmers' grandparents cultivated irrigated vegetables, though this ranked fairly low because it was purely for consumption and very local sales. Firewood was reportedly abundant, so few purchased it. There was little market for charcoal, and donkey carts were the domain of the pastoralists' grandparents. Most pastoralists and some farmers said that their grandparents depended heavily on milk in their diets, but due to tradition and the fact that so many people had their own milk cows, few sold it. Previously, someone who had more milk than they needed was expected to find someone who needed milk. Those few who did sell milk valued that source of income highly. Pastoralists' grandparents disdained labor because they reportedly all had herds.

As Darfur's economy becomes increasingly connected to national and international markets, it is likely livelihoods will continue to adapt. A changing economy brings both new opportunities and new risks. Program teams should monitor these aspects of the context and livelihood strategies, in addition to program indicators, to understand how changes will change the nature of risks and to support resilience of new livelihood strategies. A tool such as the ISI would be helpful to such an effort.

3.2 Participation in income activities

Households in Darfur use a variety of activities throughout the year to meet their needs. The ISI uses three different measures of participation in an activity: time spent on an activity, expenditures on an activity, and income from that activity. Direct measurement of each of these is very difficult and

Table 7. Current generation farmers' income sources at the end of the rainy season

	2018	2019	2021
Selling grain/harvest	65.2%	70.1%	52.5%
Petty commerce or tea	48.7%	35.8%	42.6%
Vegetable cultivation	38.6%	31.4%	35.5%
Goats	30.4%	27.0%	24.8%
Labor	56.3%	45.3%	31.9%
Firewood	21.5%	10.9%	36.2%
Chickens	32.9%	19.0%	13.5%
NGO distributions	1.9%	6.6%	29.8%
Other skilled labor	10.1%	9.5%	10.6%
Donkey cart	9.5%	6.6%	9.9%
Gifts and remittances	12.0%	9.5%	3.5%
Grass collection/sale	13.3%	0.7%	5.0%
SILC/savings	5.7%	7.3%	5.7%
Salary, policy, gov't.	4.4%	2.9%	11.3%
Migrate for labor	0.6%	0.0%	12.8%
Charcoal making	6.3%	2.2%	4.3%
Sheep	3.2%	2.9%	2.1%
Cows	1.3%	0.7%	0.0%
Other	17.1%	10.2%	20.6%

Note: Darker red indicates lower percentage of farmers engaged in an activity. Darker green indicates a higher percentage of farmers.

imprecise. Households are often reluctant to provide information about total income. Instead, we asked participants to estimate the proportion of their time, expenditure, and income associated with each of their activities.

The end of the rains is a very busy time of year. If farmers have insufficient grain to sell to pay for normal household expenses like purchasing complementary food, they may sell an animal to get cash, but more often they try to earn this cash through additional activities that pay immediately, like wage labor working on other farmers' crops in addition to their own. If sufficient grain from a previous harvest remains in a household's stores and the following harvest appears promising, farmers will sell grain from the previous harvest while prices are seasonally high, and make room for the new harvest. At this same time of year, pastoralists are culling their herds by selling year-old males while they are at peak condition and before they begin to compete with productive females for feed and water, both of which will become scarcer and more expensive as the dry period extends. Therefore, data collected at this period show high engagement in primary and many peripheral supplementary activities.

The study includes three rounds of data collected during the pre-harvest season of three different years (2018, 2019, 2021), allowing us to compare

Table 8. Current pastoralists' income sources at the end of the rainy season

	2018	2019	2021
Goats	67.4%	64.2%	48.0%
Selling grain/harvest	59.9%	63.5%	51.5%
Cows	51.2%	42.8%	33.9%
Chickens	41.3%	28.9%	15.2%
Petty commerce or tea	33.1%	25.8%	24.6%
Vegetable cultivation	25.0%	30.2%	27.5%
Sheep	29.1%	35.2%	11.7%
Firewood	11.6%	9.4%	29.2%
Selling milk	16.9%	19.5%	7.6%
Agricultural labor	15.7%	11.3%	14.6%
NGO distributions	1.7%	2.5%	27.5%
Camels	13.4%	10.1%	0.0%
Gifts and remittances	7.6%	6.9%	8.2%
SILC/savings	9.9%	5.7%	2.9%
Donkey cart	7.0%	6.3%	5.3%
Other skilled labor	4.1%	4.4%	4.1%
Salary, policy, gov't.	3.5%	1.3%	7.0%
Migrate for labor	0.0%	0.0%	11.1%
Labor	3.5%	1.9%	2.9%
Animal trade	1.7%	0.0%	5.8%
Charcoal making	5.8%	0.6%	0.6%
Grass collection/sale	1.7%	0.6%	4.1%
Other	9.3%	14.5%	19.9%

Note: Darker red indicates lower percentage of pastoralists engaged in an activity. Darker green indicates a higher percentage of pastoralists.

changes year on year without the effect of the changes associated with different seasons. Tables 7 and 8 show the proportion of households in each livelihood specialization reporting income from the various activities at this time of year. The color coding allows the reader to quickly see trends. The darker green shows the highest percentages and the darker red shows the lowest percentages. Most activities remained relatively stable, with a few notable differences.

Salaries rose in 2021 as villagers were hired to support World Food Programme (WFP) distribution. With fewer than usual other wage opportunities locally, there was more migration in search of work, usually to other parts of Sudan. Little food had been distributed during the first two years of the study but increased in 2021 due to the hardships associated with the pandemic and hyperinflation.

In 2018 (baseline), after several difficult years, farmers reported higher dependence on less-preferred activities like grass collection, firewood, and gifts. These reduced in 2019 as households benefited from the bumper harvest and investments in other activities. As the stresses of the pandemic containment measures and hyperinflation eroded gains, we see firewood, grasses, and even charcoal-making partially resume, but not gifts.

Trends in pastoralists' income sources show similar, but slightly less stressed, trends. Income from sales of milk and livestock dropped off significantly in 2021 as pastoralists reported difficulty accessing many central livestock markets where most livestock is traded. Sales of firewood increased, as did NGO food distributions, military and WFP salaries, and migrating for labor.

Table 9 shows data on time spent on seven key activities, broken out by data collection period. They confirm most trends seen above from income, but perhaps capture more of the stress on pastoralists. They show increased time collecting firewood and doing labor in the later periods.

Table 9. Average time expenditure per household by period

	Period								
	Baseline	1	2	3	4	5	6	7	Total
Cultivation specialists									
Cows	1.9%	0.6%	2.7%	0.7%	1.4%	1.3%	2.0%	0.0%	1.3%
Firewood	45.3%	38.3%	41.3%	48.6%	33.8%	60.4%	41.6%	71.8%	47.7%
Goats	39.8%	28.6%	33.3%	36.1%	34.5%	36.2%	37.6%	33.8%	34.9%
Labor	54.0%	33.8%	19.3%	29.2%	39.3%	20.1%	34.7%	29.6%	32.6%
Petty commerce	51.6%	35.1%	32.7%	27.1%	35.9%	36.2%	36.6%	49.3%	38.2%
Rainy season cultivation	96.3%	90.3%	33.3%	31.3%	92.4%	40.9%	69.3%	98.6%	69.3%
Vegetable cultivation	57.1%	52.6%	74.0%	70.1%	36.6%	71.8%	65.3%	44.4%	58.8%
Livestock specialists									
Cows	50.0%	45.6%	42.4%	42.0%	38.3%	40.9%	27.9%	48.3%	42.6%
Firewood	36.7%	34.5%	48.9%	47.0%	32.9%	63.5%	53.2%	61.6%	47.1%
Goats	67.8%	54.4%	56.5%	54.7%	55.7%	63.0%	56.8%	54.7%	58.1%
Labor	17.8%	15.8%	9.8%	8.3%	9.6%	11.0%	28.8%	21.5%	14.6%
Petty commerce	39.4%	32.2%	37.0%	19.9%	24.0%	28.7%	27.0%	29.7%	29.9%
Rainy season cultivation	93.3%	80.1%	37.0%	27.6%	91.0%	43.1%	70.3%	97.7%	66.7%
Vegetable cultivation	37.2%	36.3%	41.3%	38.7%	32.9%	39.2%	48.6%	32.6%	37.9%

Both livelihood specializations engaged most heavily in similar activities, but to different degrees, and with variations across time reflecting the changing seasons, particularly in relation to cultivation. **We see once more that pastoralists were heavily engaged in rainfed cultivation and were only slightly less engaged in cultivation than farming households.** Although both specializations engage heavily in rainfed cultivation, they come to it with different levels of experience and skill, and use the harvests differently. **All livelihood specializations therefore benefit from both cultivation and livestock management programming activities, but tailored to the role these activities play in their respective livelihood strategies.**

Farming specialist strategies are especially prone to seasonality in both the farmers' efforts and their income, but the farmers use their time strategically. Figure 2 provides a graph across all periods showing the proportion of farmers spending time on key activities per period. Both green lines emphasize activities that reflect the seasonality of rainfed cultivation, with households reporting both working on their own fields and working as labor in other people's fields to earn immediate cash. When these activities are less available, farmers used their time to cultivate vegetables (orange line), filling in with firewood and grass collection when they had extra time. **In the final period, when households were highly stressed by inflation and the COVID-19 pandemic was inhibiting movement, labor did not rise with rainy season cultivation as would be expected. Instead, households increased firewood collection to cope.**

3.3 Food security trends

Two different measures of food security were used: sources of food and the Household Food Insecurity Access Score (HFIAS).

