ADAPTING PARTICIPATORY EPIDEMIOLOGY TO ESTIMATE THE INCIDENCE OF HUMAN DISEASES IN MOROTO DISTRICT, KARAMOJA, UGANDA

September 2024

Andy Catley, Raphael Lotira Arasio, Judith Moru

Karamoja Resilience Support Unit (KRSU)

Feinstein International Center, Friedman School of Nutrition Science and Policy, Tufts University

USAID FROM THE AMERICAN PEOPLE

Ambasáid na hÉireann
Embassy of Ireland

Tufts UNIVERSITY
Gerald J. and Dorothy R. Friedman
School of Nutrition Science and Policy
FEINSTEIN INTERNATIONAL CENTER

KARAMOJA RESILIENCE SUPPORT UNIT

Adapting participatory epidemiology to estimate the incidence of human diseases in Moroto District, Karamoja, Uganda

Andy Catley, Raphael Lotira Arasio, Judith Moru

September 2024

United States Agency for International Development (USAID) Contract Number: 617-15-000014
Karamoja Resilience Support Unit

www.karamojaresilience.org

Implemented by:
Feinstein International Center, Friedman School of Nutrition Science and Policy at Tufts University
PO Box 6934
Kampala
Uganda
Tel: +256 (0)41 4 691251

Suggested citation: Catley, A., Arasio, R.L., and Moru, J. (2024). Adapting participatory epidemiology to estimate the incidence of human diseases in Moroto District, Karamoja, Uganda. Karamoja Resilience Support Unit, Feinstein International Center, Friedman School of Nutrition Science and Policy at Tufts University, Kampala.

Photo credits: Anthony Egeru

TABLE OF CONTENTS

1. INTRODUCTION

In 2018, women in Amudat, Moroto, and Kotido Districts of Karamoja produced detailed analyses of the seasonality and causes of child malnutrition, including monthly patterns of malnutrition, food availability, workload, malaria, and diarrhoea.[1] This work involved the systematic use of participatory epidemiology (PE) methods such as monthly calendars and causal diagrams that were adapted to the Karamoja context. As pastoralist and agro-pastoralist areas of Africa are characterized by marked seasonal variations in rainfall and related movements of people and livestock, disease exposure and transmission can also be highly seasonal, but specific seasonal patterns vary by disease. In the case of malnutrition, malaria, and diarrhoea, an understanding of seasonality has practical implications for health planners who might, for example, pre-position relevant preventive measures. However, to guide both the planning and evaluation of disease prevention or control measures, health planning needs information not only on seasonal occurrence but also on the amount of disease that is present by season and year. This raises the question of whether PE methods can be further adapted to measure disease incidence and if so, how these estimates could complement the health surveillance system in Karamoja or food security and nutrition assessment (FSNA) surveys.

Within the broad range of human diseases reported in Karamoja is specific interest in waterborne diseases by health and water authorities. In terms of measuring malnutrition and food insecurity, the term "waterborne diseases" tends to be used synonymously with "diarrhoea," while also recognizing that malaria incidence is associated with the presence of water and mosquitoes. The monitoring and evaluation of programs that aim to improve clean and safe water supply can include measurement of waterborne diseases, malaria (and other vector-borne diseases with a water component), and diseases associated with poor hygiene and sanitation. Therefore, PE methods could be useful for supporting the monitoring and evaluation of these programs.

In terms of measuring malnutrition in Karamoja, the FSNA surveys represent a gold standard approach by combining anthropometric measurements with representative sampling, according to well-recognized good practices for nutrition surveillance. When the surveys are repeated twice each year, in around May/June and December/January, two point-prevalence estimates of malnutrition indicators are produced. However, if malnutrition prevalence varies by season, it is difficult to interpret these estimates without knowing the prevalence in other months or seasons. The measurement of diarrhoea and malaria by the FSNA uses questions that ask respondents to recount incidents of disease in children aged 0–59 months of age during the previous two weeks. Assuming that respondent recall is accurate, biannual FSNA surveys provide data on malaria and diarrhoea for a total of four weeks per year in this age group; for the remaining 48 weeks of a year, the incidence of these diseases is not measured. As noted above, due to the likely seasonality of these diseases, it is also difficult to interpret the FSNA results relative to the actual minimum and maximum incidences by season.

In contrast, the health surveillance system in Karamoja collects data from health facilities each month and so overcomes the temporal limitations of the FSNA data. However, health facilities only collect data on cases that are presented to health workers, and the use of these workers is affected by their accessibility, availability, affordability, and acceptance, as well as the quality of service provided. For example, if a health facility has limited or no availability of medicines then potential users are less likely to attend the facility. Similarly, if the cost of treatment is not affordable. In situations where only a small proportion of a population uses the health system for one or more diseases, population-based prevalence estimates can be underestimated as many cases are undetected by the system. In agro-pastoral and pastoral settings in East Africa, health service delivery can be particularly difficult due to poor infrastructure and the need to reach small and mobile populations in large areas. In a recent study on access to health and nutrition services in Karamoja a range of socio-cultural, economic, seasonal, infrastructural, health facility and individual barriers were reported.[2] For example: "*The majority of the participants reported that bad roads, hard-to-reach areas, poor communication network, and long distance to health facility were the*

1 Catley et al., 2018.

2 Njuguna et al., 2024.

main bar¬riers that hinder the patients from accessing health and nutrition services." This issue of affordability applied not only to the direct cost of healthcare but also to the cost of transport: "*There is no money to pay for transportation and food to eat. Sometimes, when you are hungry and your body is weak to walk to health facility, stay sick at home is better*." Other challenges were summarized as, "*Long waiting time, early closing of health facility, drug stock out, lack of healthcare workers in the facility, lack of ambulance, lack of privacy, poor sanitation in health facility and poor-quality services were health facility related barriers that identified in the present study. Not being able to get a service when needed can affect health seeking behaviour of the patients and it becomes the bar¬rier for access to health services*." To illustrate how the health system can underreport disease prevalence, the Karamoja Resilience Support Unit (KRSU) compared FSNA data on severe acute malnutrition (SAM) with data from health clinics. Prevalence estimates using health clinic data were up to 12 times lower for SAM than FSNA estimates.[3]

In summary, FSNA estimates of disease prevalence (for malaria and diarrhoea) are affected by temporal limitations as they cover only four weeks per year; they also focus on a specific age group: children 0–59 months of age. In comparison, health system data is affected by spatial limitations as the data depends on the use of health workers by people affected by illnesses; only those cases observed by health workers are reported. With these issues in mind, the adapted PE method aimed to cover a one-year period, cover more age groups than the FSNA, and be more population based than the health surveillance system.

3 See Annex 1 for details of the comparison of food security and nutrition assessment (FSNA) and health clinic data.

2. DESIGN AND TESTING OF PARTICIPATORY EPIDEMIOLOGY (PE) METHODS FOR ESTIMATING DISEASE INCIDENCE

2.1 PREPARATORY STAGE

Literature and secondary data on human diseases in Karamoja was reviewed.

Participatory epidemiology methods are used in local languages. Therefore, initial preparatory work included documenting the names for diseases and symptoms in the main languages used in Moroto District viz. Matheniko and Tepeth. This involved six focus group discussions (FGDs), which anticipated that local disease names would include names that were used for a specific disease, a disease symptom, or a mix of symptoms and/or perceived causes. Informal interviews were also conducted with local government health workers to document their knowledge of local disease names, which were based on day-to-day consultations.

The repetition of interviews enabled us to make judgements on the extent to which a disease had a common, widely used name versus a disease for which various names were used. By reference to a standard textbook on tropical diseases,[4] we were able to associate some local disease names with English names while also recording local names for which the English disease name was not known.

The proposed PE method for estimating disease incidence was a modified proportional piling method (see below). Based on our previous experience with this method, we assumed that it could cover up to 10 diseases, and so the FGDs asked participants to focus on the 10 most important diseases from their perspective. We also asked participants to consider diseases in adults, and then diseases in children up to 5 years of age.

2.2 PROPORTIONAL PILING FOR DISEASE INCIDENCE ESTIMATES

Proportional piling was used with 16 independent groups of community members comprising between 10 to 34 people (5 to 20 women and 0 to 17 men) and covering all sub-counties in Moroto District (Annex 2). At each stage of the method, the group was asked to discuss the task that they were set by the facilitator and provide a collective response.

Using the list of 10 local disease names that were recorded in stage 1, the group was asked to produce a local object to represent each disease, plus an object to represent "All other diseases."

The group was asked to consider the 12-month period January to December 2023. They were provided with a pile of 100 counters and asked to divide the pile to show the pattern of "Adults who remained healthy" vs. "Adults who became sick" during the year. This resulted in two piles of counters, representing the proportions of healthy and sick adults. The group was encouraged to discuss the task and adjust the piles of counters until they were in general agreement.

The local objects representing the different diseases were then placed in a row on the ground, and the group was asked to distribute the counters in the sick pile against the disease objects to show the pattern of diseases observed during the year. Again, the group was encouraged to discuss the task and adjust the piles of counters until they were in general agreement. The number of counters in each pile was recorded.

