



## OPEN ACCESS

## EDITED BY

Laura Dean,  
Liverpool School of Tropical Medicine,  
United Kingdom

## REVIEWED BY

Mary Chambers,  
Oxford University Clinical Research Unit,  
Vietnam  
Hikabasa Halwiindi,  
University of Zambia, Zambia

## \*CORRESPONDENCE

Geoffrey Muchiri  
[✉ geoffrey.muchiri@cbm.org](mailto:geoffrey.muchiri@cbm.org)  
Moses Okwii  
[✉ okwmoses@gmail.com](mailto:okwmoses@gmail.com)  
Paul Bukuluki  
[✉ pbukuluki@gmail.com](mailto:pbukuluki@gmail.com)  
Johan Willems  
[✉ Johan.Willems@cbm.org](mailto:Johan.Willems@cbm.org)  
Juliana A. Amanyi-Enegela  
[✉ Juliana.Amanyi-Enegela@cbm.org](mailto:Juliana.Amanyi-Enegela@cbm.org)  
Girija Sankar  
[✉ girija.sankar@cbm.org](mailto:girija.sankar@cbm.org)

## SPECIALTY SECTION

This article was submitted to  
Disease Prevention  
and Control Policy,  
a section of the journal  
Frontiers in Tropical Diseases

RECEIVED 30 July 2022

ACCEPTED 16 January 2023

PUBLISHED 16 February 2023

## CITATION

Muchiri G, Okwii M, Bukuluki P, Willems J,  
Amanyi-Enegela JA, Yibi M and Sankar G  
(2023) Challenges and strategies for the  
uptake of mass drug administration among  
pastoralist communities in South Sudan.  
*Front. Trop. Dis.* 4:1007480.  
doi: 10.3389/fitd.2023.1007480

## COPYRIGHT

© 2023 Muchiri, Okwii, Bukuluki, Willems,  
Amanyi-Enegela, Yibi and Sankar. This is an  
open-access article distributed under the  
terms of the [Creative Commons Attribution  
License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or  
reproduction in other forums is permitted,  
provided the original author(s) and the  
copyright owner(s) are credited and that  
the original publication in this journal is  
cited, in accordance with accepted  
academic practice. No use, distribution or  
reproduction is permitted which does not  
comply with these terms.

# Challenges and strategies for the uptake of mass drug administration among pastoralist communities in South Sudan

Geoffrey Muchiri<sup>1\*</sup>, Moses Okwii<sup>2\*</sup>, Paul Bukuluki<sup>2\*</sup>,  
Johan Willems<sup>1\*</sup>, Juliana A. Amanyi-Enegela<sup>1\*</sup>,  
Makoy Yibi<sup>3</sup> and Girija Sankar<sup>1\*</sup>

<sup>1</sup>IEH/NTD, Christoffel-Blindenmission Christian Blind Mission (CBM), Bensheim, Germany, <sup>2</sup>R&D, Kampala University College, Juba, South Sudan, <sup>3</sup>NTD-MoH, Ministry of Health South Sudan, Juba, South Sudan

Preventive chemotherapy through mass drug administration (MDA) to control and eliminate neglected tropical diseases (NTDs) requires the active participation of communities living with NTDs, or at risk of NTD infections. Despite considerable progress by national control and elimination programs, achieving consistent and sustainable treatment campaigns that reach pastoralist communities remains challenging, which in turn delays the achievement of global disease elimination goals. The challenges of accessing pastoralist communities for treatment also hinder the achievement of the UN's Sustainable Development Goals' (SDGs) pledge to "leave no one behind". Elimination targets cannot be achieved if significant proportions of endemic populations, such as pastoralists, are missed out during treatment campaigns. In South Sudan, close to 70% of the population is categorized as pastoralist, with previous data on MDA showing low access to and acceptance of MDA among the pastoralist community, as well as inconsistent treatment coverage. To address this challenge, a cross-sectional study design was conducted in five counties, with 239 pastoralist community respondents participating in in-depth interviews (IDIs), key informant interviews (KIIs), and focus group discussions (FGDs). Our findings show that, in the pastoralist community, high mobility, lay perceptions about the causes of NTDs and methods of treating them, limited awareness of MDA, and suboptimal health-seeking behaviors are the major factors that limit accessibility and participation. Our results suggest that improved uptake of MDA in these communities may be achieved by timing treatment campaigns to take account of pastoralists' seasonal migration patterns, by involving pastoralist leaders in planning and social mobilization activities, by engaging community members as community drug distributors (CDDs), by using participatory behavior change approaches to design NTD interventions, and by addressing negative perceptions around the medicines involved, including those related to drug expiry and drugs causing impotence or other side effects. The results from this study could enable national programs to address the challenges of implementing treatment campaigns through the enhanced involvement and representation of pastoralist communities.

## KEYWORDS

preventive chemotherapy, mass drug administration, pastoralist, neglected tropical diseases, lymphatic filariasis, onchocerciasis

## Introduction

Neglected tropical diseases (NTDs) are both a cause and consequence of poverty (1), causing physical and intellectual impairments, preventing children from attending schools, and reducing individual economic productivity (2–5). This group of diseases is termed “neglected” because the affected populations are often among the most vulnerable and hard to reach, cannot afford appropriate medical services, and have little means of effecting political change in society (4). Similarly, interventions addressing these diseases receive considerably less funding from donors than those addressing some other diseases, such as HIV/AIDS, tuberculosis (TB), and malaria (6, 7).

Preventive chemotherapy through mass drug administration (MDA) is a proven strategy applied by national control and elimination programs against NTDs including lymphatic filariasis (LF), onchocerciasis (oncho), trachoma, schistosomiasis (schisto), and soil-transmitted helminthiasis (STH) (6, 7). High treatment coverage of MDA campaigns is required to achieve reduced transmission and improve morbidity in communities in which NTDs are endemic (8).

