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Using Participatory Epidemiology to Investigate the Causes and Seasonality of Acute Malnutrition in Marsabit and Isiolo Counties, Northern Kenya: Methods and Experiences

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Contents

1. Introduction

1.1 About this report

In 2021 the Nawiri project conducted a community-level analysis of the seasonality and basic causes of acute malnutrition in selected locations in Marsabit and Isiolo Counties in Kenya. The specific questions for the analysis were:

- How do communities explain malnutrition in children and mothers by reference to the diets of healthy and malnourished children?
- What is the seasonality of malnutrition and related factors?
- How do communities describe and prioritize the causes of malnutrition in children and mothers?
- What are the differences in the diets of healthy vs. malnourished children in terms of specific food types and the seasonal availability of food types?
- What are community participants' suggestions and priorities for improving nutrition, and what is the reasoning behind their views?

In addition to answering these questions, the analyses also had a methodological component and aimed to adapt and test the use of participatory epidemiology (PE) for understanding malnutrition. Originally developed by veterinarians in pastoralist areas of East Africa, PE had been used in a study on human malnutrition in Uganda[1] but had not been previously used in pastoralist areas of Kenya for human health problems. This report covers the PE methods that were used in Marsabit and Isiolo, whereas the findings of the analyses are available in separate Nawiri reports.[2]

1.2 Why participatory epidemiology?

In the 1990s veterinarians in East Africa started to adapt participatory approaches and methods to investigate livestock diseases, especially in remote and conflict-affected pastoralist areas. An important aspect of the approach was a recognition that pastoralists often possessed strong knowledge on livestock production and diseases, including the clinical signs and epidemiology of diseases. Over time, this use of participatory methods became known as "participatory epidemiology" (PE), and from the early 2000s PE became institutionalized and normalized in many African countries. Understanding and practice of PE shifted from a relatively small group of practitioners and epidemiologists to a wide range of universities, government epidemiology units and research institutes, and local and international NGOs.[3] International agencies such as the World Organization for Animal Health and the Food and Agriculture Organization also supported PE, particularly in the form of participatory disease surveillance, which was integrated into national and regional surveillance programs as PE spread to Asia and Latin America.[4] As a measure of the uptake and adaptation of PE, in 1996 there was only one peer-reviewed journal article on PE methods. In August 2021, a search of Science Direct using the terms "participatory" and "epidemiology" produced a list of 2,813 publications, mostly related to veterinary epidemiology in low-income countries.[5]

1 Catley et al., 2018.
2 Burns et al., 2021a; 2021b.
3 Catley, 2009.
4 Allepuz et al., 2017.
5 Allepuz et al., 2017.

One area of adaptation of PE included the standardization and repetition of PE methods that produced ranks, scores, or proportions, thereby creating datasets that could be analyzed statistically. This approach led to estimates of disease incidence and mortality, analysis of seasonality and causation,[6] and an understanding of complex syndromes involving multiple infections.[7]

In common with many other sectors and disciplines, the use of participatory approaches and methods by veterinarians has been characterized by diverse interpretations of "participation." For some, participation meant a move towards partnerships with communities, joint analysis of problems, and on the part of professionals, an understanding that livestock keepers can make important intellectual contributions to learning and problem solving. This way of working was broadly in line with the early concepts of community participation and the emergence of participatory rural appraisal.[8] However, other uses of PE have followed far more conventional research and often non-participatory approaches. For example, the use of questionnaires to collect information has rarely been a participatory process, and concerns about the limited value of questionnaires were an important driver of alternative methods. Similarly, workshops or other activities involving professional experts have been called "participatory," even when there was limited or no involvement of community members.

1.3 Participatory approaches to human health and nutrition in pastoralist areas

In contrast to veterinary research and national livestock disease surveillance systems, the use of participatory approaches and methods in the human health and nutrition sectors has been limited in pastoralist areas. Rare examples include a participatory assessment of women's health in southern Ethiopia,[9] and studies on malnutrition in the Somali Region of Ethiopia[10] and Karamoja, Uganda.[11] In 2018, Feinstein International Center, Friedman School of Nutrition Science and Policy at Tufts University piloted PE to specifically look at the causes and seasonality of malnutrition in pastoralist and agro-pastoralist communities in Karamoja, Uganda.[12] The study demonstrated that in contrast to more conventional methods, analysis using PE can generate a wealth of rigorous, technically plausible information within a matter of weeks or months. It also yielded detailed information on the causes of malnutrition and the relationship between these causes and seasonality and livelihoods. The study also identified new seasonal patterns of malnutrition missed by biannual nutrition surveys.[13] These results encouraged the Nawiri partners to propose further piloting and testing of the PE approach in the context of the Kenyan arid and semi-arid lands (ASALs).[14]

Although fairly recent, there appears to be a growing recognition of the potential of participatory methods in nutrition research. For example, in addition to the Karamoja study, a recent mixed methods study looking at the causes and seasonality of malnutrition in Laisamis sub-county in Marsabit included some PE methods, and focused on local knowledge and perspectives.[15] Under Nawiri, the PE approach was piloted in Marsabit and Isiolo counties in early 2021.

6 Catley et al., 2012.
7 Catley et al., 2001.
8 Chambers, 1994.
9 Tezera and Desta, 2008.
10 Sadler and Catley, 2009.
11 Stites and Mitchard, 2011.
12 Catley et al., 2018.
13 Ibid.
14 Catholic Relief Services, 2019.
15 Food and Agriculture Organization (FAO), UNICEF, and Washington State University, 2020.

2. Design and methods

2.1 Design outline

The PE design drew heavily on work by Feinstein in Karamoja, Uganda in 2018[16] and involved the following stages:

- Setting the questions for the analysis and identifying methods that are suited to answering the questions;
- Initial design work, including selection of locations and required repetitions of methods;
- Ethnographic work to document local language for words and terms related to malnutrition, months, and seasons;
- Collection and review of secondary literature and data, used in part for real-time triangulation of information in the field;
- PE training for field teams, focusing on field practice of PE methods, field testing, and refinement of methods;
- Implementation of PE field work;
- Summarizing of PE findings, e.g., in graphs and diagrams, supported by narrative;
- Assessment of reliability and validity;
- Write-up and sharing of reports.

The work was carried out between February and April 2021 in North Horr and Loiyangalani wards in Marsabit County and Cherab and Chari wards in Isiolo County.

2.2 Design of participatory epidemiology methods

To support the design of the PE methods, an ethnographic approach was used to gain insights into women's general awareness and understanding of malnutrition and related issues, and how they described the causes of malnutrition in children and mothers. Central to the approach was understanding local language, and the extent to which specific words or phrases were used in relation to malnutrition and why. This approach produced useful information in its own right but also guided the design of PE methods (section 2.4) by ensuring that relevant and appropriate language was used with the methods, and that some potential non-sampling errors were prevented. For this stage we used two methods, discussed below.

A literature review and key informant interviews were conducted. Due to COVID-19 movement restrictions in Kenya, telephone interviews were used with 31 key informants, combined with a desk review of relevant literature. The selection of key informants was guided by the main languages used in the selected areas, i.e., Gabra in North Horr and Borana in Cherab and Chari. The information was triangulated with community participants during field testing (see below). This work was led by an anthropologist from Marsabit with local language skills and long-term field experience in northern Kenya. This stage allowed for the identification of some of the key indicators for the PE methods (section 2.4).