Further questions were then asked to understand the group's responses (piling), such as why more cases of a certain disease were observed relative to another disease, the causes of the diseases, and seasonal and annual variation in disease occurrence. These responses were recorded.

The method was then repeated for diseases in children aged 5 years and below. All methods with participants at community level were used in July 2024.

Data from proportional piling was summarized using SPSS version 29.0.2.0 software.

2.3 CAUSES OF DIARRHOEA

Diarrhoea prevalence or incidence can be used as an indicator of access to clean water and therefore, an indicator of the impact of new water facilities. However, we assumed that in cases where diarrhoea was the only or main symptom, various non-water-related causes were possible, including dietary causes

4 Farrar et al., 2023.

or certain types of contaminated food. To examine this assumption, we asked participants to identify and rank different causes of diarrhoea using simple ranking. This ranking was repeated with six informant groups for diarrhoea in adults and 10 informant groups for diarrhoea in children.

2.4 OTHER PARTICIPATORY EPIDEMIOLOGY (PE) METHODS

Given the importance of understanding the specificity of local diagnoses and disease names when using proportional piling, we later used matrix scoring to explore how different priority diseases in adults were distinguished. Three diseases with similar clinical presentation were included in a matrix of disease signs/symptoms and a second matrix of diseases causes; these three diseases were brucellosis, typhoid, and malaria. A further three diseases, pneumonia, diarrhoea, and stomach ulcers, were included in the matrices for comparison. Signs/symptoms and causes for the matrices were produced using pair-wise comparison of the diseases, and each indicator was scored against the diseases using 30 counters. The matrix scoring was used only once.

A seasonal calendar was also used to explore if and how seasonal incidence of diseases contributed to disease diagnosis. Three seasons were used in the calendar and the same six diseases as used in the matrix scoring above. This method was used only once.

2.5 TRIANGULATION

An important aspect of analyzing information from PE methods is triangulation or cross-checking the findings with other sources of information. For the preparatory FGDs and proportional piling method, triangulation included:

- Reference to literature and reports to check if a disease had previously been reported or diagnosed in Karamoja, and the method of diagnosis. For suspected zoonotic diseases, literature on animal diseases was used.
- Reference to a standard textbook on tropical diseases[5] to assess the extent to which symptoms, causes, seasonality, or age-specificity of a disease described by participants were consistent with professional medical descriptions.
- Where possible, comparison of disease incidence estimates from proportional piling with prevalences estimates from research papers, FNSA reports (for malaria and diarrhoea), and other sources. These comparisons were crude and approximate due to factors such as the difference between incidence and prevalence, and the different time periods used.

5 Farrer et al., 2023.

3. FINDINGS

3.1 LOCAL DISEASE NAMES AND DISEASE DESCRIPTIONS

During the preparatory stage, participants in different locations identified 12 main diseases of adults and 15 main diseases of children under 5 years of age. Detailed information on each disease is summarized from the six FGDs in Tables 1 and 2. For all local disease names, a provisional English disease name or main symptom is provided in parentheses.

In both adults and children under 5, infectious and noninfectious diseases were identified and described. In many cases, the local disease name reflected a specific cause, symptom, or affected body part, and the symptoms described, along with causes or sources of diseases, aligned closely with the textbook description. For causes of diseases, these were based observable associations such as the presence of mosquitos or consuming dirty or contaminated water. The disease *edeke angakipi* in adults was assumed to be typhoid and was clearly associated with contaminated water. In common with the textbook description of typhoid, diarrhoea was not listed as an important symptom of *edeke angakipi*.

In relation to waterborne diseases, participants distinguished between different types and causes of diarrhoea, and they associated diarrhoea not only with unclean water but also poor diet, poorly cooked or stored food, and poor personal hygiene. While diarrhoea was identified as a stand-alone symptom/disease, it was also associated with other diseases such as *amonis* (malaria) in adults and children, and *lobute* (malnutrition) and *lonyang* (yellow fever) in children. For cases in adults where diarrhoea was the only or main symptom, the ranking of different causes is shown in Table 3. For diarrhoea cases in children, ranks of causes of diarrhoea are shown in Table 4. Notably, numerous dietary and other food-related causes of diarrhoea were identified and ranked along with causes related to unclean water. In both adults and children, there was a notable variation in ranks by location, indicating location-specific causes of diarrhoea such as the quality of local water facilities.

Table 1 Disease names and disease descriptions for locally prioritized diseases in adults, Moroto District.

Disease	Description
Edeke akiring (brucellosis)	Meaning of local name – *edeke akiring* is the disease from animal meat; *lokoyeta*, the disease that causes bone/joint pains
	Symptoms – fever; sweating; shivering; lack of appetite for milk, meat, salt, and local brew; skin darkens; fear of cold; anaemia; body weakness; joint pains
	Cause – stepping on cow dung; eating meat; medicine injected to the animal
	Local remedies – herbal preparations from *eteteleit*, *nachileta*, *ethiapus*, *eusugu*, *epie*, neem tree, *ethekon*, *ekuir*, *ekere*, *lolemwo*
	Other – brucellosis relapses. It is expensive to treat – costs Ugandan shilling (UGX) 100,000 (United States dollar (US$) 27)
Edeke angakipi (typhoid)	Meaning of local name – the disease from water, especially contaminated water from open sources
	Symptoms – cough, sour throat, fever, shivering, headache, dizziness (*kisungusungu*), body weight loss, skin turns dark, joint pains
	Cause – water from open sources, with *ngilelem* (tadpoles) and *ngikur* (worms); boreholes with rust in water
	Local remedies – herbal preparations from *ekere*, *echuchuka*, *eregae*, *ekuir*, *ekapelimen*, *ekuyen*, *ebei*
	Other – it is expensive to treat – costs UGX 100,000 (US$27); typhoid relapses

Table 1 Disease names and disease descriptions for locally prioritized diseases in adults, Moroto District.

Disease	Description
Edeke angatameta/ Edeke etau (stomach ulcers)	Meaning of the local name – *edeke angatameta*, the disease from negative thoughts; *edeke etau*: the disease that causes heartburn
	Symptoms – deep thoughts because of hunger or lack of food in the family, stress from poor harvest, or stress from sickness; insomnia; increased heart rate; weight loss; lack of appetite; someone gets isolated from others; severe heartburn; fear of hot food; fever; sweating
	Local remedies – take alcohol to suppress negative thoughts that would evoke unpleasant emotions and adverse behavioral, physiological, and health outcomes
Amonis (malaria)	Meaning of the local name – *amonis* means fever
	Symptoms – fever, shivering and fearing cold (want to bask in the sun), headache, body/joint pains, headache, vomiting, diarrhoea, difficulty to stand, increased heartbeat
	Cause – mosquitoes during rainy season and when grass/bushes have grown
	Local remedies – herbal preparations from *ekuyen*, *echuchuka*, *eliira* (neem tree), *epeeru* (bitter, like quinine)
Lokorei/Loteduka (pneumonia)	Meaning of the local name – *lokorei* means the disease of the chest (*ekore*) or rib cage; *loteduka* means difficult breathing or breathing upwards with distended neck
	Synonyms – difficult breathing, difficult to cough, chest pains, cannot bend, shivering and feeling cold
	Cause – stressful work, e.g., burning charcoal, cutting and carrying wood; cold; domestic fights that cause chest injuries
	Local remedies – herbal preparations such as *ebolith*, *nachileta*, *eusugu*, *lodwar*
Akiurut (diarrhoea)	Meaning of the local name – diarrhoea; or to pass watery or loose stool with mucus (*atekorit*) or water or blood stains
	Symptoms – stomach pain, loose/running stool, frequent diarrhoea
	Cause – open defaecation; eating cold food; eating poorly cooked food (*abuka*); eating food kept overnight; poor hygiene
	Local remedies – a mixture of charcoal, salt, and hard liquor (*etule*); herbal preparations from *etungunan*, *ekadeli*, *etopojo*, *ekapakiteng*
Lokudi (tuberculosis)	Meaning of the local name – prolonged cough, difficult to breathe, you collapse, you urinate, you produce tears, or the body stiffens
	Symptoms – dry cough; whizzing sound from the chest when breathing; chest pain; green/ pussy and turbid sputum and sometimes with blood; swollen neck lymph nodes; weight loss; difficult breathing
	Cause – associated with certain family/clan lineage (*angatekerin*); person-to-person transmission through sharing beddings, food, etc.
	Local remedies – use veterinary oxytetracycline; also use human TB drugs to treat chest problems in animals
	Other – was common in the past but has now reduced due to availability of medicine
Lolibakonyen (yellow fever)	Meaning of the local name – disease that causes yellowing of the eyes
	Symptoms – yellow, hot, sticky urine with bubbles that doesn't percolate to the ground like that of a donkey; yellow eyes; yellow face and palms; body weakness; body pains (waist and other joints); bloat; lack of appetite; anaemia ("blood vessels disappear/become thin"); yellow stool
	Cause – don't know
	Local remedies – herbal preparations from pawpaw, *emote*, *epie*, *ekadelwae*, *edwel*, *sugar cane*, *eskot*, *epeta*, *ethekon*, *avocado*

Table 1 Disease names and disease descriptions for locally prioritized diseases in adults, Moroto District.