New global targets and milestones to prevent, control, eliminate, or eradicate 20 NTDs and disease groups have been set in the WHO report *Ending the neglect to attain the Sustainable Development Goals: A road map for neglected tropical diseases 2021–2030*. These targets and milestones also include cross-sectoral actions aligned with the UN’s Sustainable Development Goals (SDGs). The road map identifies three foundational pillars that support global efforts to achieve these targets, namely (1) accelerating programmatic action; (2) intensifying cross-sectoral approaches; and (3) changing operating models and culture to facilitate country ownership (1).

In 2005, the WHO published a strategy to combat NTDs based on a combination of five public health interventions: (1) innovative and intensified disease management; (2) large-scale preventive treatment; (3) integrated vector management; (4) veterinary public health; and (5) access to water, sanitation, and hygiene (9). The first two are medical interventions, aimed at curing, easing the symptoms of, or preventing acute or chronic diseases, whereas the last three are cross-sectoral actions aimed at addressing the root causes of NTDs, i.e., poor living conditions and proximity to animals and vectors (10).

Despite considerable progress by global and national control and elimination programs, implementing consistent and sustainable treatment campaigns that reach hard-to-reach population groups, such as pastoralist communities, remains challenging, and delays the achievement of disease elimination goals. Estimates indicate that pastoralists and agro-pastoralists globally stand at 120 million, 50 million of whom live in sub-Saharan Africa (SSA) (11), representing a critical mass of the global population. The challenges with access to treatment for such communities also hinders the achievement of the UN’s Sustainable Development Goals’ vision of “leaving no one behind”.

Studies have shown that pastoralists’ reluctance to participate in MDA has been of particular concern since the smallpox eradication program era in the late 1970s, the success of which relied on high levels of herd immunity (12, 13). During the roll-out of current

elimination and eradication programs in Africa (e.g., for tuberculosis, polio, and dracunculiasis), it was also observed that individuals moving between localities may serve as potential disease reservoirs or vectors (12), and, as such, need to be strongly guarded against.

In South Sudan, an estimated 67%–70% of the population is engaged in pastoralism (14), and a huge proportion of this population is missed during treatment campaigns for reasons that are not known by the organizers and implementers of MDAs. The International Labour Organization estimates that South Sudan has one of Africa’s largest pastoral populations (15). As this population has not been included in any census, and no census has been conducted in the country since 2008, only scant demographic information is available on these groups (12, 14). Pastoralist communities in South Sudan maintain family homes and, when migrations occur, some members of the family are usually left at home. The paucity of reliable data presents a challenge to the planning and implementation of interventions to treat and control NTDs in this community, and to the design of efficient health service delivery mechanisms in general.

In addition, a significant number of pastoralists move frequently from their communities to other places in search of grazing land and water for their animals. When on the move, or when residing in cattle camps, they often miss both curative and community-based health services, such as preventive chemotherapy (PC) through MDA (16). This is because service delivery, including essential health services and MDA campaigns, is oriented toward the populations in villages and other permanent or semi-permanent settlements. Therefore, it is difficult to include this sizeable portion of the population, from communities who are residing in cattle camps or are on the move at the time of the campaigns, in such treatment campaigns.

A systematic review by Gammino et al. (12) indicated that the major factors impacting health service uptake by nomadic pastoralists include (1) distance/geographic access; (2) poor quality of health services delivered to nomadic pastoralists, including deficient infrastructure, equipment, supplies, and health products; poorly trained health care personnel, especially community health workers (CHWs), and their poor behavior and attitudes (i.e., rudeness and prejudice) toward nomadic pastoralist patients; (3) limited knowledge among pastoralists on disease and awareness of health services, and certain health-seeking behaviors, such as the accessing of formal health services to prevent and treat disease, being perceived as low priority; (4) treatment costs incurred by nomadic pastoralists, such as informal fees at health facilities, medications, and non-medical costs; (5) failure by programs to contextualize intervention designs through substantive community engagement; and (6) nomadic pastoralist beliefs, behaviors, and attitudes toward formal health sector services, and the absence of community agency (12). Gammino et al. (12) further argued that approaches tailored to the nomadic pastoralist lifestyle, e.g., integrated human and veterinary health service delivery (or “One Health”), and initiatives that engage communities in program design to address social structures were more promising in increasing the uptake of health services among pastoralist groups (17).

However, even when efforts are undertaken to achieve 100% geographical coverage during MDA, therapeutic coverage will be lower when a proportion of the population is not present in the villages at the time of the interventions.

The South Sudan NTD Master Plans, 2016–2020 and 2021–2026, highlight PC using MDA as the national strategy for controlling and eliminating the five PC-NTDS of lymphatic filariasis, onchocerciasis, schistosomiasis, soil-transmitted helminthiasis (STH), and trachoma (18, 19).

A review of South Sudan's national MDA reports (unpublished) indicated that, by 2021, South Sudan had conducted four rounds of MDA, in the years 2021, 2019, 2018, and 2017, with varying geographical coverage. Previous MDA programs in pastoralist counties have been characterized by low levels of access and acceptance, and therefore inconsistent treatment coverage. This study therefore sought to understand the challenges of increasing the uptake of MDA among pastoralist communities in South Sudan so that future campaign efforts can be tailored to bridge treatment gaps.

## Methods

### Research design

The study adopted a cross-sectional and descriptive design, utilizing qualitative methods of inquiry to promote an in-depth understanding on factors that influence pastoralist movement patterns, perceptions on NTD etiology, and sociocultural obstacles, and motivators influencing decisions to participate in MDA among pastoralist communities. Primary data were collected through in-depth interviews (IDIs), focus group discussions (FGDs), and key informant interviews (KIIs).

### Research sites

The study was conducted in five counties of South Sudan, namely Tonj South County in Warrap State, Terekeka County in Central Equatoria State, Yirol West County in Lakes State, Kapoeta South County in Eastern Equatoria State, and Jur River County in Western Bahr el Ghazal State. The counties were selected in consultation with the South Sudan National Ministry of Health based on the following criteria: (1) counties that have pastoralist communities, or are seasonally inhabited by pastoralist populations; (2) counties in which both onchocerciasis and lymphatic filariasis are endemic; (3) counties that have participated in one or more rounds of a MDA; and (4) counties that registered inconsistent treatment coverage during previous MDA campaigns.