In the statistical analysis of food sources, there was no significant difference between farmers

Figure 2. Proportion of farmers spending time on key livelihood activities by period.

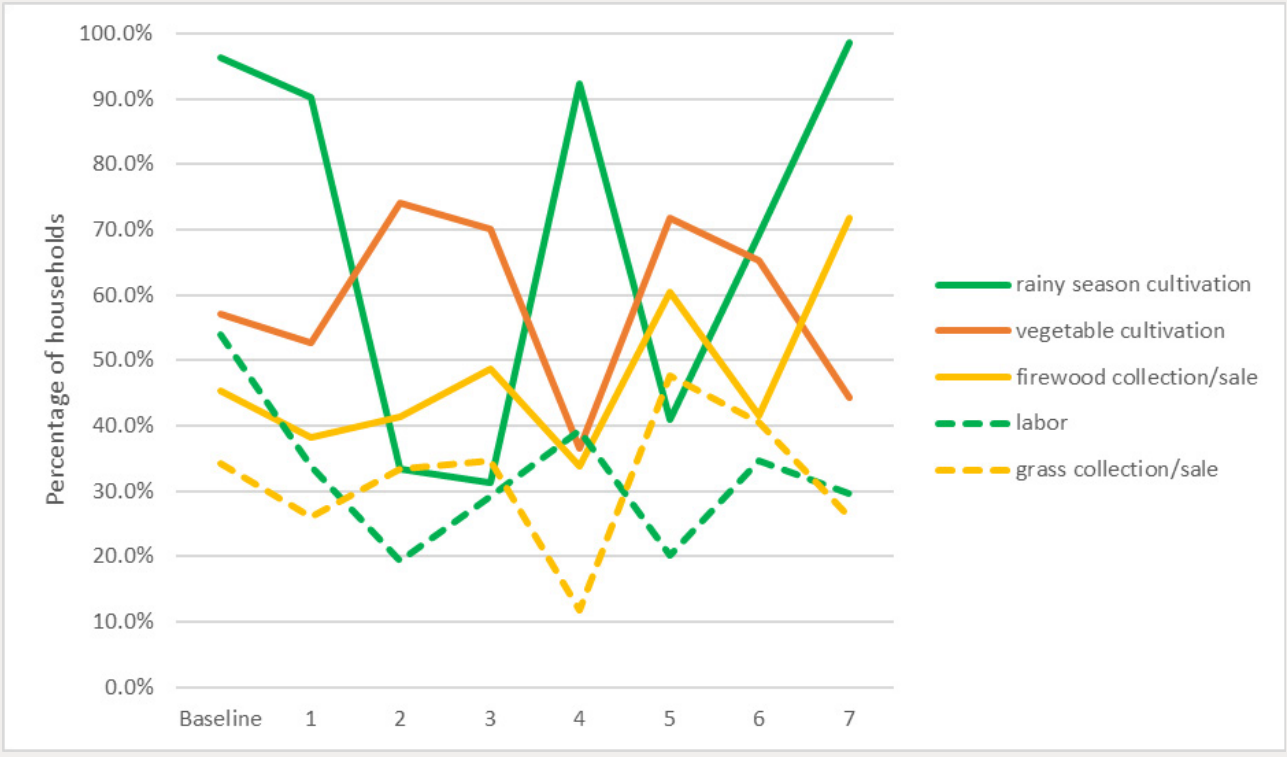


Figure 3. Proportion of food from own production compared to purchase, by season.

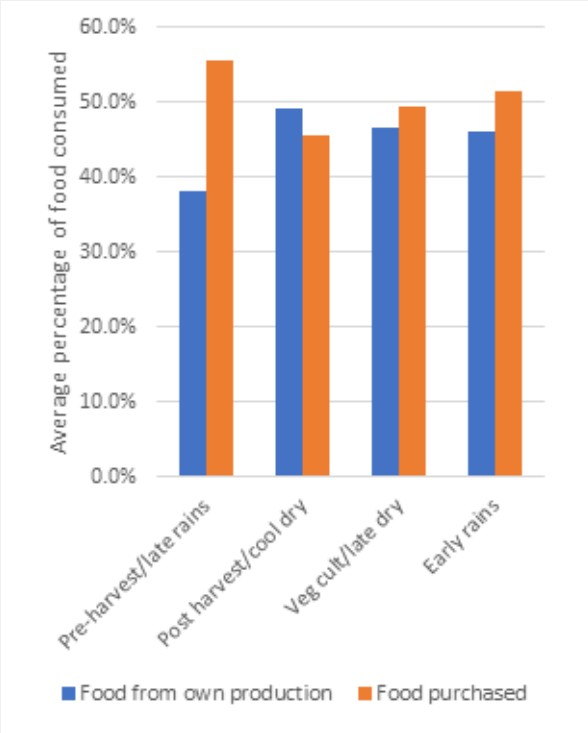
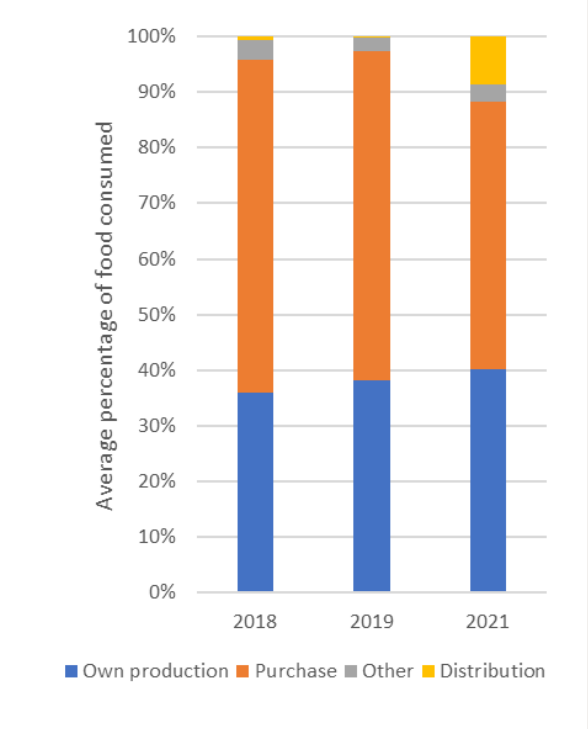


Figure 4. Source of food consumed pre-harvest, by year.



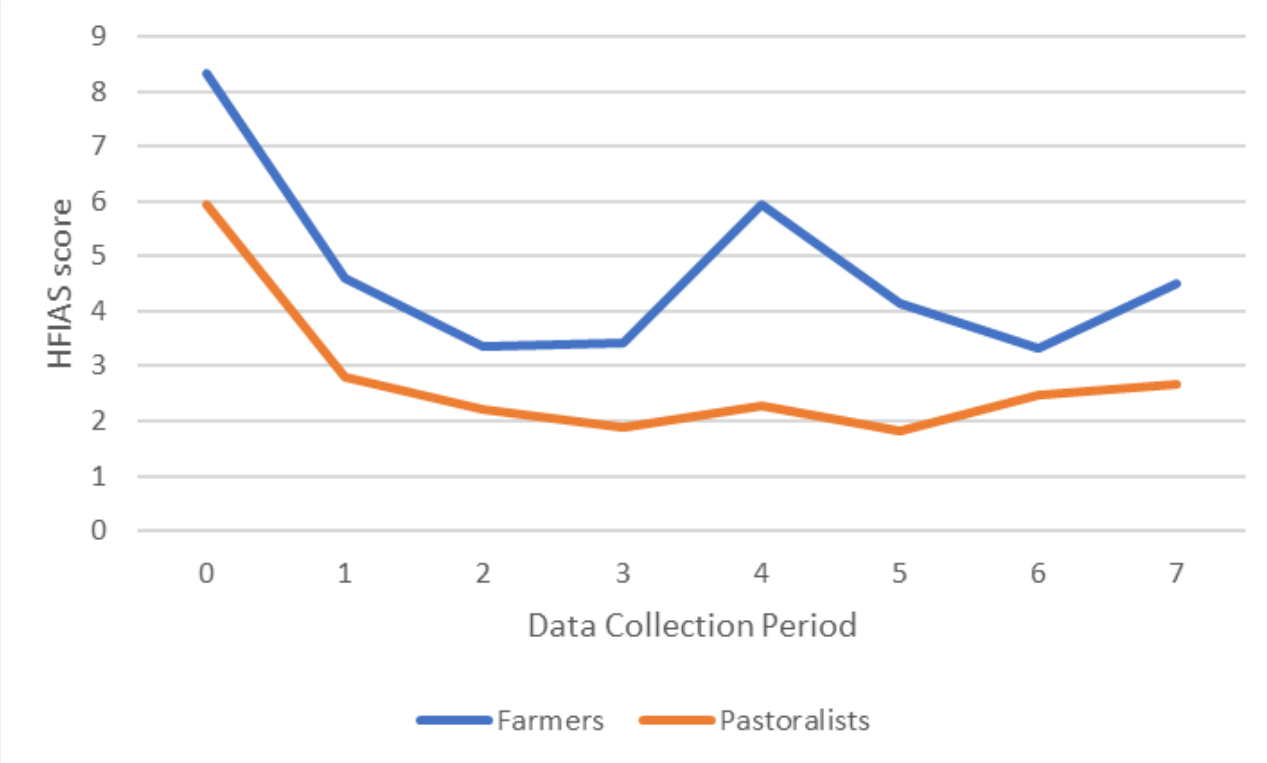
and pastoralists, so these figures include both specializations. Figure 3 shows the expected trends, where households are most dependent on food purchases just before the harvest and least dependent just after the harvest, with food from their own production moving in an opposite pattern.