Disease	Description
Lochirin (lumbago)	Meaning of the local name – the disease of the waist area (*achir*)
	Symptoms – severe lower back or waist pain; leg pains; can't stand upright; share some symptoms with *moru-ariwon*
	Cause – *moru-ariwon*, carrying heavy loads or overworking
	Local remedies – use of herbal preparations, e.g., from *ekorete*, *echorokongu/emus*, *etumune*, *ekere*
Lokou (migraine; headache)	Meaning of the local name – the disease of the head
	Symptoms – severe headache, fever, dizziness (*kisungusungu*), eyes itching, reddening of eyes, profuse lacrimation, impaired vision, poor gait (difficulty in walking), difficulty to stand, sometimes a symptom of typhoid, painful to look up, some deaths if not managed, sounds in the head, can't hear well
	Cause – Satan, typhoid, overworking when burning charcoal (working in the sun), when rituals were not performed when you were young, hunger
	Local remedies – perform rituals using a sheep/goat (but difficult now due to lack of livestock); cover the head with mesenteric fat; use of herbal preparations, e.g., from *ekorete*, *ekere*, *ekadelwae*, *ethiapot*, *loderekae*, *ethekon*, *lobelamon*, *etulelo*, *lopusieor*, *eminit*, *epetet*; bleeding the forehead
Moru-ariwon (pelvic inflammation due to untreated urinary tract infections)	Meaning of the local name – "the bending mountain," to mean you can't walk upright but bending
	Symptoms – sometimes presents with similar symptoms like *lochirin*, weight loss, stomach rumbles/growling/cramps, body pains (at the back, legs, hands, neck), intestines roll upwards, stomach pain without diarrhoea (similar to *ekeot*), occasional diarrhoea, pebble poop or pellet-like stool with mucus (*atekorit*), infertility
	Cause – starvation, consuming brewer's waste (*adakae*)
	Local remedies – stomach massage by an expert, taking enough milk (relaxes the intestines or reduces spasms), taking herbal preparations, e.g., from *eegong*, *lobelamon*, *ekorete*
Logoloi (venereal disease)	Meaning of the local name – the disease of the pelvic area or the disease that affects the pelvic area (*ngagoloi*)
	Symptoms – painful urination, dark-yellow urine and sometimes with pus, infertility, itching at the private parts, pain at the waist and pelvis, small drops of urine (urine incontinence)
	Cause – sexual intercourse, sharing a toilet or bathing facilities with the infected people
	Local remedies – herbal preparations, e.g., from *epie*, *ekapelimen*, *epatit*, *lolepito*, *eusugu*, *eloglog/lokwaras*, *elomaru*, *ekamongo*

Table 2 Disease names and disease descriptions for locally prioritized diseases in children under 5 years of age, Moroto District.

Disease	Description
Lonyang (yellow fever)	Meaning of the local name – the disease that causes yellowing of the whole body (icterus) including faeces; even a black child turns yellow
	Symptoms – body turns yellow (skin, lips), inner part of the arm is pale, hot yellow urine (with bubbles), hot yellow stool/diarrhoea, child looks fat despite the sickness, blood vessels become thin or disappear ("no blood"), anaemia ("eyes become white"), bloat, difficult/fast breathing, fever
	Cause – breastfeeding mothers no longer restricted from taking certain foods associated with *lonyang*; eating meat from animals dying from *lonyang* (anaplasmosis in animals)
	Cause – transmitted from mother to child through breastfeeding or when in the womb
	Local remedies – restrict breastfeeding mothers from taking ghee, milk, fatty meat, animal blood – these foods were associated with *lonyang* in children – the child is infected through breast milk
	Local remedies – as in adults
Lobute (oedema due to malnutrition)	Meaning of the local name – the disease that makes the child to look fat (*ebutel/etumit*)
	Symptoms – oedema (it starts from the face and spreads to the legs), yellowish diarrhoea
	Cause – poor diet; inadequate breastfeeding; inadequate food
	Cause – suspected to be resulting from (a sequelae of) *lonyang*
	Local remedies – herbal preparations from *emoroth* (for bathing), *edongdongamuroi*, *eome*; feed child on chicken meat
Loteduka (pneumonia)	Meaning of the local name – difficult breathing or breathing upwards/with extended neck
	Symptoms – difficult to eat or breastfeed; difficult breathing; fever; flu but no cough; breathing from the mouth
	Cause – exposure to cold
	Local remedies – dress the child in warm clothes in the evening or when it is cold; herbal preparations from *nachileta*, *ekitoe*, *lokirion*, *lodwar*, *ethiapo*
Amonis (malaria)	Meaning of the local name – fever
	Symptoms – vomiting (yellow vomit), fever, coughing, diarrhoea (whitish or yellowish), body weakness
	Causes – hunger, cold food, and poor hygiene predisposes to malaria; mosquitoes in the rainy season and when the grasses have grown
	Local remedies – as in adults but different doses given to children
Lokudi (tuberculosis)	Meaning of the local name – as in adults
	Symptoms – as in adults
	Cause – as in adults; plus transmission from mother to child through breastfeeding
	Local remedies – as in adults
Akiurut (diarrhoea)	Meaning of local name – as in adults
	Symptoms – as in adults
	Causes – as in adults plus teething (*ngitieng*) and "dirty" breastmilk also causes diarrhoea
	Local remedies – as in adults

Table 2 Disease names and disease descriptions for locally prioritized diseases in children under 5 years of age, Moroto District.

Disease	Description
Emidmid/edeke angaki (ear infection)	Meaning of the local name – *emidmid*, scratching of the inner ear; *edeke angaki*, the disease of the ears
	Symptoms – pain in the ear; pus in the ear; itching of the inner ear; reddening of the ear; blood in the ear; wound in the ear; crying due to ear pain; headache
	Cause – sometimes hereditary (occurs in specific family or clan lines) (*angatekerin*); other diseases; beating the child on the ear
	Local remedies – blood of the crow (*ekuruk*); apply the white faeces of chicken; herbal preparations from *eregae*, *ekapelimen*, and *ethidongoror*; gun oil; sewing machine oil; groundnut powder
Lokiserito (fungal infection)	Meaning of the local name – the disease mainly characterized by fungal patches on the body, head, etc.
	Symptoms – frequent itching, liquid or white powder released after scratching the skin, sweating, fever, patches on the body and head, lack of appetite, wounds in the mouth
	Cause – medics say it is a symptom of *lonyang*
	Local remedies – tried herbal preparations but all not effective, e.g., from *ekorete*, *esekon*, *ngalam*; also tried to use hard liquor (*etule*) on the lesions but not effective, also tried preparations from hedgehog (*napupu*) but not effective
Edeke akiring (brucellosis)	Symptoms – anaemia, poor gait, fever, profuse sweating, loss of apetite, body pains (at the head, hands, joints, neck, and legs), some symptoms similar to those of typhoid (thus, both share a local name *lokoyeta*), swollen knee/elbow joints, partial paralysis (at the leg, hand, back), dizziness (*kisungusungu*), lack of appetite for meat and local brew, predisposes to other diseases, e.g., pneumonia and tuberculosis
	Cause – it's a new disease in children, so we don't know the cause. "We suspect the clinics falsify the results so as to make money"
	Local remedy – perform rituals, herbal preparations, e.g., *ekorete*, *esiakut*, *eteteleit*
	Other – it is difficult or expensive to treat using local remedies or modern medicines
Lokoo/ngiip (scabies)	Meaning of the local name – *lokoo*, the disease characterized mainly by frequent itching; *ngiip*, body rashes
	Symptoms – itching, skin rashes
Lokou (migraine; headache)	Meaning of the local name – as in adults
	Symptoms – as in adults. In addition, diarrhoea, unexplained crying, some deaths if not managed, lacrimation, nasal discharge, high fontanelle pulsing or sometimes sunken fontanelle, difficult breathing
	Local remedies – as in adults. In addition, seek the services of an intestine reader, perform rituals with a sheep/goat (cover the baby's head with mesenteric fat and rumen), herbal preparations, e.g., from *edongdongamuroi*, *ekadelwae*

Table 2 Disease names and disease descriptions for locally prioritized diseases in children under 5 years of age, Moroto District.