Two PE methods were adapted and initially tested locally for use in North Horr, drawing on the key informant interviews and literature review, and experiences from Karamoja. These methods were a causal diagram and a monthly calendar (see section 2.4).

2.3 PE field teams, training, and field testing

The work was conducted by a team of facilitators comprising nine women from Isiolo and Marsabit fluent in at least one of the local languages and

16 See Catley et al. 2018.

with specific experience working with communities in one of the two counties. This experience included public health, nutrition, research, and monitoring and evaluation. The team was led and supported by an anthropologist from Marsabit with over twenty years' research experience in northern Kenya, an epidemiologist from the Marsabit County Government health department, and a Feinstein researcher with over 20 years' experience using and adapting participatory methods in the region.

The training for the field teams was led by a Feinstein researcher from Northern Kenya with extensive experience in participatory methods, including co-leading the Karamoja PE study. The training included two days of classroom training involving both theory and practical sessions, but focusing on the two PE methods (see below). This classroom training was followed by two days of practical field work in Garbatulla and Laisamis sub-counties, where the team practiced using these two methods. A final day was spent reviewing experiences from the field practical and adjusting the methods.

Following the training, the team travelled to North Horr, where the field work started. One week of field testing of the PE methods was conducted. Part of this process was triangulating the findings from the ethnographic exercise and refining the indicators for the PE methods. Before starting the exercises, we introduced ourselves to community members as an independent team. We made it clear that our objective was to better understand issues around mothers' and children's health, but we were not in any way positioned to provide assistance. We explained that we would document and share the information with different audiences including county government and development organizations but that we could not guarantee that they would use the information. Interviews during this stage used photographs of malnourished women and children, which prompted in-depth discussions. This stage was conducted by an anthropologist with local language skills. This process was then repeated in each new assessment area, with the exception of Loiyangalani, where the tool development and testing was combined with the ethnographic exercise.

2.4 Participatory epidemiology methods

2.4.1 Monthly calendar—monthly variations in malnutrition and related indicators

A monthly calendar is a visualization method showing the pattern of selected "indicators" against months. Local names were used for the months, which had been identified from the ethnographic and field-testing phases. Before starting the exercise, participants were asked to identify a work activity or significant event that corresponded with each month of the year. As there were slight variations between communities, either a local object or a visual aid would be used to represent the activity or event. This activity or event served as a reference so that both the participants and field team were always talking about the same month.

A detailed guide to the monthly calendar method is provided in Annex 2. Key features were:

- The calendar was constructed on the ground, using diagrams to represent months and more diagrams to represent the indicators. The use of diagrams meant that illiterate informants could participate, since no written materials were used;
- Rainfall was selected as the first indicator, and informants were asked to show the pattern of rainfall against each month. Local names were used for the months. The rainfall pattern was illustrated using 100 stones, distributed across the months by the participants. The use of rainfall as the first indicator ensures that informants understand the method, as the rainfall pattern can be cross-checked against actual rainfall data;
- During the placing of the stones, informants were asked to show the *pattern* of rain distribution rather than count the stones to be assigned to each month;
- The informants were asked to consider a "typical year;"
- After the rainfall pattern was illustrated, informants were asked to explain the pattern; this further questioning also ensured that the method had been understood;

- The method was used with groups of women, and the "scoring" of rainfall by month was done based on discussion within the group;
- After rainfall had been scored, the stones were left in place and further indicators scored, one by one, with discussion and further questions for each indicator. Up to 10 additional indicators were selected. These varied between the three study sites depending on the livelihood practices in each area;
- The full list of indicators was as follows:
  - Rainfall;
  - Availability of camel milk for children;
  - Availability of cow milk for children (Isiolo only);
  - Availability of goat milk for children;
  - Availability of fish in the lake for consumption (Loiyangalani only);
  - Consumption of purchased foods;
  - Women's work;
  - Occurrence of child malnutrition;
  - Occurrence of child malaria;
  - Occurrence of child diarrhea;
  - Occurrence of human births;
  - Insecurity.

The selection of livestock milk, women's work, diarrhea, and the consumption of purchased foods as indicators was based on the causes of child malnutrition most frequently mentioned during the ethnographic stage. For the milk indicator, the two most-important livestock species in the respective area were chosen. The other indicators were selected based on their perceived relevance or for their value in validating the results. For example, the team felt that fish consumption might be an important indicator in Loiyangalani. As mentioned, the rainfall indicator is easily triangulated. To make the child malnutrition indicator age-specific, women were asked to focus on a 2-year-old child.

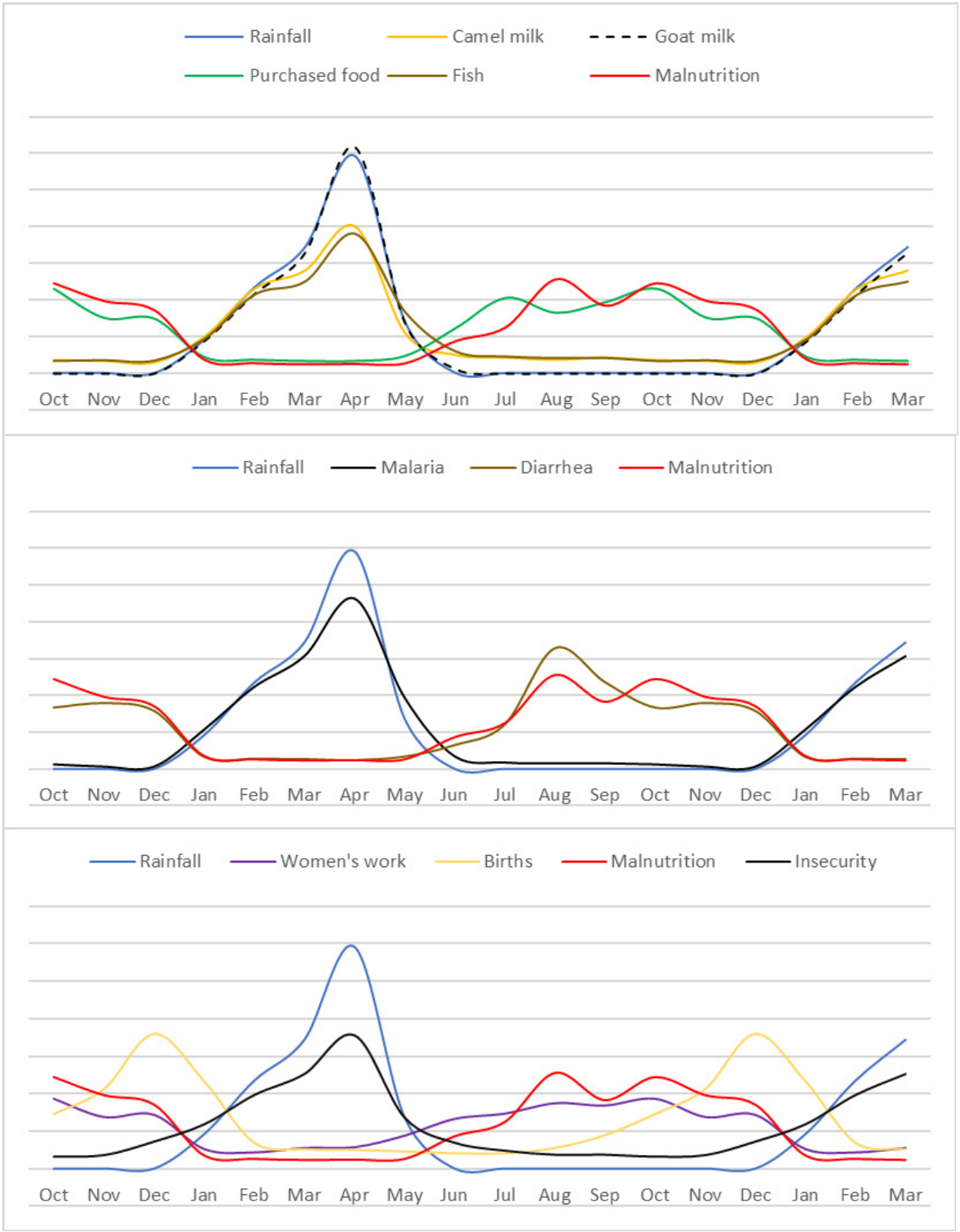
A final calendar showed the patterns of all the indicators and enabled further questions across indicators, and about the relationships between indicators. Although the calendar was a visualization method, the use of 100 counters per indicator enabled the results to be recorded numerically. The results also comprised responses to questions on the reasoning behind the scores and the relationships between indicators.