Perhaps of more interest is the comparison of same season (pre-harvest) over three years in Figure 4 (missing 2020 due to the pandemic suspension of data collection). Throughout the Taadoud II program, **households gradually increased the proportion of their food from their own production, indicating a greater amount of the previous harvest was still retained in their stores when the following harvest was almost mature, a key point in the resilience of this population.** The strength of this trend is actually greater than it appears to be in the graph. During 2018, very few people had any grain reserves, so they were eating some of the harvest green, straight from the field, seeking out those individual grain stalks that had matured early. With hyperinflation causing all food purchase prices to soar, across the three pre-season rounds of data collection, households reduced purchases of food as much as possible. Though farmers reported having to sell more of their grain to pay for expenses, this appears to have been largely covered by increased production (both rainfed and irrigated), which allowed households to still arrive at the following harvest with grain in their stores.

Up until the start of the pandemic, households reported negligible amounts of food aid. The recent food distributions in combination with increased consumption from their own production appear to have reduced the need to purchase increasingly expensive food.

The HFIAS is a more direct measure of food insecurity than source of food is. Figure 5 shows the food security trends comparing pastoralists and farmers (higher scores indicate worse food security). In general, farmers' food security as measured by the HFIAS was worse than that of pastoralists and far more seasonal. In general, we see an improvement

Figure 5. Food insecurity (HFIAS) by period and livelihood specialization .



during the first three periods, rising seasonally for farmers just before the following harvest in Period 4, then dropping to rise again at the 2021 pre-harvest (Period 7). **In general, even with the stresses of the past two years, improved production during consecutive good years of rain and timely food aid in 2021 have maintained food security that is better than it was at the start of Taadoud II.**

3.4 Gender influences

Darfurian women's responsibilities include many activities that do not generate food, wealth, or resources for the household. These are nevertheless crucial for the lives and welfare of the household and take up a great deal of women's time and energy. Women in Darfur are therefore much more aware of these support activities than men.

Depending on the preference and availability of household members, either the husband, the wife, or both were interviewed for the study. Regardless, interviewers attempted to interview the same member of the household from one period to the next for consistency in measurements. Interviewers recorded who was present for each interview.

Women reported more support activities, **both for themselves and for their husbands**, than men reported, either for themselves or for their wives. Because support activities were not ranked as producing income, ISI scores tend to be lower when women were interviewed ($p < 0.000$). Interestingly, women reported higher proportions of food from production than men reported ($p < 0.007$) but were the same as men in reporting food purchased ($p < 0.238$).

Because men and women responded differently, and there were more women respondents in some populations than others, we account for sex of the respondent in our statistical analysis.

3.5 Shocks and responses to shocks

Households reported events that affected their income or expenses in the three months leading up to each interview and how they managed the effects of that event (their "response"). Some events that *helped* household income or activities were considered "good shocks." Good shocks included for example, high productivity, the birth of livestock, high selling prices, and high labor wages (for those earning them). Unless otherwise noted, when we refer to shocks in this report, we are referring to harmful shocks.

Households reported a total of 856 "good" shocks and 4,396 harmful shocks. Good shocks were not connected to responses, and not all harmful shocks elicited a response.

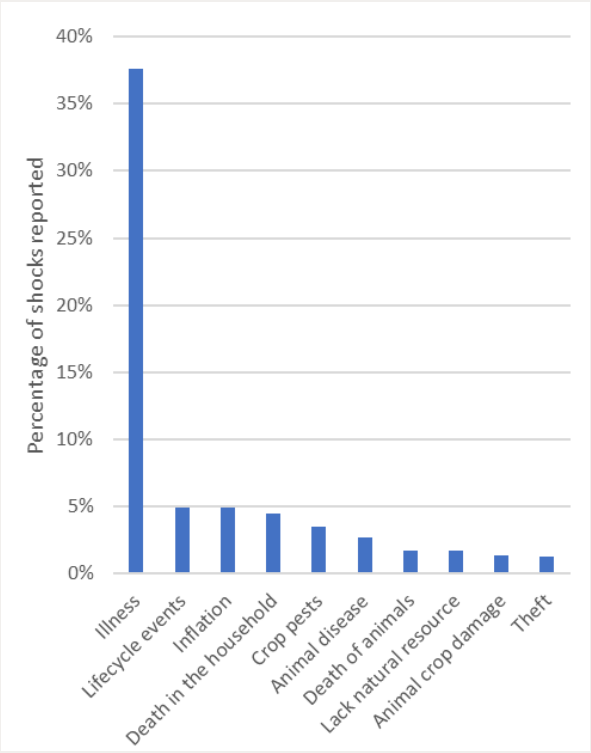
Shocks

Other than animal disease, animal deaths, and crop damage from animals (i.e., livelihood-specific shocks), shocks reported were very similar between livelihood specializations and across states. Of note in Figure 6, the top four shocks are not livelihood specific, and of the top ten, only inflation, and perhaps crop pests, were covariate shocks. Neither the pandemic containment measures nor the insecurity arising in West Darfur were named directly by respondents, though many mentioned more immediate impacts of these events, like difficulty selling produce or animals because key markets were closed.

As we would expect, pastoralists were more likely to report shocks relating to livestock while farmers were more likely to report shocks relating to cultivation. Most crop pests were mentioned in the latter period, ramping up from just one mention in the first two periods combined to 124 mentions in the last two periods, of which 110 were in North Darfur.

Illness was the most common shock **reported by all specializations in all periods, comprising 38% of all shocks reported (and 46% of all shocks in the final period).** Medical expenses, in addition to lost work, are a constant drain on families' resources and productivity. Initiatives to help families reduce

Figure 6. The ten most frequently reported shocks.



vulnerability to illness (human and animal) would reduce this very common shock. This could take multiple forms, such as vouchers for the poorest or targeted, subsidized insurance schemes.

Other commonly reported shocks were "lifecycle" events, many of which were social obligations to contribute to weddings, funerals, births, and circumcisions, as well as experiencing these events in one's own household. Most other common shocks related to livelihoods.

The most common over-arching shock influencing all expenses was inflation, though it was not always reported as a separate shock, especially after 2019. Annual inflation rose from the already very high rate of 63% in 2018 to 150% in 2020, and on to the dizzying rate of 359% in 2021. Households eventually appeared to consider inflation a somewhat constant stress that they took into account when planning their activities (World Bank 2022; Reuters 2022).

Because most income depended on selling production, whether food or animals, **much of the impact of high purchase prices was offset by higher selling prices.** Nevertheless, households reported feeling the pressure of having to pay higher prices, especially for things like healthcare and education, which are difficult to forego or reduce incrementally.

Inflation also affected how people held wealth, moving them to avoid cash savings and pushing them to make use of less-efficient methods of managing wealth. Most SILC (savings and internal lending community) groups stopped providing loans or insurance schemes because of the rapidly changing value of cash. Many savings groups stopped functioning altogether. Other groups converted cash to animals or other investments, inflation-proofing the value of their capital and even increasing real value, but reducing the ability to give loans for investments or to support members experiencing shocks.

Responses

Unlike shocks, responses varied considerably by livelihood group and state. Figure 7 shows a comparison in the proportion of all responses by livelihood specialization, and Figure 8 shows a comparison by state.

Figure 7. Responses to harmful shocks, by livelihood specialization.