Disease	Description
Longolesike/ puuru/ekodoe (measles)	Meaning of the local name – *longolesike* is believed to come from animal dung, so walk cautiously not to step on animal dung; produces widespread multicolored body/skin wounds/ rashes that look like animal dung (*ngajemei nangoleyek kwa ngasike*); *puuru* – can spread fast and to many children; *ekodoe* – means faster spread or skin peeling and remaining on bedding Some cases were seen in the shared mobile livestock camps towards the end of 2023 (in the dry season) among the Turkana pastoralists, and a major outbreak was seen among the Turkana in January 2024. The start of the outbreak in the Karamojong children was between February and April 2024. Samples were collected in April and the disease was confirmed in July 2024, followed by vaccination in July 2024 Symptoms – fever, profuse lacrimation, skin rashes in two days, reddening of eyes and lips, difficult breathing, lack of appetite, vomiting, diarrhoea, sudden death, anaemia, fire and wind phobia, dislike for meat and fats, oral rash, hot concentrated urine, unexplained crying Source –Turkana pastoralists from Kenya Local treatment – local herbal preparations, e.g., from *epetet*, *eyelel*, *ethekon*, *abir* – but these were long abandoned because of modern medicine
Ekeot (gastritis – stomach pain without diarrhoea)	Meaning of the local name – the disease characterized mainly by stomach pain without diarrhoea Symptoms – stomach pain but no diarrhoea, unexplained crying, discomfort (turning a lot) Cause – poor body/personal hygiene, consuming contaminated food, don't know the cause, taking long to feed the baby, malaria Local remedies – enema (*akipinikin*) with herbal preparations, e.g., *echuchuka*, *echogorom*, *eereng*, *lobelamon*
Lopith (Molluscum contagiosum – blisters on the skin)	Meaning of the local name – the disease mainly characterized by skin blisters like that of fire burn and often rupture Symptoms – itching, blisters that later rupture (on the legs, hands, and the face), fever, diarrhoea Cause – don't know Local treatment – local herbal preparations, e.g., from *louro/abir*, *epetet*, *elamoru*, *echogorom*
Lojaa (mouth disease)	Meaning of the local name – the disease characterized mainly by drooling saliva and continuous opening of the mouth Symptoms – white oral rashes (in the tongue, mouth, and throat), smelly mouth, difficulty to breastfeed, wounds on the lips, child keeps the mouth open, salivation, crying, fever, swollen neck/thyroid lymph nodes

Table 3 Community ranking of the causes of diarrhoea in adults in cases where diarrhoea is the only symptom (n = 6 informant groups).

Cause	Median rank by specific cause	Median rank by category
Category: causes related to food types/dietary causes		3
It is the type of food or drink that causes diarrhoea; the consumed item is not diseased or contaminated.		
Consuming wild vegetables (not spiced with ghee) (*edea*)	2	
Consuming "white ants"	9	
Eating poor diet (*epeane*)	2	
Consuming local brew (*ngagwe*), especially ngakalibooe	3	
Consuming brewer's residue/waste (*adakae*), especially from town	3	
Consuming poorly cooked food	4	
Category: causes related to food; no association with clean water		4
The consumed item has no surface contamination that might be removed by washing with clean water.		
Consuming carcass of emaciated animal	5.5	
Consuming cold food	4	
Category: causes related to unclean water/hygiene		4
Clean water not available so dirty or no water used		
Consuming contaminated, unwashed food	4	
Using dirty water (mainly from open water sources) – to drink, cook food, prepare local brew, mix with *adakae*; open defaecation as a source of water contamination	5	
Open defaecation	5	
Poor body/environmental hygiene (*angoreanut*)	4	
Category: physiological causes		10
Causes related to a person's intolerance of a food type		
Lactose (milk) intolerance	10	

Note: the lower the figure, the higher the rank, e.g., consuming wild vegetables (2) was ranked higher than consuming poorly cooked food (4).

Table 4 Community ranking of the causes of diarrhoea in children (n = 10 informant groups).

Cause	Median rank by specific cause	Median rank by category
Category: causes related to food types/dietary causes		5
It is the type of food or drink that causes diarrhoea; the consumed item is not diseased or contaminated.		
Consuming wild vegetables (not spiced with ghee) (*edea*)	5.5	
Eating poor diet (*epeane*)	4	
Consuming brewer's residue/waste (*adakae*), especially from town	4	
Only water in the stomach	10	
Category: causes related to food; no association with clean water		3.5
The consumed item has no surface contamination that might be removed by washing with clean water.		
Consuming dirty or cold food, or food kept overnight	3.5	
Category: causes related to unclean water/hygiene		6
Clean water not available so dirty or no water used		
Contact with dirty water (drinking, playing in stagnant open water)	6.5	
Open defaecation	10	
Poor body/environmental hygiene (*angoreanut*)	1	
Category: physiological causes		10
Causes related to a person's intolerance of a food type		
Change in growth stage or during teething	10	
Nonspaced pregnancies	10	
Category: specific diseases		7
Cause relates to person suffering from a specific disease		
Specific disease such as yellow fever, malaria or worms	7	
Category: other causes		5
Taking a long time to breastfeed	4.5	
Taking medicine without food in the stomach	10	

Note: the lower the figure, the higher the rank, e.g., eating a poor diet (4) was ranked higher than contact with dirty water (6.5).

3.2 ESTIMATES OF DISEASE INCIDENCE

The disease incidence estimates from proportional piling are shown for adults in Figure 1 and for children under 5 in Figure 2. In adults, brucellosis, typhoid, and malaria had the highest annual median incidences of 10.5%, 8%, and 7% respectively. For brucellosis, there was an outlier with far lower incidence of 2% in location 12, indicating that specific local practices might be present in this location to lower brucellosis transmission. Among noninfectious diseases, stomach ulcers had the highest median incidence of 6.5% and as shown in Table 1, were associated with stress.

In children under 5, malaria and yellow fever had the highest annual median incidences of 10.5% and 10% respectively, followed by cases of pneumonia (9%) and diarrhoea (8%) that likely comprised both infectious and noninfectious causes. For malaria, there was an outlier with relatively low incidence of 7% (location 11) and an extreme outlier with very high incidence of 18% (location 15). Similarly for diarrhoea, there was a low incidence outlier of 3% (location 13) and a high incidence outlier of 15% (location 9). Again, location-specific examination of contexts and practices might explain these outliers.

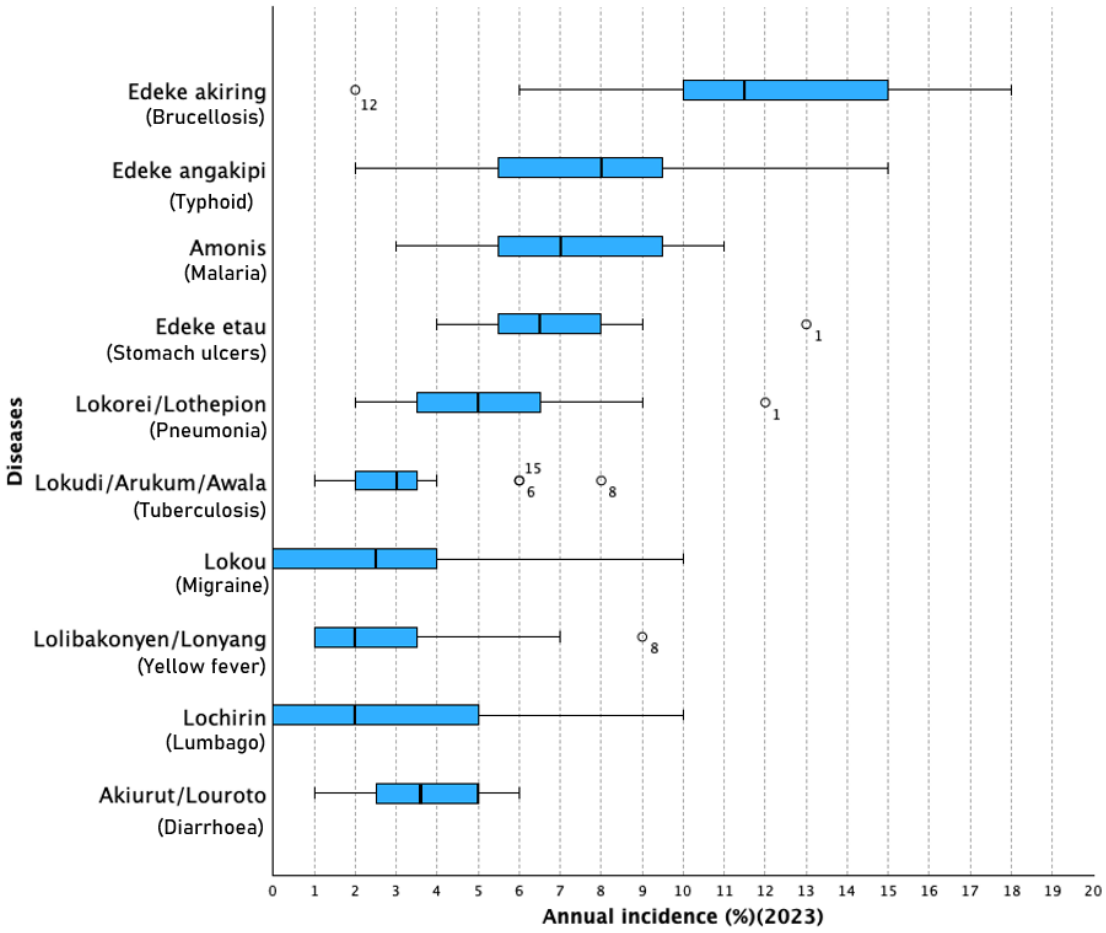
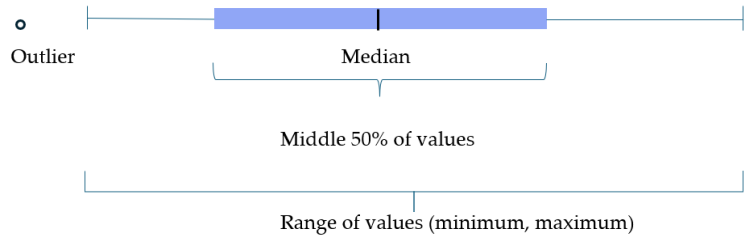


Figure 1. Annual incidence estimates for adult diseases, Moroto District, 2023 (n = 16 informant groups).