Figure 1 below is an example of a monthly calendar from Loiyangalani. In this example, 12 months and 11 indicators were used, leading

Figure 1. Example of a monthly calendar, Loiyangalani, Marsabit County.

Notes: In this example, the diagrams depicting local months are positioned on the left side of the photograph and the diagrams depicting the different indicators are positioned along the bottom of the photograph. Piles of stones of different sizes represent the relationships between the months and the indicators.

Figure 2. Summary monthly calendar graphs, Loiyangalani, Marsabit County.



Notes: There is no y-axis scale, so the lowest level of malnutrition (or any other indicator) shown does not necessarily mean a level of zero. An 18-month timeframe is used on the x-axis to clearly illustrate monthly patterns at the beginning and end of the year.

to a total of 132 "cells" in the calendar and the distribution of 1,100 counters (stones) to show relationships between months and indicators. In each ward, the monthly calendar scores from different groups of informants were summated in MS Excel, and graphs were produced to show the pattern of the indicators by month. In the case of Loiyangalani, 14 informant groups each produced a monthly calendar, leading to a total of 15,400 counters being represented in the summary graphs in Figure 2.

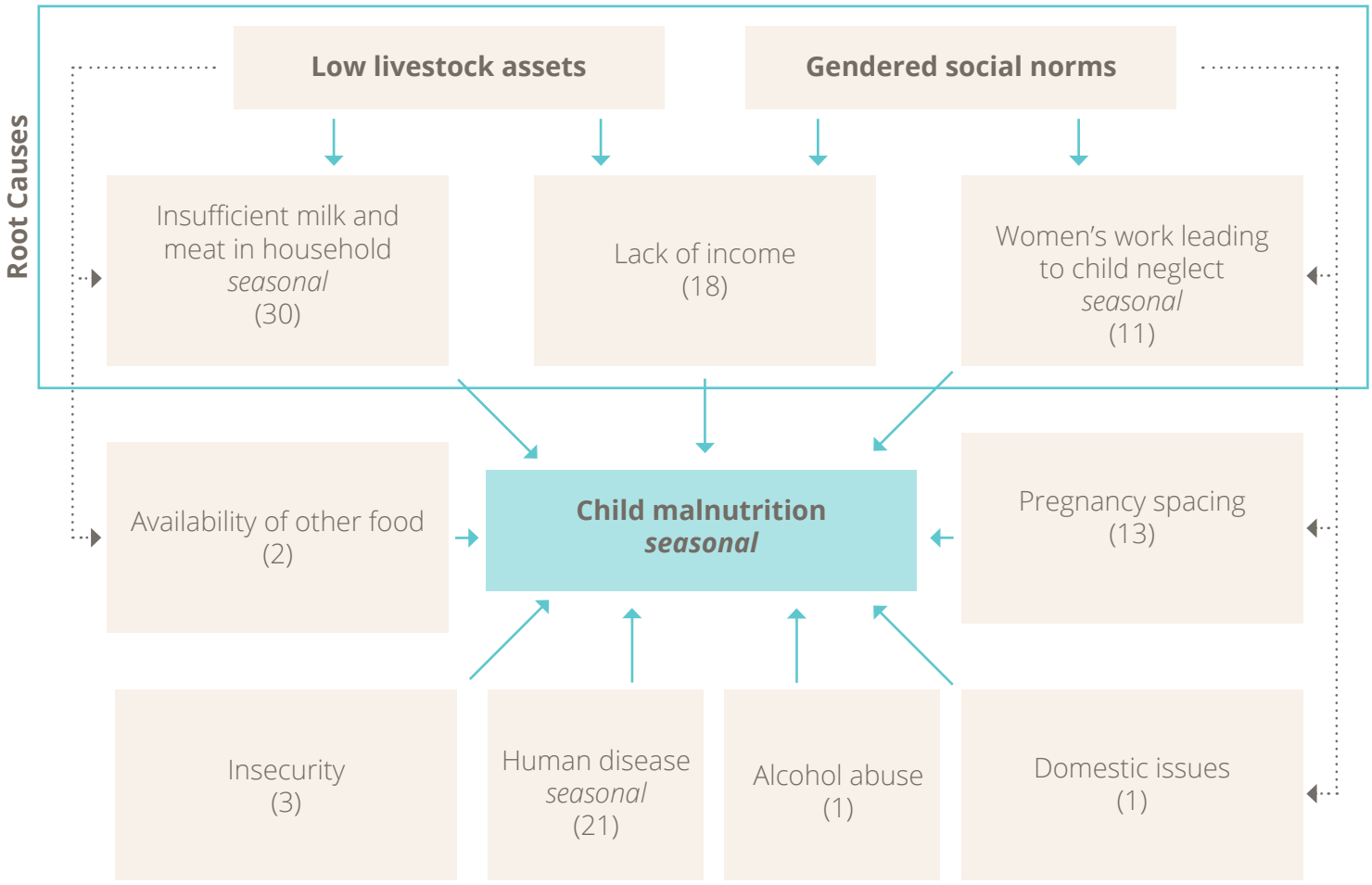
2.4.2 Participatory causal diagrams

The interviews with women during the pre-testing stage (section 2.3) showed they explained malnutrition by reference to specific causes. To capture this information more systematically, diagrams or laminated photographs were used to represent each cause,[17] along with a picture of a malnourished 2-year-old child. The diagrams of causes were placed on the ground in a circle, around the diagram of the child in the center, and women were asked to show the relative importance of each cause by distributing a pile of 100 stones. This visualization and scoring of the causes enabled further questions and discussion on the relative importance of the causes, and how different causes related to each other sequentially or in other ways. The method was then repeated with a photograph of a malnourished mother at the center of the diagram. As with the monthly calendar, the narrative reasonings provided by informants to explain their scores and relationships between causes are a critical part of the method.