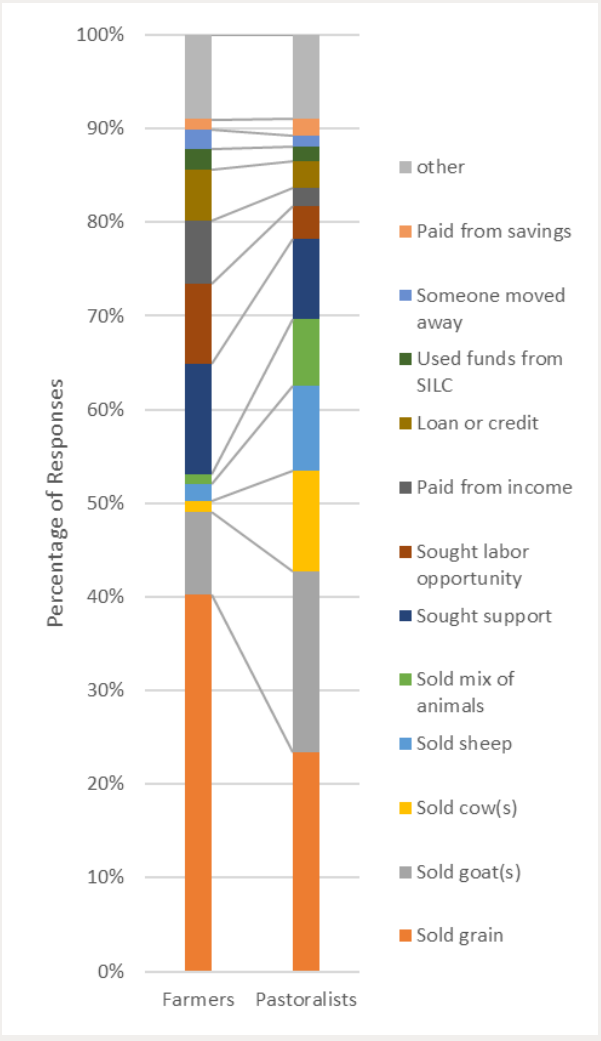
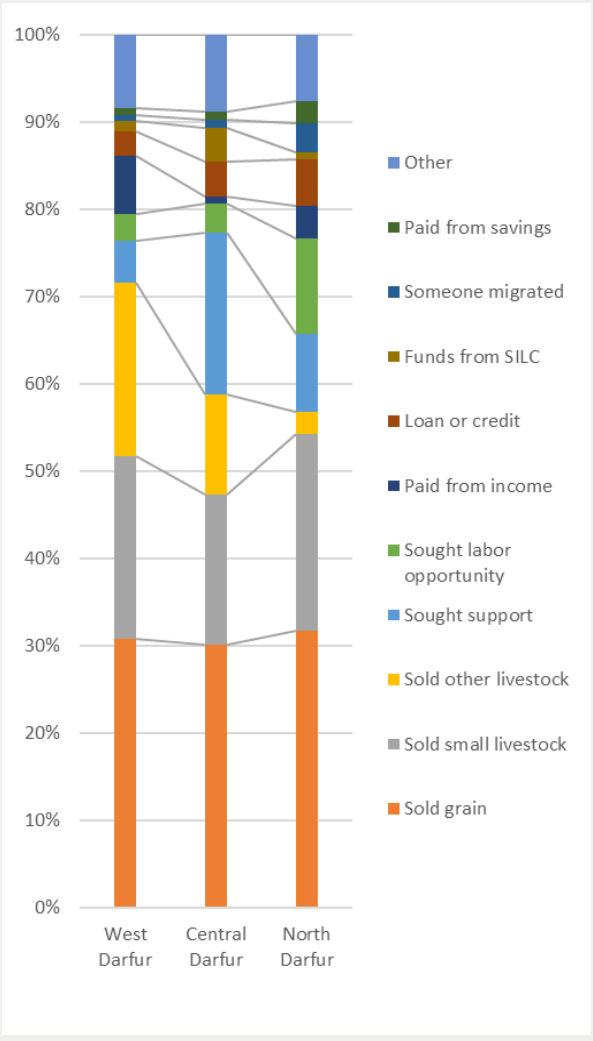


Figure 8. Responses to harmful shocks, by state.



Major responses used assets associated with a households' major livelihood activities. The most common single response for both major livelihood specializations, other than no response, was the sale of grain. Grain can be sold in any quantity, even very small quantities, to pay for very small expenses and is always a welcome contribution at lifecycle events. If we combine sales of all types of livestock, then pastoralists were twice as likely to sell animal as to sell grain. They sold a combination of animals, most often small livestock, but also commonly sold cattle. The other most common responses for farmers were to sell goats (but seldom other animals), seek support, and seek labor opportunities.

Of the 4,396 harmful shocks reported, 1,565 (35.6%) elicited no response. About 19% of illnesses did not require a response. They were often a relatively mild illness that did not require treatment but still kept a person from working. Other major shocks that often did not elicit a response were inflation and lifecycle events.

Whereas a household has little control over what shocks they experience, their livelihood specializations expose them to different risks and provide different means with which to respond or adapt when they experience a shock. The only major differences we saw in shocks were those related to primary livelihood activities, but assets, networks, and skills associated with a specialization heavily influenced how a household could respond. As we will see below, the more a household is able to engage in their specialist activities, the less likely it is that they will resort to negative responses like collecting firewood or making charcoal.

4. Evidence from the ISI score

The study generated 2,283 ISI scores, 1,038 from farmers with a mean ISI score of 258.6 (SD 169.0) and 1,245 from pastoralists with a mean ISI score 320.6 (SD 197.6), $p > 0.000$. The larger variation of scores among pastoralists was verified in discussions with Taadoud field staff. Their independent observation was that pastoralists had many more very wealthy and very poor households, while farming populations tended to have fewer outliers and more similar incomes. They proposed that the nature of farming required farming households to depend on each other more often for support, such as labor, and for food during the higher variability in food and income associated with cultivation. Pastoralist households, especially mobile pastoralists, tended to be more independent or to work within smaller family-based groups.

4.1 Trends in the ISI score across time

Figure 9 provides the ISI scores for each of the eight periods, comparing results from farmers and pastoralists. Pastoralist scores vary less over time and are generally higher. Farming specialists tend to supplement with more complementary activities, especially in the late dry season, when vegetable cultivation may be tapering off and their stocks from the main harvest are also reduced, and before the hardest work of rainfed land preparation begins. We often saw reports of respondents being absent during this time because they took advantage of the lower labor demands to travel for weddings and other social events.

Figure 9. ISI scores by livelihood specialization.

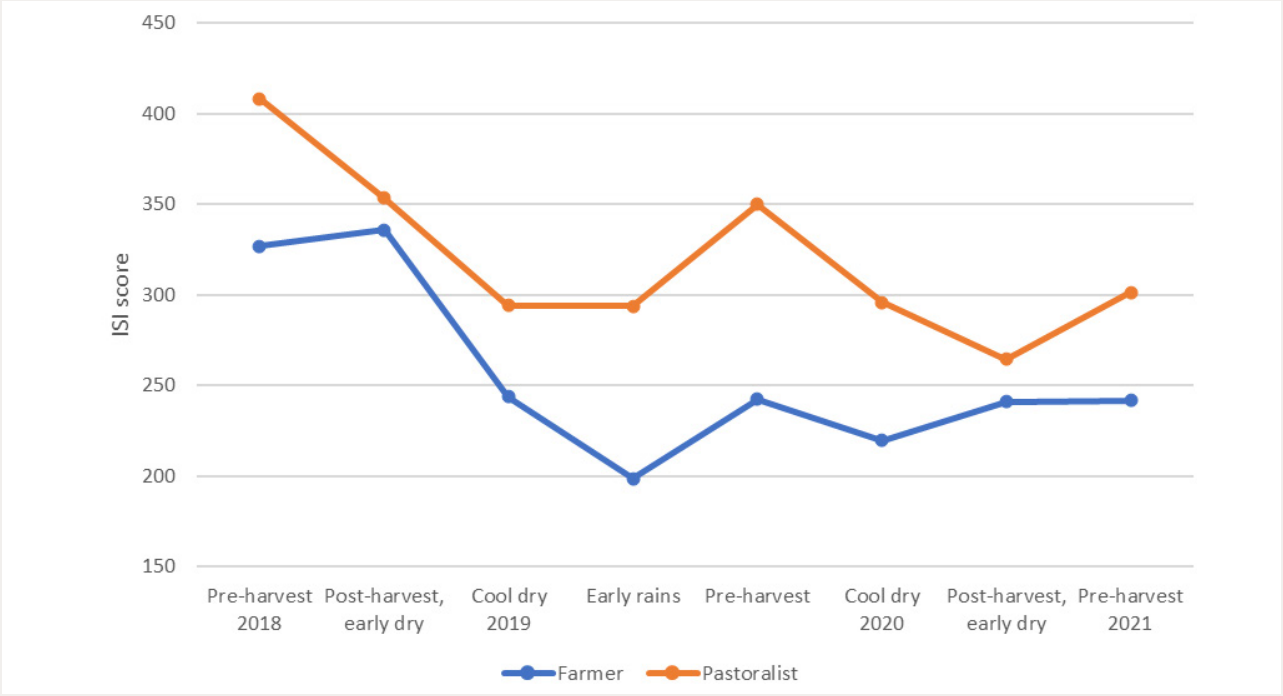
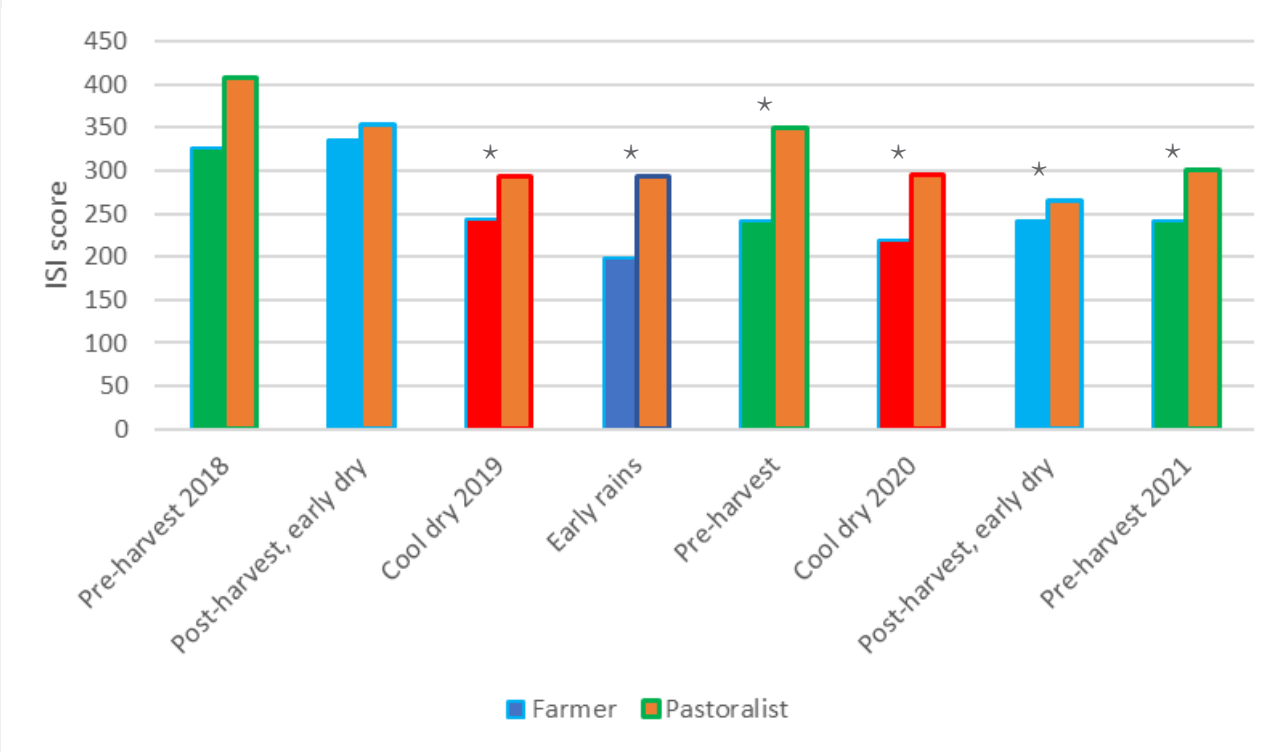


Figure 10. ISI score by season and livelihood specialization.