How to interpret the graph:



Median: this is the average annual incidence.

Outlier: an atypical value. The number assigned to the symbol is the location identifier. An atypical value shows that there was a usually high or low incidence of the disease in this location(s).

Example: the median incidence of *edeke akiring* (brucellosis) was 11.5%, and the range was 6% to 18%. In location 12, there was an atypically low incidence of 2%.

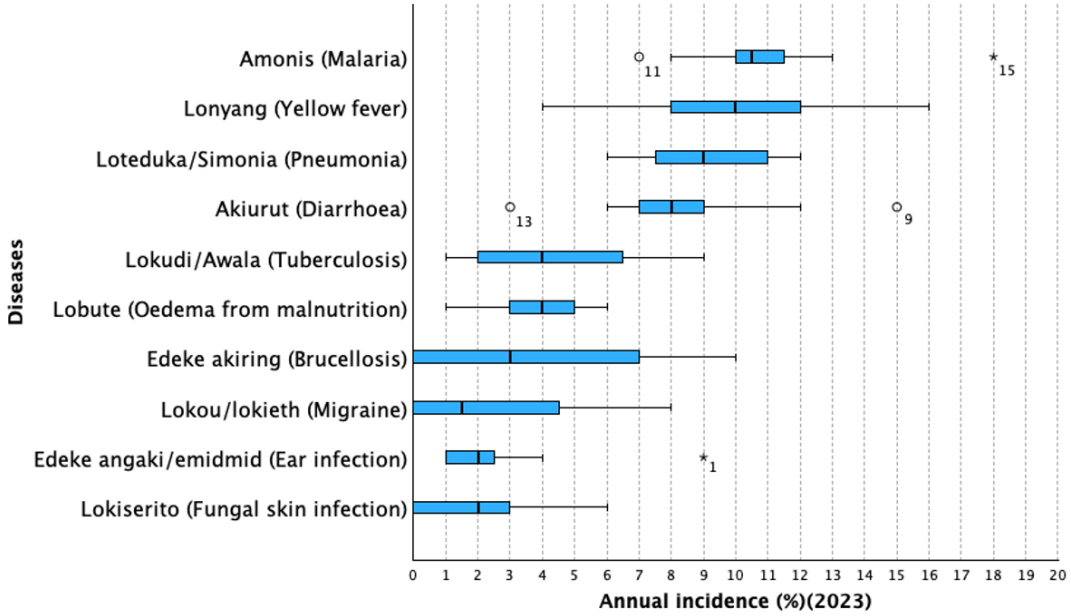
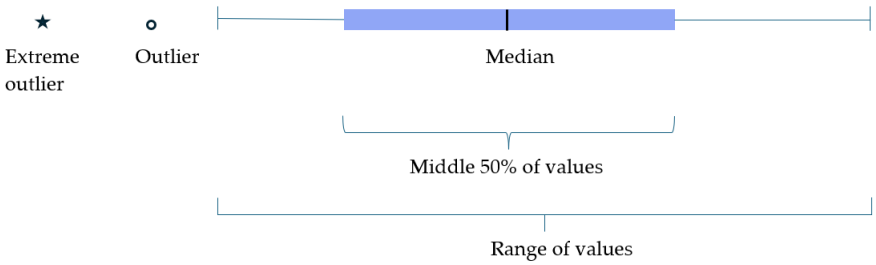


Figure 1. Annual diseases incidence estimates for children under 5 years of age, Moroto District, 2023 (n = 16 informant groups).

How to interpret the graph:



Median: this is the average annual incidence.

Outlier: an atypical value. The number assigned to the symbol is the location identifier. An atypical value shows that there was a usually high or low incidence of the disease in these locations.

Extreme outlier: a very atypical value. The number assigned to the symbol is the location indicator. A very atypical value shows that there was a very high or very low incidence of the disease in these locations.

Example: for the disease *amonis* (malaria) the median annual incidence was 10.5%. There was an outlier (atypical value) of 7% incidence in location 3 and an extreme outlier (very atypical value) of 18% in location 15.

The contribution of waterborne disease plus water-associated diseases to total disease incidence can be estimated by summating the incidences for typhoid, malaria, yellow fever, and diarrhoea from Figures 1 and 2, while recognizing that not all cases of diarrhoea were water-related (see Table 3). Using this approach, in adults, 20.5% of total disease incidence was water-related, and in children, 28.5% of total disease incidence was water related.

The incidence of diarrhoea in children has been reported to be seasonal in Karamoja, with most cases observed during rainy periods.[6] However, in follow-up questions after the proportional piling, 2023 was described as a bad year, with cases of diarrhoea seen throughout the year. This pattern was associated with poor diet, which in turn was linked to hunger and food insecurity. In the wet season of 2023, participants associated poor diet with consumption of wild

6 Catley et al., 2018.

vegetables, whereas in the dry season it was associated with consuming foods such as the residue produced when making local brew. Participants further explained that, in a drought year, diarrhoea peaks during the drought period when food scarcity peaks and again, hunger leads to the consumption of nonpreferred foods and diarrhoea. In pastoralist areas, outbreaks of cholera are also linked to drought as people congregate around declining and contaminated water sources. In Moroto District, cholera outbreaks have been reported at different times of the year, including the wet season.[7]

While participants made general associations between diseases such as typhoid and "dirty" water, they also provided very detailed accounts of specific water sources that they associated with typhoid (Annex 3). Although open water sources were commonly cited, certain boreholes were also associated with typhoid, especially poorly managed or broken boreholes.

In terms of a crude comparison with FSNA prevalence estimates using two-week recall in May 2023, the prevalence of diarrhoea, acute respiratory symptoms, and fever in children under 5 in Moroto District were 12.9%, 2.7%, and 6.8% respectively.[8]

One aspect of triangulating and validating the results from proportional piling was to compare the incidences of some diseases in adult and children under 5 by reference to the textbook descriptions (see section 2.4); for some diseases there is a recognized higher or lower incidence in children relative to adults. Examples of these comparisons are as follows:

- The incidence of malaria was 6.5% in adults compared to 10.5% in children under 5.
- The incidence of brucellosis was 11.5% in adults compared to 3% in children under 5.
- The incidence of diarrhoea was 3.5% in adults compared to 8% in children under 5.
- The incidence of stomach ulcers was 6.5% in adults and was not identified or measured in children under 5, where the incidence was assumed to be 0%.
- The incidence of oedema due to malnutrition was 4% in children under 5 and not identified or measured in adults, where the incidence was assumed to be 0%.
- Lumbago (lower back pain) was reported only in adults, with an incidence of 2%.

Yellow fever features prominently in Figures 1 and 2, and local health workers confirmed yellow fever outbreaks in Moroto District in 2023.

7 For example, see Orishaba et al., 2022.

8 World Food Programme and Uganda Bureau of Statistics, 2023.

4. DISCUSSION

4.1 PARTICIPATORY EPIDEMIOLOGY METHODS

This objective of this study was mainly methodological as it aimed to adapt and test PE methods for estimating the incidences of human diseases in Karamoja. Following the preparatory stage, the proportional piling method was designed to focus on locally prioritized diseases over a full one-year period, and for the purpose of testing the method, it covered only two age groups: adults and children under 5. More comprehensive disease incidence estimates would cover all age groups, i.e., include the missing age group of children over 5 years of age. Given the challenges of discrimination against women and girls in Karamoja and the gender-specific nature of some health problems, it would also be useful to compare disease incidences by gender.

The proportional piling method is a visualization method, but the results are recorded numerically. The method aims to limit exaggerated responses to a single disease that might occur if people with weak health services are asked about diseases on a disease-by-disease basis. When semi-standardized and repeated, the method produces data that can be summarized and analyzed using conventional statistical tests. This study used purposive sampling and a small sample, and so the data was assumed to be nonparametric and was summarized accordingly. The method can also be used with representative sampling. The method is "semi-standardized" because the diseases and scoring system were standard across all 16 participant groups, but the follow-up questioning was semi-structured and allowed flexibility to probe responses as needed. The disease incidence estimates using the method assume that disease prevention programs are in place for some diseases, and that in these cases, the estimates might reflect the impact of these programs. For example, there has been a program dedicated to detecting and treating human tuberculosis in Karamoja since 2019.[9] The method also assumes that some people with illness will recover during the year, whereas others may die. The method can be furthered adapted for mortality and case fatality estimates, e.g., by asking participants to further subdivide the incidence piles for each disease to show the pattern of people surviving versus those dying.