Figure 3. Illustrative example of a participatory causal diagrams for a malnourished child.[18]

17 We brought a large collection of photos representing different possible causes that emerged during the field testing. These were then placed inside transparent plastic sleeves as an alternative to pre-laminated photographs.
18 Note: All the pictures (visual aids) used are prompts or reminders to detailed discussion on indicators and use of local language for the indicators. Specific visual aids (including local objects in some cases) were identified based on discussion and agreement with participants.

Figure 4. Causes of child malnutrition, Loiyangalani.



Notes: : Figure is derived from interviews with women in Loiyangalani followed by scoring of causes with 10 independent groups of women and presented as a proportion of the total. The numbers in parentheses represent the scores from all the groups presented as a proportion of the total.

2.3.3 Other methods

After completing the monthly calendar or causal diagram, participants were asked to identify areas of intervention that would address the child's or mother's malnutrition based on the issues that emerged from each method. Participants were encouraged to identify sustainable solutions as opposed to one-off emergency interventions such as the unconditional provision of food or cash. During this process, we were very careful to explain that we had no affiliation to any organization that provides assistance.

Separate focus group discussions were used to investigate the difference in diets between healthy and malnourished children under 5 at different stages in their development. The exercise was then repeated for mothers at different stages during pregnancy and then again after giving birth. Additional focus group discussions using the two PE methods were carried out for purposes of collecting complementary information and triangulating results. This additional collection of information included one exercise with male participants in North Horr, one with an El Molo fishing community, one with a pure pastoralist community in Loiyangalani, and two with agro-pastoral communities in Isiolo. The rainfall results from the two groups in Loiyangalani were combined with the other PE data for comparisons with actual rainfall data.

Seven key informant interviews were carried out in Marsabit. These included interviews with representatives from Vétérinaires Sans Frontières (VSF) Germany, the One Health project, and county medical staff in North Horr. In Loiyangalani, key informant interviews were held with an El Molo elder in Kamote village, a female fish trader in Nakuron village, and county medical staff in Loiyangalani town. The ward administrators in both areas were also interviewed. In Isiolo, three key informant interviews were carried out with livestock traders at the Merti livestock market, a herder who owned a butchery, and the chairperson of a women's self-help organization. The objective of these interviews was to collect complementary information and triangulate results from the PE exercises.

2.4 Sampling

Sites were purposively selected based on a Nawiri analysis of malnutrition hotspots in the two counties.[19] In Marsabit, North Horr ward in North Horr sub-county and Loiyangalani ward in Laisamis sub-county were selected. In Isiolo, Cherab and Chari wards in Merti sub-county were selected. Although all these areas have high rates of acute malnutrition, the specific areas selected differed in terms of ethnicity, livelihoods, and environment. In North Horr, the focus was on Gabra pastoralists specializing in camel production. In Loiyangalani, the focus was on Turkana pastoralists living close to the lake and engaged in fishing, and in Merti sub-county, the focus was on Borana pastoralists specializing in cattle production.

We aimed to conduct both PE methods in a village. The number of villages selected per ward was based on veterinary uses of PE methods such as seasonal calendars and between 8 to 12 repetitions of the method with independent informant groups. Groups size varied from between 8 to 15 women comprising mothers of different ages. Both the PE methods were carried out in 13 villages in North Horr. In Loiyangalani, the monthly calendar was carried out in 14 villages and the causal diagram in 10 villages. In Merti sub-county, the causal diagram was carried out in 16 villages and the monthly calendar in 13 villages.[20] In most but not all cases, both exercises were carried out in the same village but with different participants. Annex 1 gives the locations where the two PE methods were used. The villages were selected based on the predominant livelihoods of the community. For example, in North Horr, communities who focused on camel production were selected; in Loiyangalani, villages that combined both livestock production and fishing were selected. The selection of villages was based on interviews with ward administrators and local knowledge of the field team members.

19 The study had initially planned to include Kargi South ward in Laisamis sub-county, but this location was dropped in favor of Loiyangalani to avoid potential overlap with a similar study.
20 PE methods were also used during four additional focus groups across the study areas. However, the results were only used for purposes of triangulation and for collecting additional information.

In Loiyangalani, the study also included a pilot in Mt. Kulal where the PE methods were tested in eight villages. However, as four of these villages were agro-pastoral and four were pastoralist, different indicators were used for the methods, and so these results were not used for the analysis. A separate briefing paper on this case study will be published at a later stage.

2.5 Reliability and validity

2.5.1 Reliability

A reliable method produces the same results if it is repeated. For example, a questionnaire that contained a question that was interpreted differently by different informants would be unreliable.[21] In the PE analysis, the reproducibility of the monthly calendar and participatory causal diagram was assessed as a measure of reliability. We assumed that within a given ward, general contextual and livelihood systems would be similar, and observations on these systems by different informant groups would also be similar. Therefore, reproducibility was assessed by measuring the level of agreement between the independent informant groups in each ward. The Kendall coefficient of concordance (W) in SPSS software was used for this assessment, and agreement between groups was categorized as weak ($p > 0.05$), moderate ($p < 0.05$), and strong ($p < 0.01$).[22]

2.5.2 Validity

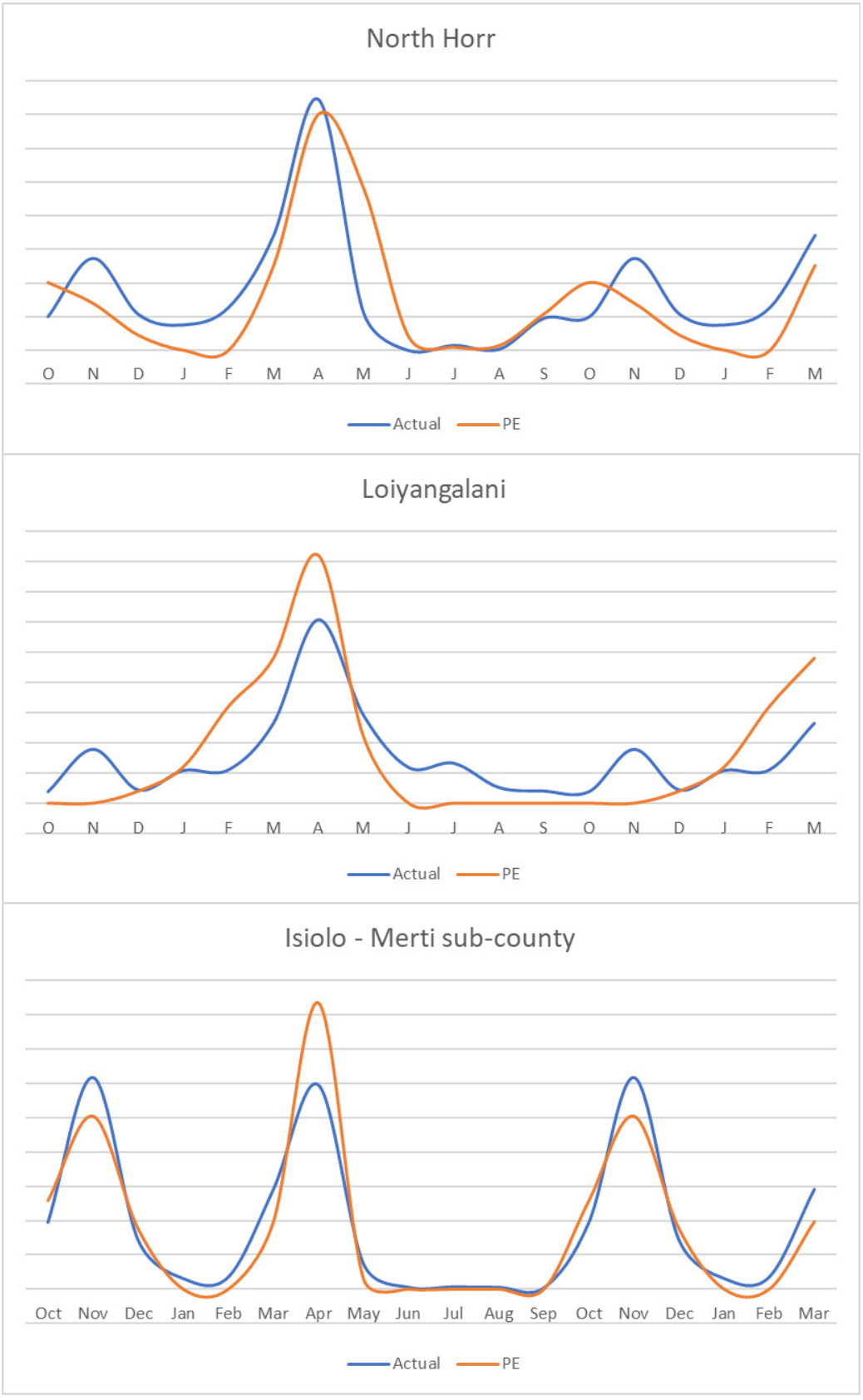
The validity of a method concerns the truthfulness of the results. In qualitative research, it can draw heavily on the process of triangulation. In PE, triangulation involves cross-checking results against other sources of information, which might be other methods or informants, or secondary literature. This literature can include textbook descriptions, such as seasonal variations in pastoralist livestock milk production or the incidence of human diseases. Triangulation is not always straightforward. For example, the indicator used in a PE method might not be an exact match to an indicator or variable in the secondary literature or cover the same time period. Local social, environmental, or other factors might lead to findings that differ from standard descriptions of problems or issues, but which can be explained based on the local context.