### Study population

The study enrolled a representative sample of pastoralist youth and women and men, aged 12–17 years, and 18–49 years, respectively, for the FGDs. IDIs were conducted with pastoralist migratory group leaders, male elders, and female leaders, who are regarded as the major influencers and decision makers, and were aged 18 years and above. KIIs were conducted with healthcare providers, NGOs/organizations working with pastoralist groups, county health departments, women leaders, youth leaders, local chiefs, teachers, and religious leaders. The key informant interviewees were identified purposively based on their role and experience in relation to the study objectives.

In each study site, the cattle camps (20) were the enrollment points for FGDs and IDIs. This was meant to increase the chance of interacting in detail with the wider pastoralist group, and it provided a purposive sample of pastoralist women, men, youth, and their leaders. In total, 239 participants were enrolled in the study across the five study sites. The concept of saturation (21), commonly used in qualitative research, guided the number of FGDs, KIIs, and IDIs conducted during the study.

### Data collection

Data were collected by a team of trained research assistants. Prior to data collection, data collection tools were pre-tested to test suitability of the instruments. All data collection tools were translated into local languages understood in the targeted counties. Study participants for IDIs and FGDs were shown printed photographs of the diseases being discussed (lymphatic filariasis, onchocerciasis, trachoma, schistosomiasis, and soil-transmitted helminthiasis). Photographs for each disease were shown separately to reinforce understanding of the disease being discussed. All interviews were, with verbal consent from study participants, audio recorded using Android-based smart tablets, and were later uploaded to a cloud-based application.

### Data analysis

The audio interviews were translated and transcribed verbatim into English. Data analysis began with daily end-of-day debriefs with field teams to identify emerging key themes. These were captured in notes and Microsoft Excel® (Microsoft Corporation, Redmond, WA, USA) spreadsheets for sorting, as analysis continued iteratively throughout data collection.

A coding frame (codebook) based on the transcripts and emerging themes was developed. The quality of transcripts was checked by a quality control team, which reviewed them based on the audio recordings. Data cleaning of each transcript was done through proofreading of the transcripts to find and replace placeholder text, add missing words and fillers, and false starts where necessary.

Transcripts were uploaded and coded using Dedoose™ (SocioCultural Research Consultants, University of California, Los Angeles, Los Angeles, CA, USA), a web-based qualitative data analysis tool. The codebook generated insights grounded in the views expressed by the study participants. The evidence to support the codes was noted under each of the codes and the data were reduced into segments, which were stored and organized in Excel worksheets. A summary description of the emerging themes, making use of key quotations, cases, and explanations, was used when writing up the results.

## Results

### Factors that limit pastoralists' participation in mass drug administration

The study findings identified two major factors that limit pastoralists' participation in MDA in South Sudan: the seasonal

pastoralists' migrations, which hinder their access to MDA drugs; and the lack of inclusion of pastoralists in MDA program activities such as planning, social mobilization, and drug distribution. These two factors are also worsened by existing health system barriers that limit overall access to health services in the country.

## Seasonal pastoralists' migration

Intra-African migrations are common in pastoralist societies (22) and are influenced by a combination of environmental and social factors. The study results indicate that seasonal migration among pastoralists in South Sudan occurs annually, and affects their participation in MDA, as they are kept away in distant and remote locations for long periods of time.

## Pastoralist migration patterns and influence on MDA

The results of this study indicate that the pastoralists' migratory routes in South Sudan are diverse, and are largely influenced by the search for water and pastures for their livestock, as well as conflict dynamics. The migratory routes are spread across multiple counties, in some extending into neighboring countries such as Sudan in the north, the Central African Republic in the west, or Ethiopia in the east. The migrations take place on an annual basis and usually start at the onset of the dry season in October, and continue to the beginning of the rainy season (from April to June of the following year).

The study found that, across all five study sites, migration of pastoralist populations (men, women, youths, elders, and children) maintain similar movement routes through phases, depending on the roles each party holds. For example, before a migration occurs, an advance team is usually sent ahead to survey the area, then the remainder of group follows. In the Yirol West, Jur River, and Tonj South counties, for example, the advance team is usually composed of young boys, 12–17 years of age, whose role is to identify an appropriate area for grazing and settlement. Once they have done so, they burn the existing grass in the chosen area, shave off their hair, and return to their home village. After 2 weeks, when their hair has grown (the growth of their hair is an indication that pastures have regrow in the targeted migration area), the migration begins. There is a symbolism and a kind of ritualization embedded in the transition from low, or poor pasture presence, to the new growth of pasture for animals when considered alongside the boys' cutting off their hair and later, their new hair growth. In Kapoeta South County, for instance, the role of the advanced team, largely composed of youths, goes beyond the identification of a place of settlement and pastures to the construction of temporary houses and fencing off the cattle camp area before the arrival of the main group (which comprises first the adult men and, later, the women and children). Women tend to arrive last, after the men and youths have built the shelters and protective/safety measures are in place. Once this has been put in order, the women and girls take on their gendered roles, that is domestic chores and care work, as guided and regulated by the social and gender norms prevalent in pastoralist communities.

These pre-migration activities are key in informing MDA program managers about the intended migration destinations if proper coordination is done with the pastoralists' migration leaders. The excerpts below from respondents justify the above arguments.