A critical aspect of proportional piling for disease estimates is interpreting local diagnoses and disease names. This is particularly important when different diseases have similar symptoms and so could be confused by participants. The preparatory stage is therefore very important for understanding the specificity of local disease names and deciding which disease names to use. As shown in Tables 1 and 2, participants not only used symptoms to identify diseases but also their knowledge on causes, seasonality, and age-specificity of diseases. As the method is used with groups of people rather than single informants, the proportional piling results arise from group consensus. Given the level of detail and specificity of disease information that people provided during the preparatory stage, we judged that there was sufficient local knowledge on human diseases to use the proportional piling method. When considering the validity of local diagnoses, it is also important to note that disease diagnosis by health professionals in Karamoja relies heavily on clinical diagnosis, and when laboratory tests are used, the validity of these tests depends on the specificity and sensitivity of the test in question, and other factors. In terms of identifying livestock diseases in East Africa, veterinary practitioners have long recognized the diagnostic skills of pastoralists, and their clinical ability is comparable to that of veterinarians.[10] This is not to say that all pastoralists are experts on all diseases, but that there is sufficient local knowledge to contribute to useful analysis of human (and livestock) diseases.

Although proportional piling was not used to measure the incidences of the different causes of diarrhoea (as ranked in Tables 3 and 4), the method could be easily adapted further for this purpose. For example, when participants have shown the pattern of the main diseases, the pile of counters depicting diarrhoea could be sub-divided to against the main categories of diarrhoea in Tables 3 and 4 to show the incidence of diarrhoea by category.

9 Implemented by Makerere University Infectious Diseases Institute, this is the USAID Program for the Accelerated Control of TB in Karamoja.

10 Catley, 2006.

After the proportional piling, we later used matrix scoring in one location to further assess how local diseases were distinguished. We assumed that matrix scoring could be a systematic way of understanding local diagnostic capacity and disease name specificity. In the matrix we included three diseases with similar clinical presentation—brucellosis, typhoid, and malaria—and three diseases for comparison. As shown in Annex 4, Table A4.1, an extensive list of 38 symptoms was produced by these participants and scored. Table A4.2 shows how the same diseases were described against different causes; Table A4.3 shows a seasonal calendar. These results were highly consistent with the textbook description of the diseases, indicating that local disease names for these diseases were specific enough for their use in proportional piling (and other PE methods). Further use of matrix scoring is recommended to cover other diseases and other districts of Karamoja.

Another important aspect of the proportional piling method is recall. We used a one-year recall period based on our experiences with validating this method for livestock disease estimates. However, FSNA surveys use a far shorter recall period of two weeks, which is generally considered to be good practice when using questionnaires with individual informants. As the proportional piling method used groups of informants, there is discussion within the group during the piling, and piles are adjusted until the group feels that their visualization of disease patterns is correct. However, there is the challenge that validation of the local incidence estimates is not possible because there is no incidence data against which these estimates can be usefully compared. As noted in the Introduction, FSNA prevalence estimates cover only a four-week period each year (assuming two FSNA surveys per year) in three diseases/symptoms in children under 5, and data from the health system only records cases that are presented to health workers; the level of non-presented cases is unknown. What can be stated with certainty is that according to local health workers, the presence of each of the infectious diseases identified by study participants has been confirmed in Karamoja by conventional medical diagnosis. Plus, when comparing incidence estimates between adults and children under 5, the results from proportional piling were technically plausible.

4.2 DISEASE INCIDENCE ESTIMATES

A general finding was that participants noted that disease incidence estimates and seasonality for some diseases vary by year according to climatic or other factors. This was most evident for diarrhoea, as participants described dietary causes of diarrhoea and linked diarrhoea to hunger and food insecurity, e.g., drought years were associated with high levels of hunger during the dry period and increasing reliance on nonpreferred foods, with a related risk of diarrhoea. This finding illustrates the importance of interpreting disease incidence data according to context and using follow-up questioning to understand the reasoning behind the estimates. Changes in rainfall, food prices, conflict, or other factors will likely affect some disease incidences. The finding also points to the need for repeating disease incidence estimates each year.

It is beyond the scope of this report to analyze or discuss each of the reported diseases in detail but of note was the high incidence of brucellosis in adults (Figure 1) and to a lesser degree, in children under 5 (Figure 2), as well as strong local ability to diagnose the disease and describe its zoonotic nature (Tables 1, A4.1 and A4.2). Brucellosis was likely first reported in Karamoja in 1966,[11] and it has been the subject of various studies in Uganda and Karamoja since then;[12] it is well known by medical and veterinary practitioners in Karamoja. The high incidence of the disease demonstrates the need for a dedicated program to prevent brucellosis in Karamoja involving public health and veterinary authorities.

4.3 UNDERSTANDING DISEASE INDICATORS FOR ASSESSING WATER FACILITIES

The study findings are relevant to practitioners who are responsible for measuring the impacts of programs that aim to improve human health or water facilities. An objective of providing new water facilities can be to reduce the incidence of waterborne diseases such as typhoid and cholera, and the study shows how baseline incidence estimates for typhoid can be obtained using PE and within an operational context of localized programming. For selected water sources, the human population covered by the water source could be selected, and participants groups could be selected from this population. Similar approaches can be used for cholera incidence estimates, and annual

11 Cox, 1966.

12 For example, see: Lolli et al., 2016; Komugishu, 2023; Bugeza et al., 2023.

repetition of proportional piling would enable tracking of disease incidences over time using a participatory monitoring system.

The study also reaffirmed the importance of mosquito-borne diseases in Moroto District, indicating the need for water programs to not only provide safe water in terms of water quality, but also consider breeding sites for relevant mosquito species in open water sources, runoff from new facilities, and water storage vessels. Again, participatory monitoring using PE could track the incidences of diseases such as malaria and yellow fever.

The study showed the limitations of using "diarrhoea" as an indicator for measuring the impacts of health or water programs, not least because a substantial number of diarrhoea cases are likely to have a dietary cause, including consumption of contaminated items that could not be cleaned even if clean water was available. Monitoring systems that use diarrhoea as an indicator would need to unpack different causes of diarrhoea, and PE methods are useful for doing this; see section 4.1 for how to adapt proportional piling for this purpose.

Overall, we concluded that if used carefully by trained workers, proportional piling is a useful way to estimate disease incidences and complement information from the FSNA surveys and health surveillance system in Karamoja. With limited resources, the approach could be repeated in other districts of Karamoja and expanded to include other age groups and a gender-specific analysis. Repetition of a PE approach each year could support the monitoring and impact evaluation of health programs and programs to improve water facilities. The PE approach fits well with concepts of localization and the need to better involve communities in the analysis of local health problems and ways to improve health services. Drawing on our experiences with training veterinary epidemiologists in PE since 2000, training of health workers in PE requires an initial five-day training course covering the theory and practice of PE methods, followed by field-level mentoring support and further short training of data analysis and presentation.

REFERENCES

Bugeza, J., Roesel, K., Moriyon, I., Mugizi, D., Alinaitwe, L., Kivali, V., Kankya, C., and Cook, E.A.J. 2023. Sero-Prevalence and Factors Associated with Anti-Brucella Antibodies in Slaughter Livestock in Uganda. *Frontiers in Epidemiology* 3:1213592. doi: 10.3389/fepid.2023.1213592.

Catley, A., Lotira, R., and Hopkins, C. 2018. Hidden Peaks: Women's Knowledge on the Seasonality and Root Causes of Child Malnutrition in Karamoja, Uganda and Their Programming Preferences. Karamoja Resilience Support Unit, United States Agency for International Development (USAID)/ Uganda, UK aid, and Irish Aid, Kampala. **https://karamojaresilience.org/wp-content/uploads/2021/05/201811_krsu_hidden_peaks_nutrition_online.pdf**.

Catley, A. 2006. The Use of Participatory Epidemiology to Compare the Clinical Veterinary Knowledge of Pastoralists and Veterinarians in East Africa. *Tropical Animal Health and Production* 38:171–184.

Cox, P.S. 1966. Brucellosis--A Survey in South Karamoja. *East Africa Medical Journal* 43 (2): 43–50.

Farrar, J., Hotez, P.J., Junghanss, T., Gagandeep, K., Lalloo, D., White, N.J., and Garcia, P.J. (eds.). 2023. *Manson's Tropical Diseases*, 24th edition. Elsevier.

Komugishu, M. 2023. Prevalence of Human Brucellosis and Associated Factors among Febrile Patients Aged 18 Years and Above Attending Kaabong General Hospital, Karamoja Region, Uganda. Master's dissertation, School of Public Health, Makerere University.

Lolli, C., Marenzoni, M.L., Strona, P. , Lappo, P.G. , Etiang, P. , and Diverio, S. 2016. Infections and Risk Factors for Livestock with Species of Anaplasma, Babesia and Brucella under Semi-Nomadic Rearing in Karamoja Region, Uganda. *Tropical Animal Health and Production* 48 (3): 603–11.

Njuguna, C., Tola, H.H., Maina, B.N., Magambo, K.N., Nabunya, P. et al. 2024. Perceived barriers of access to health and nutrition services under drought and food insecurity emergency in north-east Uganda: a qualitative study. *BMC Public Health* 24:390. **https://doi.org/10.1186/s12889-024-17830-5**.

Orishaba, P., Opollo, M.S., Nalwadda, C., Muruta, A., Makumbi, I., Kabali, K. et al. 2022. Cholera Epidemic amidst the COVID-19 Pandemic in Moroto District, Uganda: Hurdles and Opportunities for Control. *PLOS Global Public Health* 2 (10): e0000590. **https://doi.org/10.1371/journal.pgph.0000590**.

