

Registered Report Stage 1: Proposal

Climate Forecasting, Adaptation, and Legitimacy: Experimental Evidence from Turkana, Kenya *

(Author names removed for double-blinding)

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Abstract

This project will explore whether seasonal forecasts enable pastoralists to cope with long dry seasons in Turkana, Northern Kenya. This is a timely concern as the long dry season in East Africa is projected to become longer in a warming climate. (Wainwright et al., 2021) We also test whether integrating traditional knowledge produces more culturally appropriate information for greater impact in a context where people prefer forecasts from local seers and mistrust official scientific information. We will explore heterogeneous effects by gender, which shapes access to information and risk sharing networks, vulnerability to shocks, and potential short-term coping actions. This is crucial to understanding long-run adaptation. We will achieve this using an experimental evaluation of a feasibly scalable intervention co-created with local stakeholders and policymakers. Our project will test whether information reached households, whether it changed beliefs and desired actions, and finally whether it improved livelihoods and reduced losses.

Keywords

Climate adaptation, climate information, pastoralism, climate shocks, Kenya

JEL Codes

Study Pre-Registration

Study Pre-Registered on AEA RCT Registry as AEARCTR-0017480

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0.1 Proposed Timeline

The proposed timeline for this experiment is as follows, and is also presented in Figure 11. The timing is mostly decided by the March-April-May rainfall season, and when the KMD produces their climate information.

- January-February 2026: Collect baseline survey information
- February 2026: Prepare climate information outputs, as soon as the KMD has completed downscaling their forecasts for Turkana. These outputs will be shared with the CHVs, who will deliver this information to households by the end of February
- Late-March 2026: Begin collecting midline information on updates to expectations and intended coping actions
- June/July 2026: Collect endline data, during the dry period after the normal rainy period.

Reporting checklist for Stage 1 submissions

Section	Item	Description and details to report	Reported?	Page(s)
Cover page (required)	Title	Informative title specifying the study design, population, and interventions	✓	p.1
	Study pre-registration status	Link, registration identifier and registry name (or intended registry if not yet registered)	✓	p.2
Abstract (required)	Keywords	Up to six keywords, to be used for indexing purposes.	✓	p.1
	Abstract	Summarize research question, outcome variables, methodological framework and contribution in less than 150 words.	✓	p.1
Timeline (required)	Expected completion date	Expected date for completion of the pre-specified research design.	✓	p.2
Introduction	Background and relevance of the study	Brief overview of previous research, and relevance of the research question(s) for the field of economic development	✓	p.4
	Research question(s)		✓	p.5
Research design	Basic methodological framework	Outline of the identification strategy in your study (experimental/non-experimental)	✓	p.7
	Hypotheses	Pre-specified hypotheses to be tested in the study and reported as primary findings in the Stage 2 full manuscript	✓	p.9
	Outcome variable(s)	Definition of the main outcome variable(s) and (if applicable) secondary outcome variable(s)	✓	p.17
		Specification of how outcome(s) will be constructed from the dataset	✓	p.17
	Intervention(s)	Details of the intervention (when, where, how, by whom)	✓	p.12
		Number of treatment arms and whether they are exclusive or overlapping	✓	p.12
		Randomization strategy	✓	p.11
	Theory of change	Instructions and supporting materials for administering the intervention	✓	p.11
		How and why the intervention is predicted to lead to certain effects	✓	p.9
	Sample	Specification of unit of analysis (individuals, organizations, countries, etc.)	✓	p.8
		Data source(s)	✓	p.16
	Data collection and processing	Projected sample size and statistical power calculations	✓	p.21
Type of data, collection method/data source(s), and timeline for collection		✓	p.16	
Rule for terminating data collection / stopping rule				
Empirical analysis	Statistical method(s)	Main evaluation method(s) and underlying assumptions	✓	p.20
		Rules for handling missing values	✓	p.19
	Multiple hypothesis testing	Definition and rules for handling outliers	✓	p.21
		Strategies to prevent false positives	✓	p.22
	Heterogeneous effects	Anticipated heterogeneous effects and theoretical justification	✓	p.20
	Statistical model	A functional (mathematical) form of the causal mechanism explored in the study	✓	p.20
Specification if regression model is linear, generalized linear, or other		✓	p.20	
Pilot Analysis	Pilot Results	How will standard errors be calculated	✓	p.20
Pilot Analysis	Pilot Results		✓	p.23
Bibliography	Bibliography	References can be in any style or format as long as the style is consistent.	✓	p.24
Other items	Appendices	Tables and figures	✓	p.26

1 Introduction

Climate change poses a significant challenge for pastoralist groups in the Sahel as rainfall becomes more erratic and dry seasons become longer. Pastoralists are highly vulnerable as their livelihood depends on livestock who suffer during droughts when pasture is scarce. This scarcity of pasture can lead to risky and dangerous migration as well as other costly and dangerous forms of coping, including conflict. (McGuirk and Nunn, 2025) While pastoralists face significant risks from climate shocks, they also have a wide range of potential coping strategies, within their livestock herding lifestyle and in terms of alternative livelihoods. (Alfano and Gorchach, 2025) Despite this, the most common interventions with pastoralists to reduce livelihood loss and conflict are interventions to insure against losses (Gehring and Schaudt, 2024) or cash transfers to dampen the effect of livestock loss. There is relatively little work exploring whether early warning can enable the effective use of broad range of coping strategies in a timely manner to prevent significant livelihood loss in the first place. This is likely explained by the challenges preventing existing climate information systems from providing effective forecasts to pastoralists. These include practical barriers (language barriers, complexity of information, etc.) as well as dissonance with indigenous and traditional knowledge (*emurons* reading goats) common in the area.