In the monthly calendar, triangulation varied by indicator. Examples are provided below.

Rainfall—We compared rainfall patterns from the monthly calendars with objective measures of rainfall (Figure 5). In all areas, PE-derived rainfall patterns corresponded closely with actual monthly rainfall averages. All three areas receive two rainy seasons. The longer (heavy) rains start between the end of February or early March and peak in April, with an abrupt decline by the end of May. The short (light) rains generally start in early October, peak in November and decline in December. However, in Loiyangalani, if it rains at all during this second phase, it is almost entirely concentrated in the month of November. The PE results from all areas showed identical peaks in April during the longer heavy rains. For the second phase, the results from North Horr and Isiolo show the second peak in October and November respectively. In Loiyangalani, the PE results did not capture this second peak, as participants do not consider rain at this time of year to be normal. An analysis of rainfall data from 1970–2008 supports this PE result, showing long-term averages distorted by a few years with unusually high rainfall in November;[23] in more than 50% of years, the area received less than 3 mm of rain in November.[24]

21 This is an example of a non-sampling error. When calculating the total error of a survey, non-sampling errors are squared; small increases in non-sampling error have a large impact on total survey error.
22 Siegel and Castellan, 1988.
23 For example, in 1972, 1977, and 1997 rainfall in November was between 5–7 times the average rainfall for that month or 10–14 times the average if you exclude these years. In 1977, the total rainfall in November was almost the same as the average annual rainfall even if you include these outlier years.
24 Source: Lekapana, 2013.

Figure 5. Objective rainfall vs. rainfall patterns from PE.

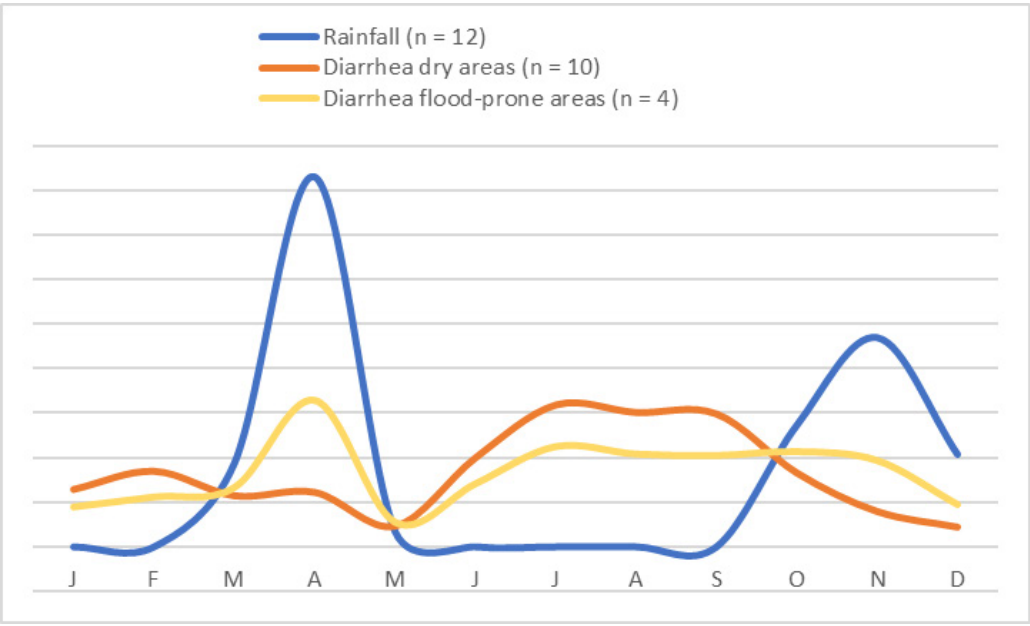


Availability of livestock milk for children—The PE results from all three areas showed a correlation between rainfall and the availability of livestock milk. In dry pastoralist areas, milk production in animals typically depends on the availability of water and pasture; a close correlation between rainfall and livestock milk availability is expected and technically plausible. For example, Kenya's drought early warning bulletins consistently show elevated levels of livestock milk production during seasons and years with above-average rainfall.[25] Camel milk is still available during the dry season although in smaller quantities. This availability of camel milk was captured in the results. During this period, the camels are in the dry season grazing areas so children can't access the milk, which also explained the reduced availability of milk at this time that was captured in the results.

Occurrence of child malaria and diarrhea—In general, the incidence of malaria is associated with rising mosquito populations. Therefore, in dry pastoralist areas, malaria is typically linked to the rainy season and mosquitos breeding in stagnant water. The PE results from all areas are technically plausible, showing a correlation between malaria and rainfall distribution.

Similarly, from a technical perspective, diarrhea would likely increase in the rainy season in areas with limited sanitation and where human water sources could become contaminated. However, the monthly calendars in all study areas showed the presence of diarrhea throughout the year but with an increase during the dry season. Informants provided very logical reasons for this finding. For example, they explained that the water quality in wells deteriorates during the dry season. In Loiyangalani, they also attributed the increase in diarrhea in the dry season to dust contamination from high winds at this time of year, as well as to the increased consumption of indigestible "hunger foods." The same finding emerged during a PE training exercise in Laisamis ward and was supported by data on diarrhea cases from the health center in North Horr showing peaks in diarrhea in the two dry seasons. There was also location-specific variation in the monthly pattern of diarrhea. In four villages situated in a flood-prone area on the banks of the Ewaso Nyiro River, the results showed child diarrhea peaking in April during the long (heavy) rains, then decreasing rapidly in May, increasing again during the dry season, and then decreasing again during the short (light) rains (Figure 5).[26] This finding is interesting as it indicates that heavy rain and

Figure 5. Comparison of diarrhea occurrence in dry vs. flood-prone areas.