Note: * indicates a statistically significant difference between livelihood specializations.

Figure 10 contains the same information as Figure 9 but emphasizes the seasons to allow year-on-year comparisons by season. The different colors represent different seasons. For example, the three pre-harvest periods are colored green while the cool dry periods are colored red. This composite representation allows us to see trends across the full study as well as by season.

We see in Figure 10 that the ISI score is highest for both specializations in the first period. They were lowest during the early 2019 rains for the farmers when farmers were still building their initial resilience and had few preferred complementary activities. But for the pastoralists, the ISI score was lowest in the post-harvest period in the 2020 post-harvest, mid-pandemic period when they were struggling to access markets for their livestock and were resorting increasingly to activities like collection of firewood.

4.2 The relationship between the ISI score and food insecurity (HFIAS)

Measurement of food security has been well studied with numerous validated measures. The Household Food Insecurity Access Scale (HFIAS) is perhaps one of the most widely used measures in humanitarian settings. The higher the score, the worse the food security. Many early efforts to measure resilience used changes in food security as a proxy. For example, if food security changed after a shock, it was felt that household or population was not resilient to that shock. The interviews for this study included the HFIAS to see whether food security had similar trends to the ISI score.

Figure 11 compares trends in food security (HFIAS) with the ISI score for farmers, and Figure 12 compares them for pastoralists. To orient ourselves in these graphs, remember that Periods 0, 4, and 7

Figure 11. Comparison in trends of food insecurity and ISI score among farmers.

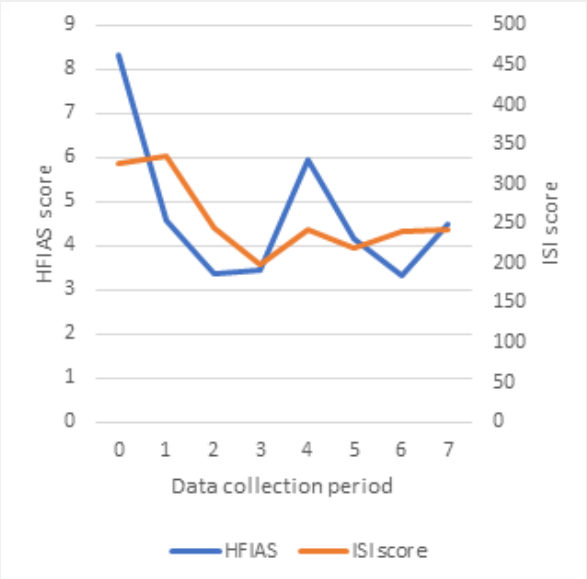


Figure 12. Comparison in trends of food insecurity and ISI score among pastoralists.

were the early or pre-harvest periods for 2018, 2019, and 2021 respectively.

Food security for farmers is generally worse and far more variable and seasonally dependent than the ISI score, clearly showing the rise in food insecurity just prior to each harvest but rising less with each harvest. The reverse is true of pastoralists; their activities change more seasonally, while their food security is more consistent.

A higher ISI score indicates a situation of building resilience, and a higher HFIAS indicates worse food security, so if improving resilience equated to better food security, we should see them moving in opposite directions. But these two measures appear to be roughly trending together, telling contradictory stories. We propose that resilience and food insecurity are related concepts but are not the same thing, and measures of food insecurity cannot accurately replace measures of resilience.

The baseline was the most food-insecure period, coming after several poor-to-mediocre years of rains, but in the midst of an exceptionally good rainy season. At that time, households were highly engaged in building their preferred (Tier 1) activities.

With the harvest and the sales of yearling livestock in good condition, food security improved drastically. This was maintained through most of the following year by engaging in supplemental activities while both eating and selling from their bumper crop or their well-conditioned herds. During the same time the following year, food security did not worsen to the previous year's levels as many households still had grain in their stores from the previous year. We see a final rise in food insecurity with the 2021 pre-harvest period. Period 7 was an exceptionally difficult time, but food distributions were keeping food security from deteriorating even as their resilience (ISI score) remained stable.

4.3 Factors influencing changes in the ISI score

While graphs of trends are helpful to see changes across time, it is difficult to know from such direct comparisons how much of the change in ISI scores is due to changes in food insecurity and how much is from other factors.

Table 10 gives the results of three different time series regression equations, incorporating changes from one period to the next. The first set ("total

Table 10. Time series regression of factors associated with the ISI score

	Total sample				Farmers				Pastoralists			
	Coeff.	SE	p value		Coeff.	SE	p value		Coeff.	SE	p value	
Category of shock (against no shock)												
Small shock	33.15	14.19	0.019	*	61.72	21.85	0.005	**	8.20	18.30	0.654	
Big shock	22.68	15.06	0.132		43.77	23.16	0.059	†	2.95	19.46	0.880	
HFIAS score	1.67	0.79	0.035	*	1.13	1.07	0.290		2.26	1.20	0.059	†
Proportion of food purchased	-19.73	16.12	0.221		-52.66	26.63	0.048	*	-8.51	19.90	0.669	
Sale of an animal	22.49	8.66	0.009	**	-16.13	15.60	0.301		34.48	10.53	0.001	**
Support from others	-22.88	10.48	0.029	*	-12.59	16.04	0.433		-30.78	13.78	0.025	*
Negative use of natural resources	-87.73	55.60	0.115		-128.13	66.44	0.054	†	31.96	116.33	0.784	
Labor or extra effort	-8.22	9.81	0.402		-8.81	13.53	0.515		6.94	14.54	0.633	
No response	43.21	12.17	0.000	***	70.48	18.57	0.000	***	24.11	15.90	0.129	
State (against West Darfur)												
Central Darfur	-232.56	16.34	0.000	***	-147.27	23.12	0.000	***	-302.42	21.30	0.000	***
North Darfur	-48.60	16.40	0.003	**	15.28	22.74	0.502		-106.68	21.75	0.000	***
Sex of respondent (against male)												
Female	-15.11	8.74	0.084		-7.31	13.55	0.590		-20.32	11.24	0.071	
Both	16.54	8.78	0.060		15.81	13.43	0.239		15.58	11.52	0.176	
Pastoralists compared to farmers	74.86	13.58	0.000	***								
R2 overall			0.3610				0.2174				0.4867	*

Note: *p<0.05, **p<0.01, ***p<0.001, †near significant (p<0.06)

sample") includes both farmers and pastoralists, the second includes only farmers, and the third includes only pastoralists.

These equations show how much differences in the ISI score are due to various factors. Only those figures with stars next to them are statistically significant, meaning those without stars should be ignored for the most part because they could be just due to chance in the sample. The more stars (the smaller the p value), the more confident we are that there is a real relationship there. The larger the coefficient on the lines with the stars, the more the ISI score will change for each unit of change in the factor on that line.

Some of the lessons we can draw from these equations are:

- Livelihood specialization and location have a strong influence on the ISI score. It is therefore dangerous to simply take one measurement to compare the resilience of livelihood specializations or locations. Instead, the ISI score should be used to track changes across time, either for a full population or for each specialization independently.
- Farmers who could absorb a shock without having to go to special measures to respond and who had more food in their reserves (i.e., were purchasing a smaller proportion of their food) had higher ISI scores, but they did not necessarily have better food security as measured by the HFIAS.
- Pastoralists with higher ISI scores were more likely to sell an animal in response to a shock.
- Much lower ISI scores for farmers were associated the collection of natural resources (grasses, firewood), and making charcoal.
- Much lower ISI scores for pastoralists were associated with soliciting support from others.
- Investment in livelihood activities or homes was generally associated with higher ISI scores, but as it followed the same trends (i.e., was "collinear") with not responding at all to a shock, for statistical reasons we could not include it in the same regression equation.

In general, the equations in Table 10 confirm statistically many of the observations described throughout this report.

Regardless of specialization, a **household's resilience depends on how much they are engaged in their specialist activities. Households that are most engaged in the more-preferred activities and less engaged in the less-preferred activities (higher ISI score) are most able to absorb the effects of a shock without a response. When a response is necessary, households with higher ISI scores use the resources associated with their preferred activities to respond. Those that are less engaged in the preferred activities (lower ISI score) are less able to simply absorb the impact of a shock and more likely to engage in less-preferred, less-effective responses.**

While most of the major shocks were not associated with livelihood specializations, some shocks were. Therefore, some of a household's vulnerabilities are associated with their main livelihood activities. Food security has only a very loose relationship with resilience and is a very poor predictor of a household's ability to withstand and recover from shocks.