“Young men go ahead with the cattle, young boys follow them in the middle, then women and girls come last.” FGD male, aged 18–49 years, Yirol West County

“In Kapoeta South, before migration takes place, a community meeting is always called by the elders and leaders to inform the community about the movement. Afterwards, young energetic boys are sent to identify the next camping area. The area is then fenced off, and later the rest of the delegation comes with cows, women, and children. The men start to move, when they reach to the place where they have decided to camp, they cut the thorns to fence the camp; then, they bring children and women.” FGD with adult males, Kapoeta South County

“The young men, plus the youth, go ahead with the cattle, then women and children follow them after. But they migrate together; no one remains.” KII male, aged 18–49 years, Kapoeta South County

“The youth go to the cattle camp and the old men remain behind to water the few goats/sheep. The young men go there with the girls. Old women remain in the villages; they do not migrate”. FGD with adult males, Kapoeta South County

These migratory dynamics and the fact that not everyone in the community migrates at the same time, have implications for MDA campaigns; advance teams of youths are sent to identify the migration locations and to ensure that they are secure and have the requisite pasture and water, after which the men follow. Women and children are the last to arrive. The frail and weak remain behind. The planning of MDA and NTD prevention services needs to take into account these migration patterns, to effectively target pastoral communities.

## Pastoralists' leadership structures

The results show that pastoralist groups maintain a structured leadership system that is responsible for decision making and conflict resolution. In the Jur River, Tonj South, Terekeka and Yirol West counties, study participants indicated that every immigration group/cattle camp has its head/leader, locally referred to as the “Majong-wut”. The “Majong-wut” is assisted by deputies, depending on the size of the herd, who support him in the day-to-day management of the cattle camps. The major roles of the cattle camp head “Majong-wut” and his deputies include the provision of overall leadership to the cattle camps, making critical decisions on migration routes, and conflict resolution within and outside the cattle camps. The “Majong-wut” is usually appointed by the community with the prerequisites being that they exhibit maturity, are married, are thought to be responsible enough for the task, are experienced in conflict management, are deemed to be objective in judgment, and to come from a good family background. In Jur River County, the migration group head assumes the additional responsibilities of

ensuring peaceful coexistence between the host communities and the members of his migration group.

In Kapoeta South County, the migration groups are headed by the chief or an elder, who assumes the same roles and responsibilities as those of the “Majong-wut”.

“Yeah, we have “Majong-wut” (migration group head) with his deputies who always represent us in our camp and he is the one who tells us where to go when the pastures for the cows are finished ... decisions for migration are always made by the “Majong-wut”.” FGD with males aged 18–49 years, Yirol West County

“We have a leadership structure headed by me as “Majong-wut” (migration group head) with my two deputies.” IDI male, aged 18–49 years. Tonj South County male, aged 18–49 years.

“The leadership structure we have here and other cattle camps comprises of one cattle camp leader and 2 deputies to a cattle camp of 30 to 50 kraals and a cattle camp of 100 to 200 kraals have 1 cattle leader and 4 deputies. In this leadership, only responsible people are appointed to head, because they are experienced people in conflicts management and they can judge in fair way.” IDI male, aged 18–49 years, Tonj South County

“The leadership in the cattle camp is under a camp chief or elder who reports to the boma chief or direct to payam level chief, and migration is decided by the cattle camp chief or the elder. Before the migration date, he calls for the senior men, youth, and the women to communicate the decision to the men and youth to execute the decision.” IDI male, aged 50 years and above, Kapoeta South County

“The leadership is structured in such a way that, there is a chief (elder) in charge of the camp who will report to the chief in charge of the Boma, and the Boma chief will report to the payam chief.” KII female, aged 18–49 years, Kapoeta South County

The existing pastoralist leadership structure provides an opportunity for MDA programs to harness MDA social mobilization with pastoralist leaders so as to foster access to, and the acceptance of, MDA.

## Pastoralist population characteristics and their roles in the migration

Across the five study locations, the pastoralist population involved in migration comprised a combination of youths, men, women, children, and elders. The number of people involved in the migrations usually ranges from 100 to 600, depending on the number and sizes of cattle camps; the consequences of such a large group missing out on MDA, therefore, could be very serious. Within one county/MDA implementation unit, there are several migration groups, ranging from 10 to 50 depending on the area’s abundance of water and pastures, and the lack of conflicts within it, as these are the factors that influence migrations.

Each group in the migration population (youth, women, children, and elders) plays a unique role in the migration cycle. For example, across the five study locations, it was unanimously accepted by study

participants, including female participants in FGDs, that the key roles of women and girls are the general household chores of cooking, cleaning, and collecting water, selling milk, purchasing household items, shelter construction, milking cows, and looking after goats and calves. In addition, women were cited as custodians of healthcare through their treatment and care for the sick the injured, and their encouragement of men to access healthcare services when critically ill. Study participants also reported that, when the rainy season approaches, women are usually the first to return to their home villages to engage in cultivation. The roles played by the women in the migration cycle in South Sudan are quite similar to those played by women in neighboring countries, such as Uganda and Kenya, as cited. These diverse roles of pastoralist migration population groups are similar to those identified by Naomi Kipuri and Andrew Ridgewell (2008) (23).

“We fetch water from the river, and then cook food for young children and elderly because there is no cow to be milked. We also go and fetch wild fruits and we boil them to cook food.” FGD with females aged 18–49 years, Yirol West County

“Our work as women in the cattle camp is to look for what to eat for the entire family members.” FGD with females aged 12–17 years, Terekeka County

“The women take care of children and when a child is sick, she takes care of the treatment in the hospital, and sometimes visit the witch doctors to seek for the child’s healing.” KII female, aged 18–49 years, Kapoeta South County

The results also showed that men play a critical role in sustaining the pastoralists’ migration, with their major functions being the provision of protection and security to the migration group, the provision of counsel to the migration group leaders of the cattle camp, and cattle grazing. In relation to healthcare, men’s roles include the search for traditional medicines (herbs) and the transporting of patients to health facilities if critically ill.