Once common policy measure to deal with the severity of climate shocks facing pastoralist societies is index insurance, which has been shown to reduce conflict. (Gehring and Schaudt, 2024) These interventions, while effective, come with the risk of moral hazard induced unintended effects on conflict. (Jensen et al., 2025) In addition, as climate change becomes more serious and shocks become more severe, insurance may not be feasible when shocks become aggregate in nature. (Vanden Eynde and Vargas, 2025) In other contexts, such as Indian farmers, long-range forecasts have been shown to be an effective intervention to help households cope with shocks. (Burlig et al., 2024) In this project, we seek to test whether similar long-run seasonal forecasts can help pastoralists cope with climate shocks, and what actions people would like to take when well-informed.

There are several challenges to dissemination of climate information in arid and semi-arid lands in Sub-Saharan Africa, such as Turkana County in Northern Kenya. These range from practical issues to more subtle challenges of cultural legitimacy and trust. The practical issues include poor communication infrastructure and network coverage, along with lack of access to communication infrastructure. This means that information quite often arrives late, or via word of mouth. When this is the case, misinformation is quite common. Misinformation also occurs when people hear the forecast for all of Kenya or a different region and mistake it as the forecast for Turkana. In addition, most participants in our sample speak only Turkana, which offers a significant barrier to seasonal forecasts communicated in Swahili. Finally, traditional indigenous knowledge forecasters (known as *emurons*) are an important institution, which offers both the potential for improved dissemination and the potential for cultural barriers to trust and use of conventional scientific information.

In this project we partner with the Kenya Meteorological Department to randomly implement an intervention that overcomes these challenges in Turkana County, Kenya. We have designed our intervention to be easily scalable and to leverage existing government capacity in Turkana. We will deliver simple, easily-interpreted climate information

directly to households in the Turkana language using the network of Community Health Volunteers, present in nearly every village across Turkana. We will implement a second treatment arm to test whether integrating local indigenous and traditional knowledge increases the effectiveness of this intervention. This is related to the way that [Balán et al. \(2022\)](#) use local elites to increase state capacity, and we test whether this increases trust and take-up of forecasts. Our two major research questions are first, whether forecasts help pastoralists adapt and how, and second what is the effect of culture, tradition & indigenous knowledge in making scientific information more effective?

The plan for this project is to conduct baseline data collection in January-February 2026 to measure baseline expectations, intended actions and coping strategies, and past access to climate information. We will then conduct our intervention in February 2026 ahead of the rainy season expected to begin in March, clustered at the village level to reduce spillovers and align with collective decisionmaking units. We will then conduct a midline follow-up in late March 2026 to measure whether the interventions were implemented as intended, whether expectations changed, and whether households adjusted their intended coping strategies/actions. We will then conduct a followup in June/July 2026 to measure actual differences in actions taken and livelihood outcomes.

The theory of change is as follows. First, climate information needs to lead to a change in expectations. This change in expectations about seasonal conditions causes households to update desired actions. Then, households attempt to actually carry out these desired outcomes. These changes in actions/coping behaviours potentially lead to a change in livelihoods. Finally, the change in behaviours and change in livelihoods leads to improved wellbeing and less experience of hardship. We measure outcomes at each step of this causal chain to understand where any potential bottlenecks arise, whether it be households not having the capacity to enact their desired plans, or their coping actions not being effective, etc.

We also report here on the results of a small-sample pilot conducted in an earlier season. From this pilot, we found that the intervention successfully reached households and appears to have been trusted. The intervention appears to have shifted expectations closer to the KMD forecast (though not statistically significant in a small sample) and did significantly increase confidence in households' expectations about rainfall. We also found suggestive evidence that the pilot interventions shifted intentions over coping actions, with people who were initially pessimistic and received a good forecast being significantly more likely to report intention to take actions consistent with a good state of the world. In the pilot, the effect sizes for the hybrid group appear to be roughly twice as large as the conventional-only intervention.

In this project, we explore whether, and how, climate information and seasonal forecasts can enable anticipatory coping action in pastoralist communities in Turkana County in Northern Kenya. We also test whether blending indigenous and traditional knowledge with conventional science creates a more effective intervention. There has been significant investment in scientific capacity for modelling and forecasting of seasonal conditions, but this has not translated into significant impact for vulnerable groups due to challenges at the last mile of dissemination.

2 Context

This project is being implemented in Turkana County, Northern Kenya. Turkana is a hot and arid setting, with a temperature range between 21°C and 40°C and a mean temperature of 30°C. We focus our study on Turkana Central and Loima sub-counties, for security reasons.