Notes: The results show the occurrence of child diarrhea in relation to rainfall in Merti sub-county in Isiolo and compares villages in flood-prone areas along the Ewaso Nyiro River and villages further away from the river. Although the patterns are similar, the flood-prone areas show a spike in diarrhea in April during the long heavy rains.

25 For example, see National Drought Management Authority (NDMA), 2019.
26 Two of these villages were excluded from the analysis as they were agro-pastoral, whereas the rest of villages were pastoral.

flooding leads to an increase in diarrhea, which is plausible, whereas light rain (without flooding) improves the water quality in the wells.

Women's work—This indicator looked at the relative amount of time women spent on various activities throughout the year, with emphasis on activities that kept them away from their children for long periods of time. Although women explained that they are busy throughout the year, their workload in terms of time spent increases during the dry season. The indicator is difficult to verify against secondary literature because it is a composite indicator, comprising different types of work. However, the women gave logical explanations for why they spend more time away from their children during the dry season. In some cases, these explanations could be triangulated with other information that they had already provided. For example, the women explained that during the dry season they spend long periods engaged in firewood and charcoal production and sales to purchase food to compensate for the lack of animal food products at this time. The elevated score for this indicator at this time can then be cross-checked with other indicators such as the monthly activities (first stage of the exercise) and the availability of milk or other foods for consumption. Figure 6 below shows an example in which the increase in women's work corresponds directly with the monthly activities (collecting firewood and burning charcoal), no milk and limited fish for consumption, and a corresponding increase in the consumption of purchased foods. These logical patterns along with the explanations provide a useful way of triangulating and validating the results in real time. Specifically, this process is a form of "within-method triangulation" whereby the findings from one part of the method support the findings from another part of the same method.[27]

Other activities that take up time during the dry season include more time spent fetching water, firewood, and wild foods, and herding animals. Not only are these plausible; they are supported by other sources. For example, average distances to household water sources in Marsabit in 2020 more than doubled between April and September, and livestock trekking distances tripled.[28]

Child malnutrition—The results from all areas showed an increase in child malnutrition during the dry season and a decrease with the onset of the rains. This finding is supported by numerous studies that show malnutrition peaking during the dry season in pastoralist areas.[29] A recent study in Marsabit showed child malnutrition peaking towards the end of the long dry season in August, the same month as the peaks identified in two of the study areas. Participants explained this peak in terms of a decline in milk availability for consumption. The relationship between rainfall, improved pasture, milk availability, and child malnutrition is technically plausible and is supported by other analyses. For example, a positive correlation between normalized difference vegetation index (NDVI) as a proxy for forage and mid-upper arm circumference (MUAC) z-scores in Marsabit has been reported.[30] The Milk Matters study in Ethiopia also showed a significant difference in weight-for-height z-scores of children in treatment and control groups based on the availability and consumption of livestock milk.[31]

27 Catley et al., 2012.
28 NDMA, 2020.
29 See FAO and Tufts University, 2019; and Catley et al., 2018.
30 Mburu, 2016.
31 Sadler et al., 2012.

Figure 6. Within-method triangulation in a monthly calendar.

INDICATORS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
	Lomaruk *Making Bomas for Goats*	Titima *Grazing Herding*	El El *Fetching Water*	Lochoto *Making Ghee*	Losuban *Celebrations*	*Latiak Wild Food Collection*	Lodunge Looking for *Pasture (migration)*	Lopoo *Cooking blood*	Lolongu *Collecting Firewood)*	Lokwang *Burning Charcoal*	Lomuk *Collecting Acacia pods*	Lorra *Cooking Acacia pods*
 Rainfall	••• •••	•••• ••••	•••••••• ••• ••••••	••••••• •••••••••••••• •••••••••••••• •••••••••••••• ••••••••••••••	••••• •••••							
 Availability of goat's milk	••• •••	••••• ••••	•••• ••••••••• ••••	••••••••• •••••••••••••• •••••••••••••• •••••••••••••• •••••	•••••• •••••	•• ••						
 Consumption of purchased food	•• ••	•• •••	••	•	••• •••	•• ••	•• •••	•••••• •••••	•••••••• ••••••••	•••••• •••••••••••• •••••	••••• ••••••••• ••	•••• ••••
 Availability of Fish	••••	••••••	•••••••• ••••••••••	••••• ••••••••• •••••• ••••••••••• •••	•••••••••••• •••••	•• ••	•••	•• ••	•••	•••	••	•••
 Women's work	••	•••	•• •••	•••	•• •••	•• ••	••	••••• ••••••	•••••• •••••••••	•••••• •••••••••••• ••	•••••• ••••••••• ••••	•••••• ••••••

Notes: The results from this monthly calendar from Loiyangalani show an increase in the time women spend on work during the dry season (bottom row). This work includes collecting and selling firewood in September and October. The women explained that they engage in this activity to get income to purchase food to compensate for the reduced availability of food from their own livestock (row 2) at this time. Hence, there is a corresponding increase in the consumption of purchased food (row 3) during this period.

3. Discussion

3.1. Using participatory epidemiology to analyze malnutrition

During the PE work in Marsabit and Isiolo, it was quickly evident that women had in-depth knowledge on their livelihoods and how stresses or changes to livelihoods affected the nutrition of children and mothers. Women were also knowledgeable about nutritious foods and hygiene practices and their relationship to health and nutrition. However, they lacked the income, time, or resources to effectively take advantage of this knowledge, and their decisions and activities were constrained by deep-rooted gender issues. Women proposed interventions to address malnutrition that logically followed from the monthly calendars and causal analysis. The preferred interventions focused on income generation and livelihoods support. The monthly calendar was a potentially complex method. Each monthly calendar used 12 months and up to 11 indicators, with each indicator "scored" across the months using 100 stones. This method produced a diagram with up to 132 cells and 1,100 stones (for an example, see Figure 1). Despite this complexity, women were able to construct the diagrams, score the indicators, explain the monthly variation in each indicator, and explain relationships between indicators. The reproducibility of the method was assessed by measuring the level of agreement between the groups of women, with significant agreement between the independent groups for all indicators.

The combined experience of the PE study in Karamoja, Uganda on malnutrition and the Nawiri analyses using PE in Marsabit and Isiolo Counties of Kenya show that PE can produce information on the seasonality and locally perceived causes of malnutrition that is reliable and technically plausible. The PE approach focuses on capturing community perspectives using methods that visualize and weight the issues in question, and which enable clear reasonings and explanations to emerge. Relative to some qualitative approaches that use only key informant interviews or focus group discussions, PE is more systematic, can provide more clarity on complex relationships, and includes triangulation to support or refute findings. Relative to quantitative surveys, PE is fairly quick, inexpensive, and flexible, and directly addresses important non-sampling errors.