“Men supervise the youth and monitor whatever they are doing; for example, when some youths are stealing animals, the men will report them to the elders and punish them.” KII male, aged 18–49 years, Kapoeta South County

“The roles of men are to protect the lives of the people and cattle from the external threat and also, they act as advisors to the “Majong-wut” in regards to the general welfare of the entire community of the camp.” KII male, aged 18–49 years, Yirol West County

“Yeah, the role of a man in our Dinka culture is to look after the cows by taking them to the grazing land and protect them from possible raiders” KII male, aged 18–49 years, Tonj South County

Male youths also play a key role in migratory processes. They are cited as being responsible for, among other things, the identification of migration points/routes; the provision of security and protection to the livestock and to other members of the pastoralist community; the herding of livestock; and the identification of grazing lands with abundant water, pastures, and good security. Children aged 5–13 years were identified as being responsible for cleaning the areas where

livestock sleep; the milking of cows; and the grazing of calves, goats, and sheep.

“The role of the youth is accessing area where the cattle camp needs to be migrated to. They go and check if the place is safe and good for the cows. If the place is flooded, then they will not migrate to that side. If the place has good grass (pasture), then they will go. The youth also provide protection.” KII female, aged 18–49 years, Yirol West County

“Youth provide protection to the cattle camp; they are always deployed to the enemy territories to make sure that enemy do not have access to their animals. They also look after the cattle during grazing.” IDI male, aged 50 years and above, Kapoeta South County

“Their first work is to defend the people and cattle from external threats and the second they look after the cows if there is shortage of pastures and water, they are the one to report it to the leaders.” KII male, aged 18–49 years, Terekeka County

The study results indicate that decision-making capacity in migration groups is solely vested in male adults. The migration group leader/cattle camp chief, or “Majong-wut”, makes all the necessary decisions within the camps, in consultation with his deputies, the elders, and male youths. Male participants re-emphasized that women do not have any authority and that it is only men who are allowed to make any decisions. This is a clear indication of the patriarchal nature of relationships between men and women in pastoral communities. The programming for MDA in pastoralist groups should therefore take into consideration the gender and power relations between men and women, including harmful gender norms. Gender transformative programming should also be integrated in and health and NTD prevention programs targeting pastoralists.

## Factors that influence migrations

Study participants revealed that seasonal migrations are influenced by several factors, including the following.

### The search for water and pastures

Across the five study locations, migration was attributed to the limited supply of water and pastures. Our participants reported that, over the course of the year, water sources dry up and pastures become limited and that these factors trigger migration. However, our findings also indicate that sedentarization can occur when water and pastures become scarce. The search for water and pasture is a common characteristic of pastoralists across the region, and this has been cited by several scholars, including Gammino et al. (12), Kipuri and Ridgewell (23), and Wafula et al. (24).

“Yes, we do migrate to other places during the dry season because of lack of pastures and water; even as we speak now, we are planning to migrate to Waarchok in the border with Western Equatoria ... and another group will go up to Western Bahr el Ghazal State, looking for greener pastures.” FGD with males aged 18–49 years, Terekeka County

“Yes, there are times we do migrate to Western Bahr el Ghazal State during dry season to look for pastures for the cattle.” FGD with females aged 12–17 years, Tonj South County

## Insecurity and conflicts

Insecurity, conflicts, and cattle raiding emerged as key drivers of migration. Insecurity was attributed to armed political conflicts, intercommunal or ethnic tensions, cattle raids and internal conflicts within cattle camps, and disputes over grazing land and water points. South Sudan has for the past several decades been engulfed in conflicts and insecurity in both its pre- and post-independence eras (25), and this has contributed to increased pastoralist migrations, as well as to human displacement in general. In addition, cattle raiding is cited as a traditional practice among pastoralist communities in the country, notably between the Nuer, Dinka, and Murle tribes. The conflict is attributed to the proliferation of weapons, rising bride wealth rates, and the erosion of traditional constraints on cattle raiding (26). Conflicts, insecurity, and cattle raids are widespread, and, given the centrality of livestock to the South Sudanese economy, culture, and society, livestock is therefore a major driver of conflict.

“The conflict between Buya and Toposa who are used to raiding each other, causes constant migrations. The conflict is always there, unless the government puts more effort to stop it, nothing will change.” KII male, aged 18–49 years, Kapoeta South County  
“If there is a fight among pastoralists, we also migrate to another location.” FGD with females aged 12–17 years, Terekeka County

## Climatic factors

In the Yirol West, Tonj South, and Terekeka counties, study participants reported an increase in the occurrence of annual seasonal floods and, as a result, a change in pastoralists’ migrations. Study participants revealed that annual flooding occurs from the months of June to October, and that this results in the flooding of grazing lands, as well as an increase in both animal and human illnesses, subsequently forcing them to move. South Sudan has, in recent years, experienced severe flooding resulting from heavy torrential rains that has caused massive levels of displacement (27). In 2021, eight out of ten states were affected by flooding (28) and, in 2020, over 800,000 people were displaced by floods (28). In 2019, an estimated 908,000 people were affected (29) by flooding.

“They migrate when the area is flooded, infested by mosquitoes and diseases and when cattle are not healthy there will not be enough milk, hence causing hunger and other hunger related diseases” KII female, aged 18–49 years, Yirol West County

## Disease outbreaks

Our findings showed that disease outbreaks at cattle camps affecting both humans and animals are triggers for migrations. It was noted that these diseases cause death, and that their persistence

causes migrations to take place. In recent years, outbreaks of Rift Valley fever among livestock have been common in South Sudan (30):

“If there is disease outbreak in the area where the camp is, then the cattle camp is migrated to another location.” KII male, aged 18–49 years, Yirol West County

“When there is disease outbreak, the pastoralists migrate to where there is no disease.” KII male, aged 18–49 years, Tonj South County

“We have a lot of diseases here; sometimes there is a lot of malaria and the distance to Kapoeta is far.” FGD with females aged 18–19 years, Kapoeta South County

### Duration spent by pastoralists away from their homes of settlement

This study sought to establish the duration that pastoralists are away from their settlement to enable the national NTD prevention program to appropriately plan for MDA campaigns that are inclusive of pastoralist communities. Our findings revealed that pastoralists spend a minimum of 3, and a maximum of 9, months away from their settlements, and that this ultimately affects their participation in MDA campaigns. It was noted that the time away from settlements is influenced by factors that cause migrations, as reported above. The results indicate that the return to original settlements is phased, with women and children moving first, followed by men, and then by the elderly. Participants noted that the early return of women and children to their settlements is to enable the preparation of farmlands, as most farming activities are carried out by women.