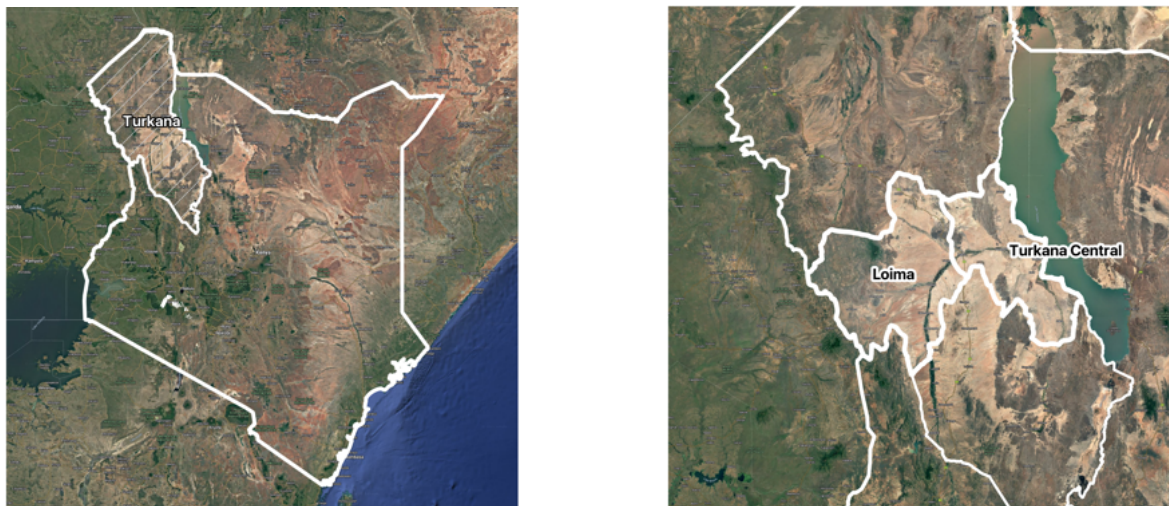


Figure 1: Turkana County

The primary livelihood in Turkana is pastoralism, with charcoal burning, agropastoralism, fisheries and mining being other important livelihoods practiced alongside pastoralism.

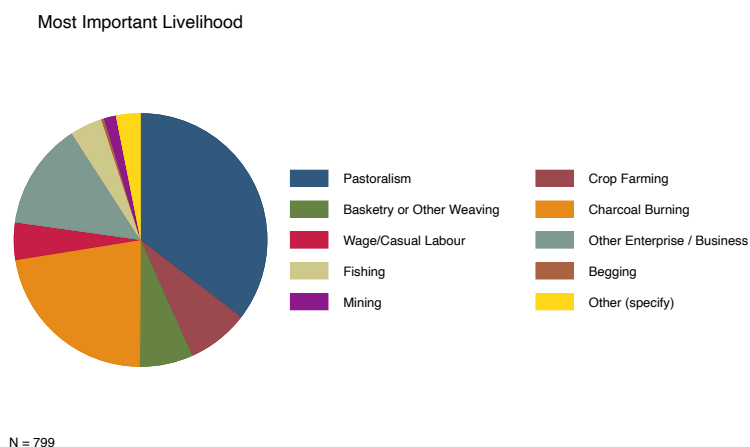


Figure 2: Most important livelihoods in rural Turkana.

Note: Source: Authors' calculation using survey data from sample.

There are several important features of the Turkana context that make the effective dissemination of climate information challenging. The first major challenge is the method of disseminating conventional scientific climate information and specifically seasonal forecasts. Many people in Turkana do not have cell phones, cannot afford network

fees, or do not have consistent network access. Many also do not own radios, or only have access to subscription-based radios that only function when subscription fees are paid. This lack of access to communication technology means that information from the Kenya Meteorological Department reaches communities slowly, passing through layers of government administrators down to the village level, or through word of mouth. This means that by the time information arrives, it is often too late to be useful. The reliance on radio also means that misinformation is a common issue, where people hear climate information for other parts of Kenya or the entire country, which may be quite different from the relevant conditions for Turkana. Another important issue is the language barrier for households that only speak Turkana. Most households in our sample report facing challenges understanding Swahili or English.

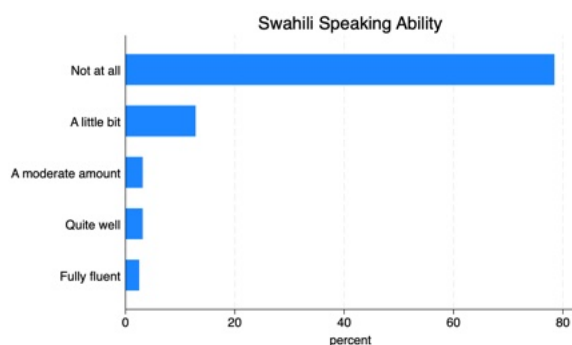


Figure 3: Swahili Fluency

Note: Source: Authors' calculation using survey data from sample in Turkana.