World Food Programme and Uganda Bureau of Statistics. 2023. Food Security and Nutrition Situation in Karamoja 2023. Kampala.

ANNEX 1: COMPARING ESTIMATES OF THE PREVALENCE OF SEVERE ACUTE MALNUTRITION IN KARAMOJA

In Karamoja, severe acute malnutrition (SAM) is measured biannually as part of the Food Security and Nutrition Assessment (FSNA) surveys. These assessments include the use of probability sampling and standardized anthropometric methods for the physical measurement of children's nutritional status for children up to 5 years of age. The FSNA method for measuring SAM can be regarded as a gold standard for estimating the point prevalence of SAM.

New cases of SAM in children are also recorded in health clinics in Karamoja. Therefore, collated health clinic data could provide an estimate of SAM incidence. The validity of this estimate would partly depend on the number of new SAM cases that were presented at the clinics relative to the number of new cases that did not attend the clinics.

Table A1 below shows the FSNA SAM point-prevalence estimates for three months in 2017 and 2018. The table also shows the SAM incidence estimates for the same three months using health clinic admissions data.

The comparison in Table A1 shows that clinic-based SAM incidence estimates were 10.9, 4.5, and 12.1 times lower than the FSNA survey SAM prevalence estimates.

Table A1 Comparing severe acute malnutrition estimates: FSNA surveys vs. health clinic data.

	Months		
	Jan–18	**Jun–17**	**Jan–17**
FSNA reports: SAM point prevalence	**2.50%**	**2.90%**	**3.4%**
Health clinic SAM admissions: number of cases by district			
Abim	82	109	*24*
Amudat	34	33	8
Kaabong	86	289	126
Kotido	145	366	214
Moroto	50	120	72
Nakapiripirit	59	317	109
Napak	39	134	52
Total cases in Karamoja	495	1368	605
Total number of children in Karamoja, 0–5 years of age[1]	214,000	214,000	214,000
Total Karamoja point SAM incidence based on admissions data	**0.23%**	**0.64%**	**0.28%**

[1]Assumes population of 1 million people in Karamoja, and 21.4% of population are aged between 0–5 years (Uganda National Household Survey, 2016/17).

ANNEX 2: LOCATIONS AND SIZE OF INFORMANT GROUPS FOR PROPORTIONAL PILING, MOROTO DISTRICT

Location		Male participants	Female participants
Naachuka village, Nadunget Town Council		6	8
Lokeriaut village, Nadunget sub-county		13	20
Lokaal village, Lotisan sub-county		2	15
Atedewoi village, Lotisan sub-county		9	13
Lokalimon village, Lotisan sub-county		11	10
Looborio village, Lowarengak parish, Lotisan sub-county		3	20
Pupu village, Rupa sub-county		2	15
Kaloi village, Rupa sub-county		8	18
Kaleuro-Nakonyen village, Tapac sub-county		17	17
Lonyilik village, Tapac sub-county		5	5
Musupo village, Katikekile sub-county		8	23
Musas village, Katikekile sub-county		6	7
Nawanatau village, Loputuk sub-county		0	10
Kopoe village, Loputuk sub-county		0	17
Nangorit village, Nadunget sub-county		6	20
Nariamaoi-Namus village, Nadunget sub-county		10	6
	Total	106	224

ANNEX 3: WATER SOURCES ASSOCIATED WITH TYPHOID AND WATER-BORNE DIARRHOEA

Water source	Location	Specific water sources
Ekipor (plural – *ngipwarin*)	Naachuka village, Nadunget Town Council	All *ngipwarin* along river Kololae
Small ox-bow pool on a small stream	Lokeriaut village, Nadunget sub-county	Nakatwan, Lokabuuru, Looyakoromae, Poro
	Lokaal village, Lotisan sub-county	Natwania, Nagothe, Nakatwan, Nakeret, Nabokor, Nakwakipi, Ngipwarin a Loteng, Nakasidookot, Nawanamuno
	Atedewoi village, Lotisan sub-county	Lokipor-anakeret, Natonia, Poro, Nabokor, Nakujan-ka-engolewas, Nageleya
	Lokalimon village, Lotisan sub-county	Nabokor, Natwania, Nakol, Nakeret, Lobwel
	Pupu village, Rupa sub-county	Lokemer-kapel, Katik-apese, Lowounot
	Nawanatau village, Loputuk sub-county	Akukurit, Apa-lotela, Kangoroknyang, Nawanatau, Lokali, Chogooro, Karukonyang, Lopur, Nangorkipi
	Nangorit village, Nadunget sub-county	Kodokochin, Lopeikiru, Toto-a-tomotun, Lotikiling
Atapar (plural – *ngataparin*)	Naachuka village, Nadunget Town Council	Apa Echurum; Pandeshon (foundation)
Pond	Lokeriaut village, Nadunget sub-county	Looyakoromae, Katiyangole, Napopong, Kaapuya
	Lokaal village, Lotisan sub-county	Naritae, Loburuk, Akonyang
	Atedewoi village, Lotisan sub-county	Lotikori
	Lokalimon village, Lotisan sub-county	Nakabuuro, Nakwapua, Nakorete, Kudule
	Musupo village, Katikekile sub-county	Nariamakadeli, Lokoromae
	Nawanatau village, Loputuk sub-county	Karukonyang, Nakwakipi
	Nangorit village, Nadunget sub-county	Nabokat, Nakodekodae, Nakidikidia, Loregae

Water source	Location	Specific water sources
Akuja or *echor* (plural – *ngakujan* or *ngichorin*)	Naachuka village, Nadunget Town Council	All *ngichorin* along river Nadunget
	Lokeriaut village, Nadunget sub-county	Ngakujan and Ngichorin along river Komatheniko (at Lokeriaut)
Pothole or well in riverbed. *Akuja* is shallow; *echor* is deep.	Lokaal village, Lotisan sub-county	Along the following rivers: • Kaaleyo River – Natikokinei, Lokaal, Apa Lochomil, Nadurkoit, Nangamit, Nakoret • Komatheniko River – Namam-chuuli, Kipir-ngakot, Majanga, Kithop, Natungunan • Poro River – Ngikawo, Naputuro, Engolewal, Lobore-a lolepo, Apei-kidor • Nayanae-angor River – Nangeleya • Apule River – Lotukuton, Lochor-angiramali, Lochor-aingok, Lomothing, Lotilo, Korikima, Looyadomo
	Atedewoi village, Lotisan sub-county	Ngakare along the following rivers: Apule, Kaaleyo, Komatheniko, Musupo, Lokwasinyon, Poro, Lomusia, Kakorikitha, Looyakoromae
	Lokalimon village, Lotisan sub-county	Along the following rivers: Kaaleyo, Komatheniko, Majanga, Poro, Apule
	Nawanatau village, Loputuk sub-county	Along the following rivers: Nawanatau, Chogooro, Loturtur, Nakiloda, Naenet, Nangorkipi
	Nangorit village, Nadunget sub-county	Along River Nakopoi
Amaata naachi/amaata (plural – *ngamatain*)	Lokeriaut village, Nadunget sub-county	Apopong, Loobore-alolepo, Najota, Lokisilei, Nabokor
Valley tank	Lokaal village, Lotisan sub-county	Najota, Lokisilei
	Atedewoi village, Lotisan sub-county	Loburuk, Lokisilei, Nabokor, Najota, Lolepo, Moru-ariwon, Apopong, Moru-emut
	Lokalimon village, Lotisan sub-county	Lokisilei, Loburuk, Lolepo, Najota, Napopong
	Kaleuro-Nakonyen village, Tapac sub-county	Natuuwa, Loitarenga
	Nawanatau village, Loputuk sub-county	Nakukurit, Kopedur, Lokali, Nakwapua
	Nangorit village, Nadunget sub-county	Nangorit
Amaata naapolon Dam	Lokeriaut village, Nadunget sub-county	Kobebe
	Lokaal village, Lotisan sub-county	Kobebe
	Atedewoi village, Lotisan sub-county	Kobebe
	Lokalimon village, Lotisan sub-county	Kobebe
	Kaleuro-Nakonyen village, Tapac sub-county	Nakonyen – under construction

Water source	Location	Specific water sources
Angolol na elele Flowing rivers/streams	Lokaal village, Lotisan sub-county	Rivers – Kaaleyo, Komatheniko, Poro, Nayanae-angor, Apule
	Pupu village, Rupa sub-county	Rivers – Apule, Kaaleyo, Komatheniko,
	Kaleuro-Nakonyen village, Tapac sub-county	Rivers – Nakonyen, Nawokotelei, Namanang, Ariu, Komun, Lotirae, Lopetae, Nakadengero, Naakuthe, Napei-yelel
	Musupo village, Katikekile sub-county	Kokile, Musupo, Rata, Napedo
Abwel Large ox-bow pool on Mian River	Lokalimon village, Lotisan sub-county	Komatheniko, Kipir, Kithop, Lokorikipi, Angamit
	Musupo village, Katikekile sub-county	Nakerepe (Lomunyen-kirion)
Elelea Permanent calm flowing river	Pupu village, Rupa sub-county	Along River Arekongu
Achuuma na ngakan Boreholes with handpumps	Lokalimon village, Lotisan sub-county	Not reported.
	Musupo village, Katikekile sub-county	These are boreholes with rust in water – Lomunyen-Kirion, Lokajikait, Lodurkoit
	Nawanatau village, Loputuk sub-county	Boreholes with rust or termites in water – Achuma-Kamuge/Lotirir, Achuma-na-Apa-Chuba, Namotoe, Naachuka, Nabur
	Nangorit village, Nadunget sub-county	Boreholes with rust in water – Nabokat, Nakoroto, Lokeeruman, Losiyae
Echwa (plural – *ngichowae*) Spring	Musupo village, Katikekile sub-county	Lochwa-ka-Achok, Namare, Naderita, Duwak, Lochwa-a-Longora, Loturtur-konete, Namongin, Lochor-angaber, Atoo, Kadurum, Lochor-Katido
Ebur Rock or crevice; a depression that stores water	Musupo village, Katikekile sub-county	Natedekitoe, Lolempus, Natak, Namidatwel, Kacherikol, Lotodo
Roof catchments	Nawanatau village, Loputuk sub-county	Napetaoi center, Nawanatau health center
	Nangorit village, Nadunget sub-county	People with iron sheet houses

ANNEX 4: USING MATRIX SCORING AND SEASONAL CALENDARS TO DISTINGUISH BETWEEN DISEASES

Table A4.1 Matrix scoring of the signs and symptoms of six diseases.