5. Making use of the ISI

Resilience is a construct so complex and multi-faceted that after decades of theorizing, there is still no recognized, widely accepted measurement for resilience. As with food security, it is likely that multiple measures, each responsive to different aspects of resilience, will be needed. The ISI provides a measure of resilience that reflects the ability of a household to respond to a shock in a way that does not push the household to resort to responses that are either distasteful culturally or that may jeopardize future income and well-being.

The ISI score was a better predictor for how a household was able to absorb or respond to a shock than food security, household composition, or the nature of a shock.

Food security was only loosely associated with the ISI score, and this association differed by livelihood specialization. Food security and the resilience of livelihoods are clearly different, though related, concepts.

The ISI score as a measure of resilience may be helpful in tracking trends in resilience and recovery from major covariate shocks but is generally less sensitive to moderate idiosyncratic shocks.

The ISI score, like the Coping Strategies Index, provides a somewhat arbitrary, population-specific score that has value only in comparison to other scores among the same population. It has proven a useful population measure for comparing one point in time with another within the same population but is less appropriate for comparing one population with another.

The data from which the ISI score is derived provide significant detailed information, which does allow for comparisons on how different populations structure their livelihood strategies and potentially highlights inequalities and vulnerabilities within populations.

Recommendations on using the ISI score for monitoring resilience in a program

1) The ISI score could be a useful tool to monitor changes to livelihood strategies and the general resilience of populations, and to guide program design if the details of the information are examined alongside the overall score rather than just using the overall score as a stand-alone measure.

Although the data collection would not be a heavy burden, the analysis may require more skill, nuance, and effort than many teams are able or willing to invest.

2) This study used a fairly high-frequency schedule for data collection to understand how the score behaved through all seasons, and the interviews included supplemental questions that could be dropped from monitoring interviews. In semi-arid climates, multi-year programs may find twice-yearly surveys just as informative, once just before the harvest and again during the late dry or early rainy season. These adjustments would reduce the burden of monitoring while still collecting the information necessary to calculate the ISI score and to interpret changes.

3) This study followed the same households throughout the three-year period. In addition to other research-related reasons, this technique helped to ensure that changes in the scores were not due to changes in the sample and reduced the necessary sample size. It also reduced the amount of time for each round of data collection because the interviewees were already familiar with the data collection methods (the use of beans to weight cards with different livelihood activities) and were acquainted with the interviewers.

In the final statistical analysis, though, we found there was little difference in results if we treated each period as a different random sample versus multiple measures with the same sample. Therefore, if visiting the same households repeatedly is not an option, random samples at each repeated data collection could substitute if care is taken to ensure the samples are equivalent.

4) The ISI score is not helpful for detecting the impact of small-to-moderate idiosyncratic shocks but does detect changes a shock might have on the profitability of engaging in an activity. The score changed little in response to idiosyncratic shocks but did seem to change with covariate shocks. We can assume that with an idiosyncratic the livelihood system in which people operate did not change and that the system supported a household's rapid return to or a continuation of the same activities. For example, if my house burns down or a herd of camels eats one of my sorghum fields, this is a shock that may reduce my income temporarily, but the general profitability of farming that sorghum field remains the same. I can also depend on those around me to provide some support if this loss results in real hardship. A covariate shock, such as hyperinflation, changes the dynamics of an activity for everyone. Not only does it mean there may be less support available from others, but the shock may also change the benefits or risks associated with a particular activity (at least temporarily), pushing me to change my portfolio of activities. For example, hyperinflation reduced the profitability of market-based activities, pushing households to rely more on alternative, often less-profitable activities, like collecting firewood instead of selling livestock or grain.

5) Any time a single score is developed for a complex, difficult-to-measure construct, there is a tendency to focus on that score and to use it inappropriately in a stand-alone manner without reference to the context or other factors to interpret its real meaning. The real value of the ISI score is that the data from which the score is generated provide a trove of useful information that can inform programming as well as the interpretation of changes in resilience. Are households replacing one activity with another? Are certain activities used less frequently? Are activities that were once preferred no longer preferred as much? If so, why?

If a program team is looking for a low-resource method of monitoring resilience and is uninterested in exploring the data used to calculate the ISI score, it may be simpler and more intuitive to rank the preferability of responses to shocks and monitor how households are responding to the constant stream of idiosyncratic shocks.

In summary, the Income Streams Index may provide a useful tool to monitor long-term trends in resilience strategies and the ability of households to withstand and respond to shocks.

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Annex A. List of people who supported the data collection and analysis

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Ibrahim Mastour
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Annex B. Methods

Study design

This is a longitudinal panel study. One sample of 370 purposively selected households across three states, representing three different livelihood specializations, participated in this study. A study field team in each state registered the households then repeated the same interview questions with the same households through eight different rounds of interviews over a three-year period.

The interviews generated both qualitative and semi-quantitative data. Changes from one reporting period to the next, in sources of income or expenses, are matched with shocks reported. Households who are able to maintain engagement in more preferred sources of income during and after a shock are considered more resilient. The qualitative data accompanying the semi-quantitative measures help to explain why a household's or set of households' measures improved or deteriorated.

Sampling strategy

Three Taadoud catchment areas,[3] from three different Darfur states, were purposively selected as case studies to capture the most variation in context and populations' experiences of shocks in order to increase the generalizability of the results. Optimizing variability in the sample was balanced by such practical considerations as all-season access, the presence of all targeted livelihood specializations, limiting travel time, and reducing transportation burdens on the partners collecting the data. Within the selected catchment areas, the same process was used to select the households to be targeted. **These samples are not meant to be representative of the entire catchment or livelihood specialization. Rather, these three samples are case studies that are indicative of livelihood and food security dynamics to help us to understand various aspects of resilience.**

Taadoud classifies participants into major livelihood specializations: farmers, pastoralists, and nomads.[4] The intention was to have viable samples of each of the three specializations in each of the three selected catchments. Such a sample would allow comparisons in dynamics by livelihood specialization while taking into account different contexts, as well as capturing the shared resources and interactions between the livelihood groups within a single catchment area.

Based on literature related to participatory activities and discussions with experts in the techniques, a sample of 40 households within a well-defined rural population is generally sufficient to capture most of the range of experiences within that population (Catley et al. 2013).

We therefore aimed to capture an initial sample of 60 households per group self-identifying as farmers, pastoralists, or nomads in each of the catchments to cover potential attrition over the following three years. ISI teams held focus group discussions with community leaders in each targeted village to conduct a wealth ranking exercise and selection of the households to be recruited. Each selected household was invited to participate through an informed consent process. Several households containing only very elderly widows were deemed unable to fully understand the consent process and were therefore not registered.

3 A geographic unit used by the Taadoud II program to target communities based on water catchment systems.

4 The Taadoud program does not have a standard definition for these specializations. Households identify themselves by their cultural specialization identity, which does not always match their current livelihood activities. Taadoud partners tend to **classify** households by their cultural specialization, but when **describing** the households, describe "farmers" as sedentary households who depend primarily on cultivation; "pastoralists" as households that were previously mobile but who have settled and now farm but still depend mostly on livestock rearing; and "nomads" as households that still move with large herds. This study sampling strategy was based on self-identification of specialization identity.

Although all five Taadoud implementing partners were willing to participate in this study, resources were too limited to take samples from all. Instead, three different partners working in three different Darfur states were selected to capture the greatest variety in experiences of shocks and livelihood systems. Oxfam's sample (later replaced by CAFOD) in North Darfur provided an example of the most arid region with the most rainfall variability. CRS's sample in West Darfur provided an example of a highly productive area with intense conflict experience. NCA's sample in Central Darfur contained all of the livelihood specializations, with most variables ranging somewhere between those of West and North Darfur, as well as containing important pastoralist migration corridors.

Tool development and ethical review

The tools and basic approach were initially developed based on the experiences of the Taadoud I operational research (OR1). During a visit to West Darfur in February 2018, the researcher adjusted the approach and further refined the questionnaires and participatory piling exercises. The study protocol and tools were reviewed and approved by the Tufts Social, Behavioral & Educational Research Institutional Review Board (SBER IRB) and the Sudan national-level Humanitarian Aid Commission (HAC). In 2019, after five rounds of data collection, the structure but not the content of the questionnaires was adjusted to simplify translation and coding, and to encourage more comprehensive capture of shocks and responses. This modified questionnaire was also approved by the Tufts SBER IRB.

Data collection

Each of the three Taadoud partners participating in the research provided teams of four to five people to collect the data, using various strategies to provide enough qualified people. CRS provided some of their own staff, supplemented by staff from the West Darfur Youth Organization for Development (WDYOD) and a member of the Ministry of Agriculture. Oxfam used staff from their partner Kebkabiya Small Holders Charitable Society (KSCS), supplemented by teachers from local schools. Like CRS, NCA used their own staff to lead the data collection team, supplemented by staff from the local NGO Darfur Development and Reconstruction Agency (DDRA) and two students from the University of Zalingei.

The Tufts research team trained all data collectors in both the interviews and research ethics. Before the baseline round of data collection, all teams were trained together in Khartoum. Immediately afterwards, the Tufts researchers traveled to Darfur to provide additional training with each team individually in their respective states, and to accompany the teams as they began the baseline data collection. As team members were replaced, the Tufts team trained new members. Interviews were conducted in Arabic, with additional explanations or clarifications in the various local languages when necessary.