In terms of analysis, PE shifts the process from remote analysis conducted solely by researchers to more local analysis. When within-method triangulation is used, a level of immediate validity can be achieved, because the triangulation takes place in the field as part of the method. In addition, the analysis of the PE data was very simple. For the monthly calendars, it was a matter of totalling the scores by indicator/month for the selected villages in each ward and producing a series of line graphs; there was very limited manipulation of the data. For the participatory causal diagrams, a comparable process was followed. This type of data handling has the advantage that a wide range of stakeholders and users can understand how the field data translated into summary diagrams or graphs. This process is a very different one from more conventional qualitative or quantitative research in which specialized software might be used to analyze data and only the researchers involved fully understand how the analysis was conducted. The simplicity of the PE data analysis also has advantages with respect to the timeliness of results, which become available within a matter of days.

The response to acute malnutrition in Africa's drylands, including the Kenyan ASALs, has overwhelmingly focused on treatment and not prevention.[32] Consequently, the research emphasis has been on the immediate and underlying

32 Young, 2020.

causes of malnutrition, and little is understood about the more systemic or basic causes such as environment and seasonality, systems and institutions, and livelihood systems.[33] The Nutrition Framework for Africa's Drylands[34] gives renewed emphasis to these systemic causes or drivers of malnutrition. The results from this study and the Uganda PE study demonstrate that these methods can be used to address some of the evidence gaps around the seasonality and basic causes of malnutrition. These methods can also be done relatively quickly and cost effectively while still maintaining an acceptable level of rigor. The involvement of community participants in the analysis also provides a useful tool for identifying community priorities for addressing malnutrition.

3.2 Challenges and opportunities

Due to COVID-19 movement restrictions, the ethnographic review had to be carried out remotely and then validated at the community level at the beginning of the field work. For the most part this approach worked, but it proved quite challenging in identifying and unpacking the indicators for the causal diagram exercise. The option to spend more time on the field identification of indicators for the causal diagrams would have been beneficial. Where possible, we would recommend a field-based ethnographic exercise, particularly for the causal diagrams.

For the monthly calendars, field identification of indicators was less of an issue, as the indicators relating to seasonality were more obvious and were quickly and easily identified. For example, milk availability was always identified as the main determinant of child malnutrition. Therefore, we simply asked the participants to identify the two most-important livestock species. So, in some areas they were camels and small stock, and in others they were cattle and small stock. An issue arose where neighboring communities specialize in different species, with some specializing in cattle and others prioritizing camels. However, we anticipated this issue and intentionally limited our sample in each study area to the ward level to reduce the chance of different livestock indicators being selected. This issue could also be handled by including all milk-producing livestock species in a given area, although this indicator has to be balanced with the number of indictors used.

Each PE exercise, if done well, takes at least three hours. So, for the monthly calendar there is a trade-off in how many indicators are selected. We chose between 10 and 11 indicators, which is the upper limit of what we would recommend. Part of the reason we chose this number of indicators is that, because we were piloting the PE methods, we were interested in looking at different indicators as well as in triangulating them. For example, malaria was not considered an important factor relative to other causes of malnutrition. However, it is easy to triangulate the seasonality of malaria relative to other diseases such as HIV/AIDS. We were also interested in looking at the insecurity and human births indicators to see if there was any correlation between these indicators and child malnutrition. However, depending on the objectives of a given PE study, we would recommend limiting the number of indicators to the extent possible.

The field-testing component was critical in learning how best to frame some of these indicators in a meaningful way. For example, the indicator on fish availability for consumption had to be interrogated, as fish are always available. However, during the dry season, even though fish may be more plentiful, they are difficult to catch as they move farther out into the lake as water levels recede and strong winds make it dangerous to venture out using traditional canoes to where the fish are. So, the question had to be framed around when the fish are available (most plentiful) in the household or village as opposed to the lake.

The indicator on human births was not straightforward, as some communities were reluctant to discuss births but were quite happy to discuss when women are most likely to conceive. Therefore, the question had to be framed in different ways depending on the community. For conceptions, the results were then adjusted based on estimates of when the mothers would give birth.

33 Ibid.
34 Ibid.

The causal analysis and monthly calendars provide a very useful starting point for identifying interventions to address malnutrition. Although we didn't have enough time to do it this way, ideally we would have done the PE exercises one day, and then we would have returned at a later stage to spend more time discussing and unpacking the proposed interventions. However, these methods could provide organizations with the tools to analyze different issues and identify appropriate context-specific interventions.

The tools are also flexible. So far, they have been used to investigate nutrition in pastoralist, agro-pastoralist, and pisca-pastoralist areas. However, they could be adapted to pure farming communities and possibly even urban or peri-urban communities where seasonal factors influence livelihoods. It might also be interesting to look at new indicators, or even adapt the method to focus on other sectors such as water, natural resource management, or gender.

One of the key takeaways from the pilot is that the PE exercises cannot be rushed. The methods take time to do well, as the indicators and questions need to be clearly understood by participants. This process takes time and repetition. One of the reasons these kinds of methods are not commonly used is that they require considerable patience and commitment, which can be challenging. It's much easier to do conventional research using standardized questionnaires. However, once participants understand the concepts and questions, the exercises can move fairly quickly. Participants feel that their contributions are being valued and validated. Throughout the work, we frequently heard from participants that this was the first time anyone had come and spent time listening to them. In one community, the participants said that if people do come, they spend no more than thirty minutes asking questions, writing things down, and then leaving. In some areas, there was also evidence of considerable survey fatigue. This fatigue was more evident during the field testing, which was mostly done closer to larger urban settlements. Participants complained that many organizations come and do "research, then they leave, and we never see any results or benefits."

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Annex 1. Locations

Locations for PE methods, Loiyangalani

Monthly calendar (n = 14 women's groups)	Causal diagram (n = 10 women's groups)
Lorus	Lorus
Palo	Palo
Kanakorot	Lardhabash
Siriantome	Layeni
Nakamasuni	Naokolea
Nyanaeris	Lenterit
Naokolea	Nawoitorong
Chanarare	Nakuron
Lenterit	Garas
Nawoitorong	Soit
Nakuron	Kamote laga
Garas	
Soit	
Kamote laga	

Locations for PE methods, Mt. Kulal

Monthly calendar (n = 8 women's groups)	Causal diagram (n = 8 women's groups)
Lolkujita (agro-pastoral)	Lolkujita (agro-pastoral)
Mbarnat (agro-pastoral)	Mbarnat (agro-pastoral)
Ngaramet (agro-pastoral)	Ngaramet (agro-pastoral)
Lmangur (agro-pastoral)	Lmangur (agro-pastoral)
Civicon (pastoralist)	Civicon (pastoralist)
Nkebelesh (pastoralist)	Nkebelesh (pastoralist)
Olturot (pastoralist)	Olturot (pastoralist)
Gatab Chini (pastoralist)	Gatab Chini (pastoralist)

Locations for PE methods, North Horr

Monthly calendar (n = 13 women's groups)	Causal diagram (n = 13 women's groups)
Boji	Boji
Barambate	Barambate
El Gofu 1	El Gofu 1
El Gofu 2	El Gofu 2
El Boro Magado	El Boro Magado
Qorka Diqa (large)	Qorka Diqa (large)
Qorka Diqa (small)	Qorka Diqa (small)
Wara	Wara
El Beso 1	El Beso 1
El Beso 2	El Beso 2
Qorka Guda 1	Qorka Guda 1
Qorka Guda 2	Qorka Guda 2
Isaqo Mallo	Isaqo Mallo