“We spend October, November, December, January, February, March, April, and May away from our main base. We return to our home area in June.” IDI cattle camp elder, Yirol West County

“Yes, we came here in November and we shall stay till March; then, we shall go back to our villages to clear our farms to cultivate in April when rains begin.” FGD with males aged 12–17 years, Terekeka County

“We spend 4 months, that is from January to May, and when rains start, we return in June: slowly, not at once ... we bring some cattle closer to the villages.” FGD with males aged 18–49 years, Kapoeta South County

“We usually return at the start of the rainy season. When the first rain starts, we come back home to help our mothers in cultivation.” FGD with females, aged 12–17 years.

“Women go back after two to three months to start cultivation while the men will remain at the new cattle camp until rainy season when grass grows and enough water is available in the village” KII female, aged 18–49 years, Yirol West County

### Strategies for increasing pastoralists’ participation in MDA

#### Involvement of pastoralist leaders during planning and social mobilization activities

As MDA drugs are often, for several reasons, perceived negatively, study participants indicated that, for MDA to be successful,

pastoralist groups/cattle camp leaders must be involved in the planning and social mobilization activities of any MDA campaign. Pastoralist leaders are highly regarded and respected members of the community, and therefore their involvement in an MDA campaign builds trust in the quality and safety of MDA drugs.

“Aaah like in the village there, let the chiefs be involved so that people will say ahh let us also join in, because they have seen their elders participating in the MDA activities.” KII female, aged 18–49 years, Terekeka County

“What I think would motivate this community to be part of the MDA activities is to inform our leadership in the cattle camp to know what types of drugs are being given by Ministry of Health, how safe they are and for how long they will distribute.” IDI cattle camp elder, Tonj South County

“When we are informed through our chiefs or elders we shall fully participate; if the drugs are brought without their knowledge, no one will accept to swallow the drugs.” IDI cattle camp women’s representative, Tonj South County

### Engagement of pastoralist community members as community drug distributors

Study participants thought that, to improve the delivery of MDA to pastoralist groups, their own people (community members) should be recruited and engaged as community drug distributors (CDDs). According to study participants, this would increase community confidence in the safety of drugs distributed, and the number of people reached, as community members better understand the pastoralist migration routes. While it is recommended that MDA programs recruit CDDs from targeted communities or villages, this guideline is not always followed for pastoralist groups because of their mobility patterns, limited levels of education, and the failure on the part of program implementers to consistently apply the MDA protocols in all contexts. This study re-emphasizes the need to follow best practices.

“There is need for government also to recruit some community mobilizers from the cattle camps for us to be fully supported because most of these people selected from homes only move around the villages and when our cattle camps are far, they will not reach us from there.” KII male, aged 18–49 years, Tonj South County

### Provision of accurate information through participatory social behavior change approaches to NTDs

We found that inadequate information about the etiology of NTDs and preventive chemotherapy has frequently limited the participation of pastoralist groups in MDA programs. It was noted that information about the root causes of the diseases (i.e., NTDs) being treated, the rationale for the treatment, and the safety of drugs should be provided. This would dispel the various myths and misconceptions surrounding NTDs and MDA drugs. Social and

behavior change strategies for NTD interventions should therefore be more engaging for pastoralist communities to increase their knowledge of, and therefore their participation in, MDA.

“Our people cannot take the drug if it is not explained to them like what kind of disease can this drug prevent/cure, and why they are given the drugs without testing. Sometimes, you can explain to them and they will refuse taking it because there is no proof that they have the disease.” KII male, aged 18–49 years, Yirok West County

### Timing of treatment campaigns in congruence with the pastoralists’ seasonal migration patterns

Study participants indicated the need to strengthen the focus on pastoralist migration patterns, to address barriers to access to health services during the migration cycle, including the pre-departure phase (when they are planning to move), during transit (when on the move), at the destination (during their temporal stay in each host community), and upon return to their homelands to engage in cultivation. The planning and design of MDA and NTD prevention programs should consider these migratory dynamics, the migration cycle of migrants (right from the start and through to the process of return to their original homelands or communities). In addition, attention should be paid to relationships between migrating or mobile pastoralists and host communities, and how these are likely to affect the effectiveness of MDA and NTD prevention programs.

“For me the best thing to do is to always find us where we are, by having own people as drug distributors.” IDI elder male above 50 years, Jur River County

“We need to capture these people at all stages of their migration, before they leave, when they are in the cattle camps or when in their villages.” KII male, aged 18–49 years, Lakes

## Discussion

### Factors that influence pastoralists’ migration patterns

Our study findings indicate that the search for water and pastures, political insecurity, disease outbreaks, cattle raids, internal conflicts, and climatic factors such as flooding and drought are some of the major drivers of pastoralist migration in South Sudan. The search for water and pastures is a common migration influencer for pastoralist communities throughout the world, and this is in accordance with findings from other studies by Wafula et al. (24) and Njiru et al. (31) in Kenya, and Akapali et al. (32) in Ghana, that identified limited water and pastures as drivers of pastoralist migration (24, 31, 32). Wild et al. (33) reported that cattle raiding is a longstanding feature of many East African pastoralist societies, including those in South Sudan (33). The authors note that the ease of accessing firearms

and the incorporation of cattle raids into the larger political conflict in South Sudan have intensified violence to unprecedented deadly levels, thus contributing to migrations (34).

For MDA programs to meet the desired treatment thresholds in the pastoralist communities of South Sudan and similar settings, the timing of national NTD control and elimination programs needs to take into consideration pastoralist seasonal migration patterns and pastoralist leaders should be involved in planning and social mobilization activities.