In addition to these practical dissemination issues, we find that in our sample of Turkana households, local traditional forecasters enjoy significant legitimacy. In particular, 43% of participants report that they prefer or are indifferent between information from the Kenya Met Department and information from local forecasters or *emurons*. This suggests that traditional information still has a role to play in terms of improving climate forecast dissemination, and suggests the potential that dissonance between traditional forms of information and conventional scientific information may present a barrier to take-up, trust, and use of seasonal forecasts.

2.1 Climate Shocks and Behavioural Adaptations in Turkana

Here we outline the different climate shocks that are frequent in Turkana and the ways they impact livelihoods. The most important characteristic of the season is the overall seasonal rainfall and the duration of the rainy season. The duration of the rainy season indicates both the amount of vegetation available for livestock to graze on and which crops can be grown during this period. Temperature is related to heat stress which impacts human and animal health. Greater heat stress makes animals less productive and less likely to give birth, while also negatively impacting agricultural yields and the difficulty of engaging in agricultural labour (Naqvi et al., 2012, Gupta et al., 2025, Yengoh and Ardö, 2020, Rahimi et al., 2021).

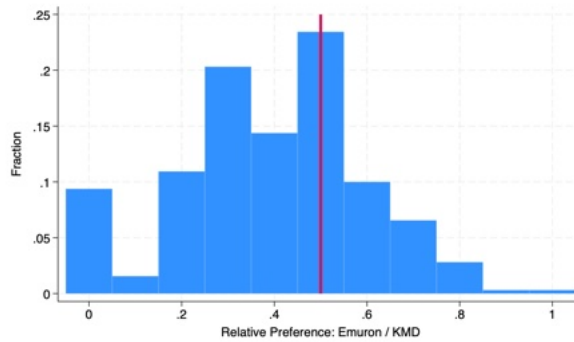


Figure 4: Relative Preference: Traditional or Conventional Scientific Information

Note: Source: Authors' calculation using survey data from sample in Turkana.

It is important to note that the October-November-December rains in Turkana were very poor, and it was nearly a failed season. For this reason, many households are already engaged in a number of hardship coping behaviours, such as having people far from the homestead grazing, reduced number of livestock, or reduced food consumption. Qualitative work post-intervention suggests that the main behavioural adaptation to a generally “good news” forecast is to switch away from these costly coping strategies, by bringing family members home, preparing the home livestock pens, and restocking their herds. This also includes other generally optimistic behaviours such as marrying sons and bringing in additional wives, deciding not to migrate this season, and borrowing money to increase food consumption in anticipation of higher incomes later. In this context in terms of livelihoods there is no such thing as too much rainfall, however very high rainfall (while improving livelihoods) does introduce the risk of flash floods. Generally, more rain is always good news in terms of pastoralism and agriculture but additional flood preparations are required.

Broadly speaking, more rainfall indicates a good state of the world, where households can expand their livestock and agriculture activities and shift away from secondary livelihoods such as charcoal burning, mining, fisheries, etc.

When households are aware of good news in advance, they are more likely to take actions that are consistent with a good state of the world for the two most climate-sensitive livelihoods of agriculture and pastoralism. Households are able to adapt by selling fewer livestock, restocking, keeping livestock at home instead of arduous and risky migration, and not travel as far for grazing migration. In terms of agriculture, households may expand production and shift to less drought-resistant crops that have a longer growing season. Given many households have some members of the household away, to cope with the poor OND season, another behavioural adaptation to good news is to bring these migrants home sooner.

3 Research Design

Our research project is designed to answer two broad research questions. The first is the major focus of this Registered Report, and the second is a more exploratory endeavour. The research questions are outlined in more detail below where we outline the hypotheses and data used to test them.

▷ **RQ1:** Do forecasts help pastoralists adapt? How?

▷ **RQ2:** What is the effect of culture, tradition & indigenous knowledge?

3.1 Experimental Sample

The eligible population for this sample follows a two-step sampling procedure. First, we sample villages within Turkana Central and Loima sub-counties within Turkana.

These villages are selected to be rural villages more than 30 minutes drive from the main city in Turkana (Lodwar). We define villages as being the catchment of a single Community Health Volunteer, where approximately ten villages are assigned to a local dispensary. The average village includes approximately 70 households.