Sign/symptom	Brucellosis	Typhoid	Malaria	Pneumonia	Diarrhoea	Stomach ulcers
Shivering/chills – *kirujurujakini akwan/tonger akwan etolim jo echamit akolong ani nabo tonger akolong/kiinakini akatorot*	9	5	15	1	0	0
Vomiting – white then green then yellow vomit – *akilek*	0	0	21	0	9	0
Nausea (a feeling of sickness with an inclination to vomit) – *kiburakini kori echamit etau akilek lakin nyileki*	0	30	0	0	0	0
Body pains (muscles and joints) – *akitibitib/akirieb akwan kori nginerin akwan*	16	8	6	0	0	0
Headache – *akirieb akou/kitegeri akou/tarama ngaki ka akou elii*	2	5	8	0	0	15
Increased heartbeat – *tama etau puth/kitobul/ebala etau rukruk/tama etau bukbuk*	9	4	0	0	0	17
Skin darkens – *akilochokin ngajul akwaan/ipoe ngaakot kori akwaan*	13	5	0	0	2	10
High fever both at day and night – *torirau kori itomonuni akwaan pepe/ itititae nakware ka aparan*	7	6	9	5	2	0
Temperature high at night and low at daytime – *amonis akwaan nakware ani iwalari todipok amonis/itítae nakware bon*	16	14	0	0	0	0
Profuse sweating – *akinyinyir looi*	12	17	1	0	0	0
Men become sexually dysfunctional (plus releasing turbid and yellow urine, and testicles swollen) – *isipiyori ekile aurere/isiitori ekile*	30	0	0	0	0	0
Body dislikes too much cold or too much heat – *engerit akwaan akilethikin nakolong ka nakatorot*	22	0	8	0	0	0
Recovery takes long, even with treatment, and relapses – *eyai akoyen angaleun/nyedaun anakwaan aitwan*	14	10	0	2	0	4
Someone recovers quickly with treatment – *eyai apak na euriana tadaun anakwaan*	0	0	16	4	10	0
Malaise/body weakness/fatigue/body discomfort – *tolilimier akwaan/ tadaun akwaan ngigof*	4	5	7	2	12	0
Without local remedies – *nyikatakinete ngikito lu ere/emamakar ekitoe lo ere*	15	10	0	0	0	5*
With local remedies – *ikatakinete ngikito lu ere/eyakar ekitoe lo ere/ echamakinit ekitoe lo ere*	0	0	15	6	9	0
Anaemia/paleness, but someone looks healthy – *tadaun kori engobari ngakot anakwaan tobur bo itwan*	12	5	2	0	4	7
Expensive to treat with modern medicines – *elal ebei ekitoe/enyami ekitoe ngasilinga/elal akitach kori ebei ekitoe*	10	8	2	1	4	5
Yellow diarrhoea – *akiurut ngachin nanyangayek*	0	0	2	0	28	0

* Disappears when the problem is solved, e.g., lack of food in the family

Sign/symptom	Brucellosis	Typhoid	Malaria	Pneumonia	Diarrhoea	Stomach ulcers
Diarrhoea – watery grey diarrhoea and with mucus or blood spots/ stains – *aremor ngachin naangora na eyei atekorit ka ngakot*	0	0	0	0	22	8
Dizziness – *kisirimi akou/kisungusungu*	0	15	6	0	0	9
Lacrimation – *igorosi ngakonyen ngakio*	0	9	21	0	0	0
Someone passes concentrated urine – *ngakul narengat kori nanyangayek*	15	0	5	0	0	10
Making wheezing sound/noises when you breathe and difficult breathing/shortness of breath – *isiyangari ekore kidiama/itedukae ekore/ toditiyer ekiyanganu/ebala ekore kwiii*	0	0	0	30	0	0
Coughing – *awala*	0	0	5	16	9	0
Chest pain – *akiterieb ekore*	0	0	0	30	0	0
Stomach/abdominal pain – *akirieb akook*	0	7	4	0	11	8
Frequent (urgent need) passing of stool – *akiker jiik kinga*	0	0	0	0	30	0
Dehydration – *engobari ngakipi anakwaan tolosi akwaan kwap*	2	4	9	0	10	5
Sunken eyes – *tolomasi ngakonyen tooma/todongolol*	1	6	8	0	12	3
Loss of body weight – *tadaun itwaan akwan/kikar*	2	4	3	1	5	15
Kills many people – *eari kori anyam ngitunga lukalak*	7	4	10	1	6	2
Wounds in the stomach – *ijemeikini akook/torengeta ngamaliteny*	0	0	0	0	9	21
Loss of appetite for meat, milk, water, food – *kitengeri akimuj*	13	3	5	2	7	0
Pain and discomfort in the upper part of the abdomen (heart burn) – *akirieb etau*	0	0	0	0	0	30
Belching – *akiyara*	0	0	25	0	0	5
Hiccups – *ekisiganu*	0	0	0	30	0	0

Note: matrix scoring in Lobur-angikwamong/Nataparakwangan, Loputuk sub-county, Moroto District, 19 participants (9 men, 10 women), September 2024.

Brucellosis – hygromas (*abuth*) seen in cattle; small joint swellings also seen in humans.

Table A4.2 Matrix scoring of the causes of six diseases.

Sign/symptom	Brucellosis	Typhoid	Malaria	Pneumonia	Diarrhoea	Stomach ulcers
Disregarding cultural abominations/restrictions and obligations – *etal*	9	5	15	1	0	0
Eating infected meat – *kitapakini akinyam akiring na edeke*	0	0	21	0	9	0
Internal body parts/muscles change – *kijulakin akon kiring kori tooma akon kwaan*	0	30	0	0	0	0
Drinking infected milk – *kitapakini akimat ngakile na aite ana edeka*	16	8	6	0	0	0
Mixing cow urine with milk – *kitapakini akinyalakin ngachoto ka ngakile*	2	5	8	0	0	15
Drinking contaminated water – *kitapakini akimat ngakipi nangora*	9	4	0	0	0	17
Mosquitoes – ngisuru	13	5	0	0	2	10
Too much exposure to cold – *akilethekin nakatorot*	7	6	9	5	2	0
Eating contaminated food – *kitapakini akinyam akimuj nae rai echap kori na engoreana*	16	14	0	0	0	0
Poor hygiene – *angoreanut*	12	17	1	0	0	0
Evil spirits, Satan, only God knows – *ngisitanin/ngakujo*	30*	0	0	0	0	0
Negative thoughts arising from (*ngatameta angakirosia anakalalak*):	0	0	0	0	8	22
a. Bad news, e.g., death or sickness of a relative – *kiira atamar atona ikon twan*						
b. When you are sick – so, fear that you will die and leave orphaned children – *edeke kelalau alokal*						
c. Family problems such as lack of food – *akoro angide*						
d. Your relative killing someone – so, fear that they might take revenge on you – *ngatiekisio na ikote ikon twan akiar niche, tama kaario ta*						

*There were mixed views on this. Some participants said that evil spirits can only cause madness but not Brucellosis.

Table A4.3 Seasonal calendar of diseases.

Water source	Rainy season (*Akiporo*)	Dry season (*Akamu*)	Drought (*Eron*)
Brucellosis	5	5	5
Typhoid	8	5	2
Malaria – rainy season, coincides with increase in mosquito population and bushes	10	3	2
Pneumonia	11	3	1
Stomach ulcers	2	3	10
Diarrhoea – greenish then yellowish (due to consumption of wild vegetables)	15	0	0
Diarrhoea – dark grey/clay-colored then with blood stains, e.g., due to consumption of brewer's waste (*adakae*) or poor diet	0	4	11
Diarrhoea – whitish – especially due to consumption of animal milk	15	0	0

Note: seasonal calendar in Atedewoi village, Lotisan sub-county, Moroto District, with 24 participants (9 men, 15 women), September 2024.