Locations for PE methods in Merti sub-county

Monthly calendar (n = 13 women's groups)	Causal diagram (n = 16 women's groups)
Dadach Basa (Cherab ward)	Dadach Basa (Cherab ward)
Korbesa (Cherab ward)	Korbesa (Cherab ward)
Mata Arba (Cherab ward)	Mata Arba (Cherab ward)
Biliqi (Cherab ward)	Biliqi (Cherab ward)
Reeg (Cherab ward)	Reeg (Cherab ward)
Saleti (Cherab ward)	Saleti (Cherab ward)
Lakole (Cherab ward)	Lakole (Cherab ward)
Dololo Dakiye (Cherab ward)	Dololo Dakiye (Cherab ward)
Mlanda Noor	Mlanda Noor
Biliqo Marara (Chari ward)	Biliqo Marara (Chari ward)
Bisan Biliqo (Chari ward)	Bisan Biliqo (Chari ward)
Bulesa Goda (Chari ward)	Bulesa Goda (Chari ward)
Awarsitu (Chari ward)	Awarsitu (Chari ward)
	Dima Ado (Chari ward)
	Godd Rupa (Chari ward)
	Bulesa Taqwa (Chari ward)

Annex 2. Field guide for monthly calendar

1. Preparation
    a. Before going to the field:
    b. Collect information on local terminology for months, and be ready to use this terminology.
    c. Prepare diagrams to represent each month, and be ready to explain these diagrams to the informants.
    d. Prepare diagrams to represent the indicators for the seasonal calendars, or use objects to represent the indicators. Be ready to explain the meaning of each diagram or indicator.
    e. Have several bags of counters ready, with bag containing 100 counters (e.g., 100 stones).

Key point—most or all informants will be illiterate. Use diagrams and verbal dialogue; do not use any written words.

2. Make a 1-year line by month

The method is done on the ground. Make a long line on the ground to represent a "Normal year." Place the diagrams for each month along the line, and:

    a. Explain the meaning of the line and the diagrams to the informants.
    b. Check their understanding, e.g., point to a diagram and ask "Which month is this?"
    c. If there are any misunderstandings, explain the diagrams again, until there is a good understanding of the diagrams/months.

3. Scoring of "Rainfall"—the first indicator
    a. Select "Rainfall" as the first indicator.
    b. Place the Rainfall diagram on the left side of the months, and explain the meaning of the diagram.
    c. Select a bag of 100 counters. Ask the group to distribute the counters to show the pattern of rainfall by month. A month with a lot of rain should be given a lot of counters, whereas a month with no rain would have no counters. The group should use all 100 counters.
    d. Leave the group for about 5–10 minutes to distribute the counters. Only intervene if the group needs clarification of the method.
    e. During the scoring there will be a lot of discussion among the group. Listen carefully to the discussion, but do not interfere. Key issues should be recorded.
    f. When the group has finished the scoring, ask further questions to check that scores are clear. Follow up any interesting score or relationships with open and probing questions.

Note—the seasonal calendar is a visual method. Do not ask the group to count the counters when distributing them across the months. Instead, ask them to use the counters to show the "pattern" of how the indicator varies by month.

4. Scoring other indicators
    a. Leave the counters for Rainfall in place—do not remove them.
    b. Select another indicator, and explain the diagram for this indicator. Check that the informants understand the meaning.
    c. Take another bag of counters, and ask the group to distribute the counters against the months for the indicator.
    d. Again, give them enough time to distribute the counters, and don't interfere. Listen to their discussion as they do the scoring, and record any key points.
    e. When the scoring has finished, ask questions to check the scores, and explain the reasoning behind the scores.

Repeat this process for all the other indicators.

Examples of indicators used and follow-up questions

Indicator	Explanation	Examples of key questions
1. Rainfall	Pattern of rainfall by month	No key questions.
2. Availability of camel milk for children	This indicator is self-explanatory and aims to show the variation in milk supply during the year.	What happens for poor households with no camels or very few camels?
3. Availability of cow milk for children	This indicator is self-explanatory and aims to show the variation in milk supply during the year.	What happens for poor households with no cattle or very few cattle?
4. Availability of goat milk for children	This indicator is self-explanatory and aims to show the variation in milk supply during the year.	What happens for poor households with no goat or very few goats?
5. Availability of fish for consumption	This indicator relates to the availability of fish for consumption.	What time of year is fish easily available? What time of year is it difficult to catch fish and why?
6. Consumption of purchased food	This indicator relates to the consumption of purchased food as opposed to the consumption of animal-sourced foods derived from livestock production.	What types of food are purchased and where do poor households derive their income to purchase these foods? Where can these foods be purchased? Are these foods available throughout the year? What are the reasons for increased or decreased consumption at different times of the year?
7. Women's work	This indicator relates to activities that require women to spend long periods of time away from their children.	For months when workload is very high, what specific activities are they engaged in? How many hours/day do women spend on this activity? Who takes care of the children when women are engaged in these activities? For women who are breastfeeding, how do they manage the child at this time?

8. Insecurity	This indicator relates to times of year when insecurity (specifically livestock raiding) occurs.	Where do these incidents happen? Who are the instigators?
9. Occurrence of child malnutrition	This indicator should show when most cases of child malnutrition are seen.	Why does child malnutrition have this pattern across the months?
10. Occurrence of child diseases—malaria	This indicator should show when most cases of child malaria are seen.	Why does child malaria have this pattern across the months?
11. Occurrence of child diarrhea	This indicator should show when most cases of child diarrhea are seen.	Why does child diarrhea have this pattern across the months?
12. Births	This indicator should show when most births occur during the year. Are births distributed evenly across the months, or are there certain months with more births?	Why do most births happen during these months?

Note—the examples of key questions are mostly open questions. They use words such as "Why?" and "How?" to open up discussion.

Supplementary proportional piling

Related to indicators 2, 3, and 4 in the seasonal calendar, a quick proportional piling can be used to gather further information.
Indicators 2, 3, and 4 about animal milk: "In the last year, what was the pattern of households with enough access to milk vs. households with insufficient access to milk?"

See the guideline on proportional piling for more information in this method.

5. Repeating the method
In the malnutrition study, the seasonal calendar will be repeated with different groups of women in different locations.

a. When repeating the method, it is important that:
   - the same diagrams are used each time to show the months and the indicators;
   - the same indicators are used;
   - the same numbers of counters are used.

b. When asking questions to check the information in the seasonal calendar, these questions can vary from place to place.

6. Recording the information
Three types of information need to be recorded:

a. When the group is scoring each item, listen to their discussion and record any key or interesting points, e.g., their reasons for placing the counters in a particular way.
b. Record all of the scores against the indicators and months.
c. With the follow-up questions, record the questions asked and the responses.

7. Options for triangulation
Rainfall (indicator 1)—the scores can be compared with actual monthly rainfall data for a "normal year."
Child malaria and diarrhea (indicators 10 and 11)—these can be compared with morbidity data from local health centers if available.
Child malnutrition (indicator 9)—compare the scores with data monthly demand for nutrition kits, monthly distribution of kits, or health records on cases of child malnutrition if available.
Births (indicator 12)—use local health records to compile frequencies of antenatal visits by month, or similar data.

Nawiri