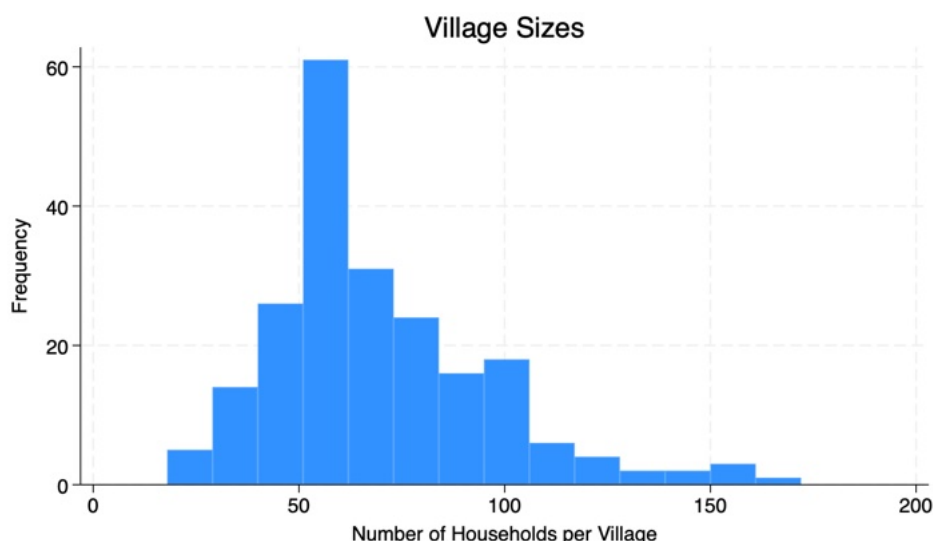


Figure 5: Distribution of village sizes

We then restrict our set of villages as follows. First, we rule out any villages that fall within urban centres. We then exclude any villages that are in areas of the county with active security concerns, both for concerns about the safety of the research team and practical issues regarding police curfews and roadblocks. We also prioritize villages where the survey team can feasibly travel from our main setup in Lodwar, therefore excluding areas where seasonal rivers and other natural barriers make travel by SUVs impossible. We then exclude areas where the local Community Health Unit was unavailable, due to lack of staff or other reasons. This is essential as the local Community Health Volunteers (CHVs) are essential for mobilizing and onboarding, as well as delivering the climate

information treatment. Community Health Volunteers are also an invaluable source of information on the location of villages as good, accurate village-level maps do not exist for Turkana. We worked with the CHVs to create hand-drawn maps for each dispensary catchment area, and then geo-coded these village blocks using ODK geopoints based on natural features. We use this to impose a buffer where we drop villages that are very close to one another, using an approximate minimum buffer distance of 1.5km between villages, as best as possible using the village location data described above.



Figure 6: Village Mapping

Within these villages we select households using a random walk procedure walking outwards with the CHV as a guide from the center of the village/settlement. The main restriction on selecting households is that we want to eliminate households with a salaried, non climate vulnerable profession. This means, for instance, excluding local teachers, chiefs, nurses, etc. to focus on households whose livelihoods are vulnerable to climate shocks and especially households engaged in pastoralism alongside other livelihoods.

The expected final sample size is 800 households in clusters of approximately 10 households per village for 80 villages. For some villages, despite our best efforts to map villages and ensure they are far enough apart to avoid spillovers, after baseline we noticed some were quite close. Wherever this occurred, we merged the two villages into a single cluster.

3.2 Descriptive Statistics and Balance

Baseline data collection has not yet begun, but the following descriptive statistics in Table 1 will summarize data from a partial baseline conducted in September 2025 before being interrupted by administrative issues. This table demonstrates the tests that will be used for balance using **simulated** treatments. We will conduct balance tests using regressions of the form

$$\text{AnyTreatment}_{iv} = \beta_0 + \mathbf{\Gamma}_{iv} + \varepsilon$$

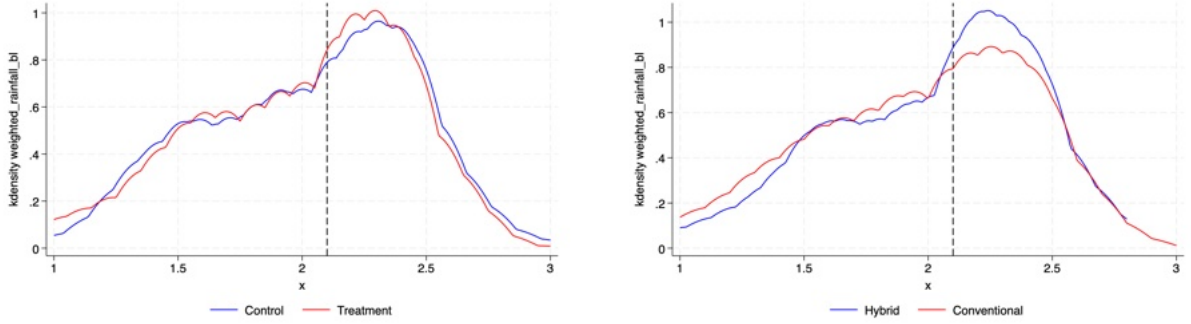
and then testing for the joint significance of the vector of baseline variables $\mathbf{\Gamma}_{iv}$. We will test this using linear regression models, logistic models, with/without strata fixed effects, and using randomization inference tests as well as frequentist for both the bundled