Three questionnaires were used in the baseline interviews. The Registration questionnaire, used only during the baseline, gathered information about the location and demographics of the household. The Preferences questionnaire, also only used during the baseline, weighed household preferences for current activities and ranked the top three to five activities their grandfathers depended on. The Periodic questionnaire, used in every round, gathered information on the households' current engagement in specific activities and two food security measures. (These questionnaires are available in Annex D).

Interviews were scheduled to take place at strategic times: planting, harvesting, the arrival of nomads to the area, the departure of the nomads from an area. This roughly translated to about every three months, a pace that was maintained until the start of the pandemic in 2020, when all face-to-face research was suspended. Once a waiver was obtained, two more rounds were collected at roughly 9-to-10-month intervals.

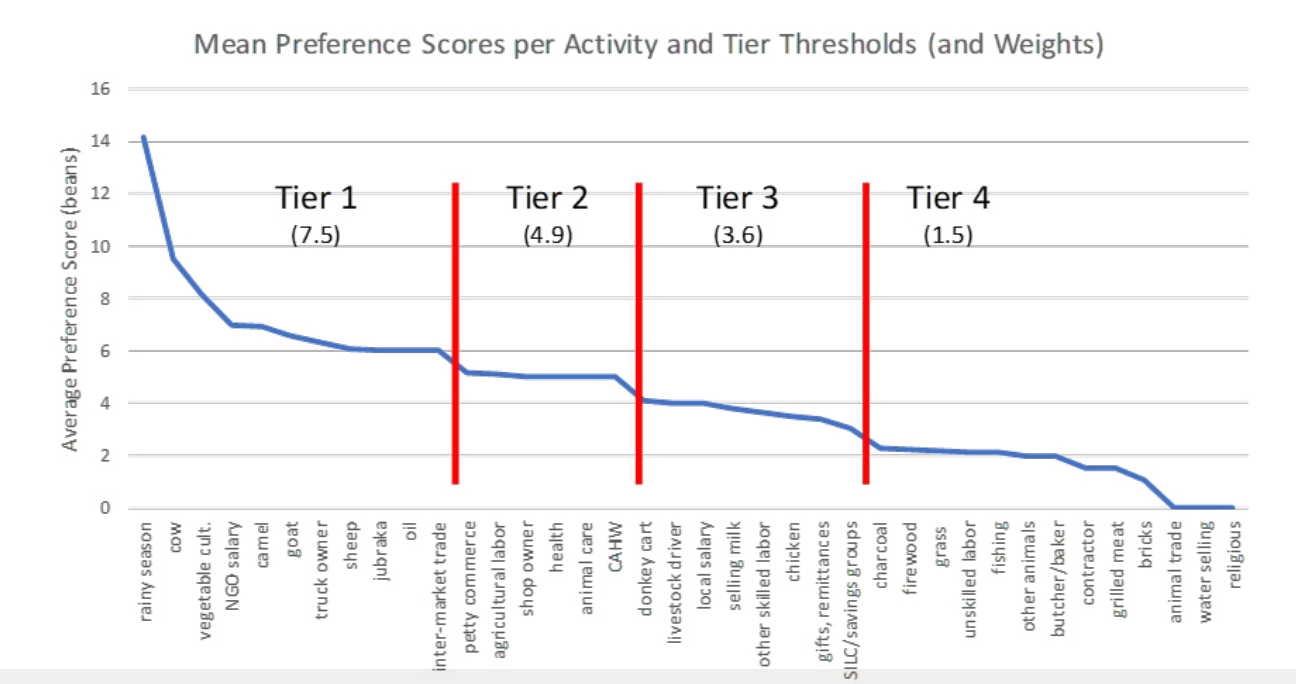
Demographics

The baseline-only information includes the age and sex of each household member, whether or not each depends on this household for the majority of their food and care, their level of contribution to the household, and the current location of each person. The purpose was to distinguish between people who were nominally part of the household from those who were active members. For example, a husband is often named as part of the household even when he lives with another wife and rarely contributes to or visits the home. Likewise, single adult sons may be listed but are essentially independent and living elsewhere. Husbands who had migrated for labor or with a herd but remained an active, supporting member of the household were included as part of the household.

Preferences

During the operational research for Taadoud I, it was noted that households with the same specialization within a village had very similar responses to the preferences, so a subset of households could be used for this exercise using the Preferences questionnaire. During the baseline interview, a subset of respondents listed all livelihood activities done in their community and then weighted them using 50 beans in a piling exercise, allocating beans according to their level of preference (Catley et al. 2013). Preference was defined as "how much they would like to do those activities if they could." They also explained why the top two or three and the bottom two or three were scored as they were. Interviewers were instructed to include the Preferences questionnaire with every second household.

Annex Figure 1. Mean preference score histogram and thresholds for the division of activities into tiers



Preference data were calculated separately for each group but, as they differed little, were combined. Average preference scores were first calculated for each activity. Using these averages, we clustered the activities into four tiers (see Annex Figure 1 for more detail on these divisions). An overall average for the activities in each tier provided a weight used in the calculation of the ISI score as described below.

Time use, income, and expenses

The ISI for the Taadoud I operational research asked respondents to roughly recall annual engagement in activities over a 15-year period, so the interviewers used the vague but well-understood term of "dependence" on activities during blocks of years. When breaking dependence down to one- to three-month periods, it becomes more complicated. A person may invest cash in renting a sorghum field at the start of the rains, then invest time and cash again to weed during the rains, and finally, benefit from the activity by eating or selling the harvest over the next 6 to 24 months. On the other hand, engagement in other activities, like daily labor, may provide benefits on the same day time is invested.

During Taadoud II, we refined the ISI to collect more detailed data, almost as the shock is happening. We therefore needed to consider the effects of seasonality and the different relationships between investments of time and resources in activities relative to the timing of the benefits. We therefore used three different measures of "engagement:" 1) time; 2) income; and 3) expenditure or investment.

Using the Periodic questionnaire, the interviewer asked how each person who significantly contributes to the household used their time during the previous two months, by activity. The interviewer also asked an open-ended question to explain anything that might have changed their use of time. Similarly, respondents weighted income sources and expenditures, noting whether each had increased, decreased, or stayed as compared to the same the previous period. Open-ended questions asked for explanations about drivers for changes in individual items as well as general influences or events changing overall income or expenses and how they responded.

Measures of food security

Two sections of the questionnaire relate to food and food security directly. One simply asks about the household's food sources over the previous two months: own production, purchase, gifts and remittances, distributions from government or NGO, and "other." This question had the added benefit of indicating approximately how long the previous harvest lasted, though partly confounded by on-going production. The second is a validated measure of food security: the Household Food Insecurity Access Scale (HFIAS) developed by FANTA (Coates, Swindale, and Bilinski 2007). These measures of food security were collected to learn about the relationship between resilience and food security.

Calculation of the ISI score

As noted above, the ISI score contains three components: time use (which income streams households are spending their time on), income (which income streams people are getting their income from at a particular point in time), and expense (which income streams and additional expenses the household is investing in at a particular time). The ISI score was calculated based on each of these engagement components individually, and then with a composite of the three. As more data points were collected, along with the accompanying qualitative data, we evaluated which of these, or which combination of these components, provided the most information about the resilience of the household.

Because women and men have very different responsibilities and work roles, time allocations and time ISI scores were measured separately for men and women. Where these were recorded for both the primary male and primary female breadwinner, the times were combined for an overall single measure for the entire household, considering men's and women's labor as equally valuable. If only one was available, this score was used.

Each ISI component score uses the average engagement (beans for time, income, or expenditures) for activities in each tier multiplied by the preference weights for that tier of activities. The Income ISI score formula is similar to the Time ISI score.

Time ISI score =
$(Preference_{Tier1}{}^{*}Time_{Tier1}) + (Preference_{Tier2}{}^{*}Time_{Tier2}) + (Preference_{Tier3}{}^{*}Time_{Tier3}) + (Preference_{Tier4}{}^{*}Time_{Tier4})$

Income ISI score =
$(Preference_{Tier1}{}^{*}Income_{Tier1}) + (Preference_{Tier2}{}^{*}Income_{Tier2}) + (Preference_{Tier3}{}^{*}Income_{Tier3}) + (Preference_{Tier4}{}^{*}Income_{Tier4})$
Expenditure ISI score =
$(Preference_{Tier1}{}^{*}Expense_{Tier1}) + (Preference_{Tier2}{}^{*}Expense_{Tier2}) + (Preference_{Tier3}{}^{*}Expense_{Tier3}) + (Preference_{Tier4}{}^{*}Expense_{Tier4})\text{-}Expense_{shock}$

General ISI Score = Time ISI + Income ISI + Expenditure ISI

Like many similar indexes such as the well-known Coping Strategies Index, the number the ISI score produces is meaningless on its own, without context, trends, and qualitative data to understand the changes in the score (Maxwell 2008). As data were collected over more periods, we were able to examine the changes in ISI scores for each case study (catchment) and their relationship to both normal variability in the seasons and to shocks experienced by the household.

Data analysis

Qualitative analysis

During the first four periods, the respondents were asked to provide explanations for the numerical data they gave through the piling exercises and anything that might have affected them during the previous two months. This qualitative data were analyzed using NVivo qualitative analysis software. This software helps the researcher to spot trends or unexpected links that give further insight into how families use their resources and activities to meet their needs, respond to shocks, or build their resilience. Comparisons between groups can help to understand how different livelihood specializations, or even the same specialization in different contexts, use activities or resources differently.