### Strategies for increasing pastoralists’ participation in MDA

The UN’s Sustainable Development Goals’ global pledge to “leave no one behind” has elevated discussions on NTDs, with a focus on improving access to treatment among hard-to-reach communities, including pastoralists. Equally important, the WHO’s *Ending the neglect to attain the Sustainable Development Goals: A road map for neglected tropical diseases 2021–2030* has set new global targets and milestones to prevent, control, eliminate, or eradicate 20 NTDs, as well as cross-cutting targets aligned with the SDGs (1).

The findings of this study suggest that pastoralist communities are more likely take part in MDA campaigns if pastoralist leaders play a greater part in planning and social mobilization activities, and if pastoralist community members are engaged as CDDs. Other factors that may increase pastoralists’ participation in MDA are the provision of accurate information through participatory social behavior change approaches to NTDs; proper timing of treatment campaigns in congruence with the pastoralists’ seasonal migration patterns; and the addressing of negative perceptions around the medicines, including those around drug expiry and drugs causing impotence or side effects. Despite some of these strategies being highlighted in MDA implementation guidelines, adherence to the prescribed guidelines has remained a challenge for some program implementers. Numerous studies (35–37) have noted adherence to the MDA process as a key determinant of the success of MDA programs. There is considerable evidence to justify the involvement of local leaders and communities in MDA campaigns. The involvement of pastoralist leaders in planning, and the engagement of community members as CDDs, creates ownership of the program and collective community responsibility in championing the fight against NTDs, thereby resulting in higher levels of participation (38–40).

## Conclusion

Attaining the global goal of elimination of NTDs by 2030 requires continuous progress in the fight against NTDs at individual and country levels, while ensuring that special population groups, such as pastoralists, are involved in the planning and coordination of MDA campaigns. NTD prevention programs that work with pastoralist communities must consider pastoralist seasonal migration patterns when timing their treatment campaigns, and should involve pastoralist leaders in planning and social mobilization activities.



## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving human participants were reviewed and approved by the Ethics Committee of the Ministry of Health, South Sudan. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

## Author contributions

GM, JW, and MY supported the development of the concept note, proposal, and protocol of the research. MO and PB supported data collection and analysis. They were the principal investigators for this study. JA-E supported the writing and review of the manuscript. GS secured funding for the study, and carried out the review of the

manuscript. All authors contributed to the article and approved the submitted version.

## Funding

The study received financial support from the Christoffel Blinden Mission, through its Neglected Tropical Diseases Program.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

## References

- WHO. *Ending the neglect to attain the sustainable development goals a road map for neglected tropical diseases 2021–2030*. (2021) (World Health Organization, Geneva, Switzerland).
- Nina S, Amon JJ. Addressing inequity - neglected tropical diseases and human rights. (2018).
- Global Health. *Neglected tropical diseases (NTDs)*. Available at: <https://www.cdc.gov/globalhealth/newsroom/topics/ntds/index.html>.
- The END Fund. *The impact of NTDs*. Available at: <https://end.org/ntds-in-focus/> (Accessed 29th September 2021).
- Álvarez-Hernández DA, Rivero-Zambrano L, Martínez-Juárez LA, García-Rodríguez-Arana R. Overcoming the global burden of neglected tropical diseases. *Ther Adv Infect Dis* (2020) 7:2049936120966449. doi: 10.1177/2049936120966449
- Macfarlane CL, Dean L, Thomson R, Garner P. Community drug distributors for mass drug administration in neglected tropical disease programmes: systematic review and analysis of policy documents. *J Glob Health* (2019) 9(2):20414. doi: 10.7189/jogh.09.020414
- World Health Organization. *Crossing the billion: lymphatic filariasis, onchocerciasis, schistosomiasis, soil-transmitted helminthiasis and trachoma: preventive chemotherapy for neglected tropical diseases*. World Health Organization ([amp]]lrn;2017). Available at: <https://apps.who.int/iris/handle/10665/255498>.
- Joanne PW, Molyneux DH, Hotez PJ, Fenwick A. The contribution of mass drug administration to global health: pass, present and future. *Phil. Tans. R Soc B* (2014) 369:20130434. doi: 10.1098/rstb.2013.0434
- Engels D, Zhou X-N. Neglected tropical diseases: an effective global response to local poverty-related disease priorities. (2020). doi: 10.1186/s40249-020-0630-9
- . 'Ibid'.
- World Bank. *World bank boosts support for pastoralists in horn of Africa* (2014). Available at: [\(https://www.worldbank.org/en/news/press-release/2014/03/18/world-bank-pastoralists-horn-africa#:~:text=Recent%20estimates%20put%20the%20total,%20Saharan%20Africa%20\(SSA\)\)](https://www.worldbank.org/en/news/press-release/2014/03/18/world-bank-pastoralists-horn-africa#:~:text=Recent%20estimates%20put%20the%20total,%20Saharan%20Africa%20(SSA)) (Accessed 1st July 2022).
- Gammino VM, Diaz MR, Pallas SW, Greenleaf AR, Kurnit MR. Health services uptake among nomadic pastoralist populations in Africa: A systematic review of the literature. *PloS Negl Trop Dis* (2020) 14(7):e0008474. doi: 10.1371/journal.pntd.0008474
- Kaplan EH, Wein LM. Smallpox eradication in West and central Africa: Surveillance-containment or herd immunity? *Epidemiology* (2003) 14(1):90–2. doi: 10.1097/00001648-200301000-00021
- Forcier Consulting. *Pastoral education program study report, January 2009*. Available at: <https://winrock.org/wp-content/uploads/2017/02/ANNEX-4-RtL-PEP-Study-Report.pdf>.
- K4D UK Government's Department for International. *Development (DFID) livestock and conflict in south Sudan* (2018). Available at: [https://assets.publishing.service.gov.uk/media/5c6abdec40f0b61a22792fd5/484:Livestock\\_and\\_Conflict\\_in\\_South\\_Sudan.pdf](https://assets.publishing.service.gov.uk/media/5c6abdec40f0b61a22792fd5/484:Livestock_and_Conflict_in_South_Sudan.pdf).
- National Bureau of Statistics (NBS). *National baseline household survey 2009 report for south Sudan*. Available at: <https://reliefweb.int/sites/reliefweb.int/files/resources/NBHS%20Final%20website.pdf>.
- . 'Ibid'.
- South Sudan Ministry of Health. *Country neglected tropical diseases (NTD) master plan, 2022-2026*. Available at: [https://espen.afro.who.int/system/files/content/resources/SOUTH\\_SUDAN\\_NTD\\_Master\\_Plan\\_2016\\_2020](https://espen.afro.who.int/system/files/content/resources/SOUTH_SUDAN_NTD_Master_Plan_2016_2020).
- South Sudan Ministry of Health. *National master plan for neglected tropical diseases 2016 – 2020*. Available at: [https://espen.afro.who.int/system/files/content/resources/SOUTH\\_SUDAN\\_NTD\\_Master\\_Plan\\_2016\\_2020.pdf](https://espen.afro.who.int/system/files/content/resources/SOUTH_SUDAN_NTD_Master_Plan_2016_2020.pdf).
- A place where nomads (especially those in south Sudan) migrate to find pasture or a void flooded areas during rainy or dry seasons. (2006) ;18 (1):59–82. doi: 10.1177/1525822X05279903
- Guest G, Bunce A, Johnson L. How many interviews are enough? an experiment with data saturation and variability. *Field Methods* (2006) 18(1):59–82. doi: 10.1177/1525822X05279903
- Awinia CS. The sociology of intra-African pastoralist migration: The case of Tanzania. *Front Sociol* (2020) 5:518797. doi: 10.3389/fsoc.2020.518797
- Kipuri N, Ridgewell A. *A double bind: The exclusion of pastoralist women in the East and horn of Africa*. Minority Rights Group International (2008).
- Wafula WM, Wasonga OV, Koech OK, et al. Factors influencing migration and settlement of pastoralists in Nairobi city, Kenya. *Pastoralism* (2022) 12:2. doi: 10.1186/s13570-021-00204-6
- Idris I. *Livestock and conflict in south sudan. K4D helpdesk report 484*. Brighton, UK: Institute of Development Studies (2018).
- Ibid.
- UNOCHA. *Humanitarian needs overview south* (2021). Available at: [https://reliefweb.int/sites/reliefweb.int/files/resources/south\\_sudan\\_2021\\_humanitarian\\_needs\\_overview.pdf](https://reliefweb.int/sites/reliefweb.int/files/resources/south_sudan_2021_humanitarian_needs_overview.pdf).
- UNOCHA. *South Sudan humanitarian snapshot October 2021* (2021). Available at: [https://reliefweb.int/sites/reliefweb.int/files/resources/south\\_sudan\\_humanitarian\\_snapshot\\_october\\_2021.pdf](https://reliefweb.int/sites/reliefweb.int/files/resources/south_sudan_humanitarian_snapshot_october_2021.pdf).