	Mean	Median	St. Dev	5th Petile	95th Petile	Num. Obs	Mean Ctrl	MeanTreat	pval AnyTreat	Rl pval anyTreat	Mean Conv	MeanHybrid	pval HybridConv	Rl pval HybridConv
Household Size	7.044	7.000	2.631	3.000	11.000	799	7.052	7.037	0.936	1.000	7.066	7.012	0.829	0.600
Polygonans (1/0)	0.332	0.000	0.471	0.000	1.000	799	0.335	0.329	0.851	0.900	0.347	0.313	0.433	0.600
Non-Thatch Roof (1/0)	0.219	0.000	0.414	0.000	1.000	799	0.213	0.224	0.714	0.600	0.221	0.226	0.885	1.000
Owns Phone (1/0)	0.814	1.000	0.390	0.000	1.000	799	0.816	0.811	0.860	1.000	0.817	0.807	0.779	0.900
Owns Radio (1/0)	0.270	0.000	0.444	0.000	1.000	799	0.283	0.261	0.492	0.400	0.254	0.267	0.735	0.800
Speaks Swahili (1/0)	0.237	0.000	0.425	0.000	1.000	799	0.227	0.243	0.599	0.500	0.207	0.276	0.086	0.100
Received Seasonal Forecast (1/0)	0.359	0.000	0.480	0.000	1.000	799	0.376	0.346	0.389	0.600	0.333	0.358	0.581	0.700
Pastoralism Most Important (1/0)	0.354	0.000	0.479	0.000	1.000	799	0.382	0.333	0.156	0.500	0.357	0.313	0.321	0.600
Livelihood: Pastoralism (1/0)	0.826	1.000	0.379	0.000	1.000	799	0.831	0.822	0.753	0.800	0.831	0.815	0.653	0.600
Livelihood: Crop Farming (1/0)	0.324	0.000	0.468	0.000	1.000	799	0.344	0.309	0.299	0.900	0.258	0.354	0.027	0.500
Livelihood: Charcoal Burning (1/0)	0.513	1.000	0.500	0.000	1.000	799	0.551	0.485	0.063	0.300	0.488	0.481	0.885	1.000
Livelihood: Other Enterprise / Business (1/0)	0.215	0.000	0.411	0.000	1.000	799	0.216	0.215	0.977	1.000	0.192	0.235	0.276	0.200
Total Number of Livestock (w5% top)	34.323	24.000	33.730	0.000	119.000	799	35.379	33.529	0.443	0.400	33.869	33.230	0.839	0.900
Total Livestock (TLU) (w5% top)	3.818	2.119	4.373	0.000	15.730	799	3.972	3.703	0.300	0.800	3.854	3.570	0.482	0.600
Total Livestock Intake (w5% top)	12.887	8.000	15.682	0.000	53.000	799	12.770	12.976	0.854	0.900	12.892	13.049	0.919	1.000
Total Livestock Offtake (w5% top)	26.613	14.000	33.106	0.000	104.000	799	27.385	26.033	0.368	0.600	27.268	24.351	0.435	0.600
Expected Rainfall: Lowest tercile (1/0)	0.334	0.000	0.472	0.000	1.000	799	0.321	0.344	0.485	0.600	0.366	0.325	0.358	0.600
Expected Rainfall: Middle tercile (1/0)	0.446	0.000	0.497	0.000	1.000	799	0.434	0.454	0.583	0.800	0.437	0.469	0.488	0.500
Expected Rainfall: Highest tercile (1/0)	0.220	0.000	0.415	0.000	1.000	799	0.245	0.202	0.146	0.300	0.197	0.206	0.820	0.800
Weighted Rainfall Expectation (z-score)	0.000	0.200	1.000	-1.700	1.388	799	0.038	-0.029	0.348	0.600	-0.084	0.020	0.272	0.300
Absolute Deviation from KMD Forecast (z-score)	0.000	-0.197	1.000	-1.400	1.808	799	0.005	-0.004	0.902	0.900	0.063	-0.062	0.198	0.400
Squared Deviation from KMD Forecast (z-score)	-0.000	-0.392	1.000	-0.768	1.902	799	-0.017	0.012	0.685	1.000	0.080	-0.047	0.207	0.600
Distribution Deviation from KMD Forecast (z-score)	0.000	-0.101	1.000	-1.427	1.943	799	0.010	-0.007	0.811	0.700	0.064	-0.070	0.165	0.300
Very Confident in Rainfall Expectation (1/0)	0.534	1.000	0.499	0.000	1.000	799	0.554	0.520	0.338	0.400	0.484	0.551	0.148	0.000
F-Test (Linear Reg)									0.955				0.964	
Chi2-Test (Logit Reg)									0.974				0.988	
Rl Test (Linear Reg)									1.000				1.000	
Rl Test (Logit Reg)									1.000				1.000	
F-Test (Linear, Strata Ctrls)									0.887				0.785	
Chi2-Test (Logit, Strata Ctrls)									0.927				0.841	
Rl Test (Linear, Strata Ctrls)									1.000				1.000	
Rl Test (Logit, Strata Ctrls)									1.000				1.000	

Table 1: Summary Statistics and Treatment balance Check

Note: Second panel includes tests of balance using F-tests for linear regressions, Chi2 for logit, and randomization inference equivalents of both.

comparison of all climate information groups against the control and for the two treatment arms against each other. These eight overall tests of balance are presented in the second panel of Table 1.



(a) Control

(b) All treatments

Note: Dashed line indicates Kenya Met Department forecast.

Figure 7: Expected Rainfall Level

3.3 Hypotheses

Theory of Change

The theory of change, and assumptions, underlying our policy innovation follows.

1. The first assumption is that households do not have sufficient early, high-quality seasonal climate information to plan adaptation/coping actions in advance. This includes both early long-term forecasts of seasonal conditions and information on the actions to take under a given state of the world. The second assumption is that there are actions that households **could** take if they had better information.