Initial responses were coded manually into "nodes" according to whether they referred to general preferences, to income, to shocks themselves, or to responses to shocks. Word frequency analyses highlighted key words that were used in association with other key words or by a particular group.

Software used for quantitative analysis

Quantitative data were entered in CSPro 7.1 and Excel, and exported to Stata 17 for analysis.

Annex C. Description of study areas and periods

Description of study areas and populations

Three areas were selected to represent very different contexts in order to make the results more generally applicable and to better understand which factors depended on the context and which were more universal.

West Darfur

In West Darfur, the study included populations from six different villages in Habila Locality, and one nomadic group that is present in the area seasonally, directly interacting with the sedentary population and sharing many of the same natural resources. This semi-arid region is known to be very productive. It has one relatively reliable rainy season sufficient to support sorghum cultivation. The land is slightly rolling, with nearly all communities near enough to at least one wadi able to provide water for livestock and irrigated vegetable gardening throughout the dry season. The region is lightly wooded. Most land is dedicated to a combination of cultivation and grazing. Small herds, especially of goats or sheep, graze in the pastureland immediately around communities. Larger herds, including cattle, graze a bit farther, often moving a couple days' walk away during the dry season. A portion of the pastoralists residing in the area throughout the year settled during the past 20 years and keep herds of cattle or camels that maintain their transhumant migrations. The economy depends largely on selling products at the large market in Habila, which is, in turn, is dependent on Geneina, though traders now arrive from the urban areas of the central region of the country. This population experienced much of the worst fighting during the conflict, with the most short- and long-term population movements. During the conflict, many pastoralists moved into the region and settled permanently while many cultivators who were displaced did not return.

Central Darfur

In Central Darfur, the study was in four villages of Zalingei Locality, about an hour's drive from the market town of Zalingei with a similar climate to West Darfur. These particular villages are relatively close to each other, with Terig/South Terig being the largest settlement of the immediate area. Like the Habila area of West Darfur, the region is lightly wooded, supporting mostly grain cultivation and livestock, with nomadic pastoralists migrating through the area seasonally. The soil in this area, though, is much rockier. There are far fewer wadis and therefore far fewer opportunities for vegetable cultivation except in major wadi areas where the land has become heavily dominated by large onion farmers. While this region did see displacement and conflict, it was less sustained and comprehensive than in West Darfur. The area has been more stable in recent years. The local economy depends on selling production in Zalingei town.

North Darfur

The study area in North Darfur is much drier, with shorter, less reliable rains, very few trees, and longer distances between villages. Though sorghum cultivation still dominates, there is more millet and sesame grown here than in the other two areas. Although much drier, the topography supports more vegetable cultivation. Hence, households depend much more on irrigated vegetable cultivation and small livestock, both of which are less vulnerable to perturbations in rainfall. This region is known for its traditional shoes, and in the early periods of the ISI this work was often reported. While this area did experience conflict, it was not as comprehensive as the area in West Darfur. Households were able to continue to own livestock throughout. The area depends on selling production in the markets in El Fashir.

Description of relevant events during each period

The baseline in 2018 (August to September) was conducted at the start of a bumper harvest, with very good pasture that followed several years of mediocre rains. Harvests in North Darfur had been particularly poor for at least three years prior to the baseline. This is important to remember as we discuss trends in the data across time, comparing results by state, as North Darfur shows different trends in the early periods.

Period 1 (November to December 2018) was a time of plenty, with granaries filled by the bumper harvest and animals fat on good pasture. Selling prices for grain were high, driven by shortages of wheat. Selling prices for animals were high due to good international demand, allowing pastoralists to sell fewer animals to pay for their needs. Some households sold surplus grain to invest in their livelihood activities, to increase agricultural production, and to diversify to new activities. For the first time in many years, a large portion of surplus income was used to purchase animals. The impact of disruptions from the political revolution that was just beginning during this period was not yet affecting livelihoods.

Period 2 (February to April 2019) was conducted as people prepared for the next rainy season and made plans to expand their activities, inhibited somewhat by inflation. Although the revolution was ongoing, livelihoods were only partially disrupted at this time.

Period 3 (May to July 2019) started with good rains. With granaries comfortably full and livestock in good condition, households were heavily engaging in their primary productive activities, encouraged by the good rain. Some farmers increased the proportion of their fields dedicated to cash crops, hoping to capitalize on the high sales prices due to inflation, but were hindered by high wages for labor and high costs for daily expenses. Both pastoralists and farmers invested in livestock with their surplus income, as well as in complementary activities such as small businesses, donkey carts for transportation, and home improvements.

The harvest in Period 4 (August to October 2019) was considered a moderately good one, the second consecutive good harvest, though it was not as bountiful as the previous harvest. The harvest was disrupted in some areas by irregular rains. Though the situation was hopeful, given the progress of the relatively peaceful regime change, inflation was draining the benefits of the two good harvests.

By **Period 5 (January to February 2020), farming households were reporting that due to continued hyperinflation, they were having to sell more grain and animals than usual to meet daily needs**, and some were reporting that their granaries were already empty. Decreased demand for vegetables and fruit in the urban areas was reducing the benefits from sales of irrigated vegetables. Pastoralists continued to sell some grain but mostly sold animals in response to shocks.

Period 6 (December 2020 to January 2021) was the first period after the start of the pandemic. Households, especially pastoralists, described market problems associated with the lockdown that began in early 2020. Localized labor shortages also resulted, with a reduction in labor opportunities for migratory laborers, negatively impacting yields. Lack of interstate travel effectively cut the connection between production and consumption areas. Both livestock sales and fresh vegetable sales suffered, and households had to sell more grain to pay expenses. As inflation continued to worsen, households moved to strategies that limited purchases and a return to subsistence crops. At the same time, the eruption of violence in Habila prevented the team from completing their data collection.

During **Period 7 (August - September 2021), tension was building toward the second coup.** Violence in West Darfur continued to flare up, affecting markets in Geneina and production in the study area. Although movement had resumed and COVID-19 restrictions eased, inflation was at an all-time high (more than 350%), reducing access to inputs, limiting many Tier 2 activities that depend on the sales of goods and services.

Annex D. Final questionnaires used

Panel Participant Periodic Interview Questionnaire

Participating Interviewee ID codes [ ] .
Date of Interview: _____/____/____ Name of Interviewer: _____

If this is not the first interview for this person, explain again the following before conducting this interview:
"As we discussed in our first interview with you, we are collecting information for a study. No one will know that the information you give us came from you, you do not have to participate, and you can skip any question you do not want to answer. Do you want to continue with this interview?" **Yes _____ No _____**

For all weighting exercises in this interview, use 50 beans, so all columns should total 50 points
1. Who are you interviewing? Husband ☐ Wife ☐ .
1.a. TIME USE DURING THE LAST 2 MONTHS *(confirm you are covering all activities underway)*

Activity	Husband Beans	Wife Beans	Other males Beans	Other females Beans
Time relaxing				

1.b. Other than **normal** changes due to expected seasonal differences, describe any events since the last interview that have affected the way your family uses its time, either in a good way or a bad way:

Person	Activity affected	Event causing change	increase	decrease

2. CURRENT MAJOR SOURCES OF INCOME

2.a. What activities are you doing?

2.b. Place the beans to show the proportions for all of your sources of income.

Activities	Beans	+	-	Notes
NGO salary or distribution				
Gift/remittance				
Savings group				
Other _____				

2.c. Is your total income more ☐ same ☐ less ☐ than this time last year?

2.d. Which activities are giving more or less income **this year**?

3. CURRENT MAJOR EXPENDITURES

3.a. What expenses do you have for your activities?

3.b. Place the beans to show the proportions for all of your expenses.

	Beans	Increase	decrease	Notes
Food				
Education				
Health				
Telephone				
Gifts and condolence contribution				
Other household needs				
Income Activities				
Contribution to SILC				
Fees/taxes/fines				
Other (_____)				

3.b. Compared to *this time last year*, which activities are you trying to do more?

3.c. Compared to *this time last year*, which activities are you doing less?

Participating Interviewee ID codes _____ .

4.a. Describe any events since the last interview that helped you to **have more food and money.**

Event description	Activity or expense affected	New activity?	income	expense

4.b. Describe any events since the last interview that have changed your **activities in a bad way**.

Event type	Source of resources to respond	Activity or expense affected	Income	expense

4.c. Describe any events since the last interview that have **increased your household expenses (not activities)**.

Event type	Expense category	Who affected?	Source of resources to respond

5. PROPORTIONAL SOURCES OF FOOD

	Beans
Own production	
Purchase	
Gift	
NGO	
Other (_____)	

6. Household Food Insecurity Access Scale (HFIAS)

No.	Occurrence Questions	Yes / No	About how many times?
1.	In the past 30 days, did you worry that your household would not have enough food?		
2.	In the past 30 days, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?		
3.	In the 30 days, did you or any household member have to eat a limited variety of foods due to a lack of resources?		
4.	In the past 30 days, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?		
5.	In the past 30 days, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?		
6.	In the past 30 days, did you or any household member have to eat fewer meals in a day because there was not enough food?		
7.	In the past 30 days, was there ever no food to eat of any kind in your household because of lack of resources to get food?		
8.	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?		
9.	In the past 30 days, did you or any household member go a whole day and night without eating anything because there was not enough food?		

The Feinstein International Center is a research and teaching center based at the Friedman School of Nutrition Science and Policy at Tufts University. Our mission is to promote the use of evidence and learning in operational and policy responses to protect and strengthen the lives, livelihoods, and dignity of people affected by or at risk of humanitarian crises.

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