29. UNOCHA. *South Sudan seasonal flooding update - 25 October 2019* (2019). Available at: [https://reliefweb.int/sites/reliefweb.int/files/resources/ss\\_20191025\\_seasonal\\_flooding\\_update.pdf](https://reliefweb.int/sites/reliefweb.int/files/resources/ss_20191025_seasonal_flooding_update.pdf).
30. Ramadan OPC, Berta KK, Wamala JF, Maleghemi S, Rumunu J, Ryan C, et al. Analysis of the 2017-2018 rift valley fever outbreak in yirol East county, south Sudan: a one health perspective. (2022).
31. Njiru BN. *Climate change, resource competition, and conflict amongst pastoral communities in Kenya*. Springer (2012). doi: 10.1007/978-3-642-28626-1\_24
32. Akapali M. *Seasonal variation in forage availability and grazing behavior of cattle in selected peri-urban areas in the northern region of Ghana* (2018). Master's Thesis, University for Development Studies. Available at: <http://udspace.uds.edu.gh:80/handle/123456789/1742> (Accessed 3 Dec 2020).
33. Wild H, Jok JM, Patel R. The militarization of cattle raiding in south Sudan: how a traditional practice became a tool for political violence. *Int J Humanitarian Action* (2018) 3:2. doi: 10.1186/s41018-018-0030-y
34. *ibid.*
35. Manyeh AK, Ibisomi L, Ramaswamy R, Baiden F, Chirwa T. Exploring factors affecting quality implementation of lymphatic filariasis mass drug administration in bole and central gonja districts in northern Ghana. *PLoS Negl Trop Dis* (2020) 14(8):e0007009. doi: 10.1371/journal.pntd.0007009
36. Krentel A, Fischer PU, Weil GJ. A review of factors that influence individual compliance with mass drug administration for elimination of lymphatic filariasis. *PLoS Negl Trop Dis* (2013) 7(11):e2447. doi: 10.1371/journal.pntd.0002447
37. Kumar A, Kumar P, Nagaraj K, Nayak D, Ashok L, et al. A study on coverage and compliance of mass drug administration programme for elimination of filariasis in udupi district, karnataka, India. *J Vector Borne Dis* (2009) 46:237-40.
38. Hodges MH, et al. High coverage of mass drug administration for lymphatic filariasis in rural and non-rural settings in the Western area, Sierra Leone. *Parasit Vectors*. (2010) 3:120. doi: 10.1186/1756-3305-3-120
39. Gyapong M, Gyapong JO, Owusu-Banahene G. Community-directed treatment: the way forward to eliminating lymphatic filariasis as a public-health problem in Ghana. *Ann Trop Med Parasitol* (2001) 95(1):77-86. doi: 10.1080/00034983.2001.11813617
40. Njomo DW, et al. Increasing coverage in mass drug administration for lymphatic filariasis elimination in an urban setting: a study of malindi town, Kenya. *PLoS One* (2014) 9(1). doi: 10.1371/journal.pone.0083413