2. First, the intervention reaches households with information that a) they were not able to access before, b) is potentially different from their existing beliefs, and c) is more accurate than their existing information.
3. Second, this information will be trusted by participants, who will change their beliefs about the upcoming dry season to be closer to the information provided or, if their beliefs were already similar, their uncertainty will be reduced.
4. Third, this change in expectations will change perceived returns to different short-term coping actions.
5. Fourth, this change in desired climate coping actions will lead to a change in actual actions. A potential consequence of this is that livelihoods will meaningfully improve.
6. The fifth step is that this experience will lead to greater trust and willingness to engage with climate information initiatives.

Main Hypotheses

1. Hypothesis 1: Treatment households will be more likely to receive seasonal climate information.
2. Hypothesis 2: Treatment households will have expectations that are closer to the forecast they receive, and greater certainty in their expectations.
3. Hypothesis 3: Treatment households will have different desired coping actions, consistent with the new information they receive. (This will be tested at midline to see if information changed what households think the optimal actions are, even if they potentially aren't able to actually carry out the actions themselves.)
4. Hypothesis 4: Treatment households will have implement different behavioural adaptations, consistent with the new information they receive.
5. Hypothesis 5: Treatment groups will have better livelihood outcomes.

Secondary Hypotheses

1. Hypothesis 6: Treatment groups will have greater trust in forecasts and greater WTP for forecasts.
2. Hypothesis 7: The hybrid intervention will have a stronger effect on expectations than the conventional intervention alone.
3. Hypothesis 8: The treatment group will respond to the overall positive information on rainfall by increasing their self-reported optimism.
4. Hypothesis 9: Better climate information will lead to less mal-adaptation, namely charcoal burning, which is a livelihood of last resort that damages the ecosystem and reduces available foliage for browsing animals.

3.4 Methodological Framework

The overall methodology here is a clustered RCT, with treatment assigned at the village level. Randomization will be carried out after baseline data has been collected and will be stratified at the level of wards. To ensure a sufficient number of villages in each strata, some wards may be grouped together to form strata.

3.5 Interventions

The basic interventions in this project are two climate information interventions in partnership with the Kenya Meteorological Department and the Turkana County Government. These non-overlapping, mutually exclusive interventions have been designed to resolve the last-mile concerns described above, namely: timeliness, ease of comprehension, and language barriers. These interventions will be targeted at the village level to try and minimize spillovers of information from treatment to control and because of collective decisionmaking which is often within-village. One intervention relies on conventional information from the Kenya Meteorological Department (KMD) alone (henceforth the *conventional* treatment), while the other incorporates information and the traditions of indigenous knowledge producers (henceforth the *hybrid* treatment). We are working with the KMD to prepare metrics of past forecast performance to determine how accurate the underlying information is. There remains a potential concern that households may update their behaviour suboptimally if the underlying forecasts are inaccurate.

3.5.1 Conventional Treatment

To resolve these issues, we will be delivering a target climate information treatment, primarily from the Kenya Meteorological Department as well as other trusted conventional sources such as GHACOF (the Greater Horn of Africa Climate Outlook Forum) produced by the IGAD Climate Prediction & Applications Centre.¹ This intervention will be delivered directly to households in treated villages. We will be leveraging existing state capacity within the Turkana by partnering with the network of Community Health Volunteers/Promoters that exists in nearly every village across Turkana. These local volunteers are an ideal means of communication for a number of reasons. The CHVs are already placed in villages across Turkana with a manageable catchment of households, meaning they can quickly distribute information. Because they deliver information by walking around the village and going directly to households, they are able to overcome challenges of network and radio access. They are also experienced at communicating complex public health in an easily understood way, which means they are equipped to deliver other complex information in an accessible way. To further make KMD information understandable, we construct a series of simple infographics conveying the key information provided in the KMD seasonal forecast. All of this material is translated in to Turkana language (or *ngaturkan*) and we then train the CHPs so they understand the information and are easily able to explain it to households. The CHPs then conduct their household visits within days of us disseminating the information, visiting each household in the sample at least once to ensure all household members get access to the information.

¹GHACOF 72 for March-April-May 2026.

Using the CHV network is also ideal in terms of controlling spillovers, as each CHP covers a single village entirely assigned to a single treatment arm so there is reduced likelihood of them sharing information across arms.



Figure 8: Community Health Worker

The key pieces of information in this conventional treatment are as follows:

- KMD Expected level of rainfall as probabilistic forecast over “Below Average”, “Normal”, “Above Average”
- GHACOF Expected level of rainfall as probabilistic forecast over “Below Average”, “Normal”, “Above Average”
- Expected beginning of rainfall as probabilistic forecast over date ranges
- Expected cessation of rainfall as probabilistic forecast over date ranges
- Expected temperature as probabilistic forecast over “Below Average”, “Normal”, “Above Average”
- Coarse KMD map of expected spatial distribution of temperature across Turkana
- Detailed KMD map of expected spatial distribution of rainfall across Turkana
- Map of Vegetation Forecast produced by the PASSAGE project. [Barrett et al. \(2020\)](#)

The conventional treatment graphic information sheet is in Appendix [C.1](#).

3.5.2 Hybrid Treatment

As discussed above, in addition to climate information provided by the Kenya Meteorological Department, Turkana also has indigenous and traditional knowledge providers who are well-regarded within the community. We design an intervention to combine this traditional information with the conventional KMD information to test the additional benefit of hybrid indigenous-conventional knowledge. This will help identify whether indigenous information has greater trust and cultural legitimacy than providing conventional scientific information alone. This is of academic interest, in terms of understanding the role of culture, but is also of key policy importance as the Kenyan government's revised 2025 meteorology bill specifically mandates the inclusion of indigenous knowledge from communities such as the Turkana.



NATIONAL ASSEMBLY PASSES METEOROLOGY BILL, 2023

The National Assembly has approved the Meteorology Bill (Senate Bill No. 45 of 2023) after adopting amendments that will modernize Kenya's weather services while safeguarding indigenous knowledge and community rights institutional governance.

The Bill, considered in the Committee of the Whole House establishes the Kenya Meteorological Services Authority to replace the current department, with an independent Board anchored in law.

Clause 7 was amended to compel the Authority to integrate traditional and indigenous knowledge into weather forecasting through participatory scenario planning. The House also inserted a requirement for collaboration with the National Drought Management Authority (NDMA) in developing drought early warning systems.

"This ensures the science of weather prediction does not ignore the centuries-old wisdom of local communities," Hon. Musau told the House, as lawmakers cited examples of traditional forecasting methods among communities such as the Ogiek and Turkana.

Figure 9: Kenya Meteorology Bill - passed August 2025

The dominant form of indigenous information in Turkana comes from elders known as *emurons* who interpret signals from the natural environment as well as conducting goat auguries and reading intestines. We partner with these indigenous traditional knowledge (ITK) forecasters so we can include their knowledge alongside KMD forecasts in a hybrid intervention. The information set is the same as for the KMD forecast, but includes the indigenous alongside the conventional scientific information. To minimize uninformative differences between the two treatment arms, we first presented the KMD information to emurons so that they could aggregate this KMD forecast with their own information. To limit other differences between the two treatment arms, we ensure there are the same number of graphics and the same amount of information in the conventional and hybrid treatments, with the only difference being that the hybrid treatment includes the ITK information alongside the KMD information. We show that in both forecasts, the

information is broadly similar with normal/above normal being by far the most likely outcome, and one source selecting “Normal” as most likely and one selecting “Above Normal” as most likely. For both conventional/hybrid, the overall message is that normal/above normal is by far the most likely compared to a poor season with below average rain. The rainfall maps also present a very similar picture. Traditional forecasters do not forecast temperature, only rainfall, so temperature information comes only from the KMD.

- KMD & ITK Expected level of rainfall as probabilistic forecast over “Below Average”, “Normal”, “Above Average”
- KMD & ITK Expected beginning of rainfall as probabilistic forecast over date ranges
- KMD & ITK Expected cessation of rainfall as probabilistic forecast over date ranges
- KMD Expected temperature as probabilistic forecast over “Below Average”, “Normal”, “Above Average”
- KMD & ITK Map of expected spatial distribution of rainfall across Turkana
- Map of Vegetation Forecast produced by the PASSAGE project. [Barrett et al. \(2020\)](#)

The main challenge with integrating traditional and conventional information is that traditional information often takes a narrative oral format, describing the process of generating the information.² This means it is not normally provided in a quantitative manner that can be presented alongside the KMD forecasts. Given this information includes the process directly, it is also not feasible to have ITK forecasters convert the conventional scientific forecast into a traditional forecast by producing an analogous narrative, as the KMD forecasts from downscaled climate models could not be described in the same way. For this reason, rather than making the conventional forecasts look like a traditional forecast, we work with emurons to convert their traditional forecast into a probabilistic forecast using a quantitative proportional piling method of belief elicitation. This method is the same as that we use with participants, as described in more detail in section 4. We use the proportional piling method to gather a consensus from among the emurons as to their expectations over the level of rainfall and the likely start/end of the season’s rainfall.

This information is then presented alongside the conventional scientific information in graphics and associated script. This information is then delivered directly to households in treatment villages by CHVs, just as with the conventional treatment. The hybrid information handout is in Appendix C.3.

²For instance, an emuron’s communication of their forecast to others in their village would often begin with something like *We old men sat beneath the tree, and together we looked at the goat . . .*



Figure 10: Traditional Forecast Process

3.6 Timeline

The overall timeline for this experiment is as follows, and is also presented in Figure 11. The timing is mostly decided by the March-April-May rainfall season, and when the KMD produces their climate information.

- January-February 2026: Collect baseline survey information
- February 2026: Prepare climate information outputs, as soon as the KMD has completed downscaling their forecasts for Turkana. These outputs will be shared with the CHVs, who will deliver this information to households by the end of February
- Late-March 2026: Begin collecting midline information on updates to expectations and intended coping actions. The intention is that this will be collected prior to the onset of major rains to ensure the expectations we measure are not a realisation of actual outcomes.³
- June/July 2026: Collect endline data, during the dry period after the normal rainy period.

4 Data

The main data in this project is collected using surveys coded in ODK and hosted on the ONADATA platform. These surveys will be conducted by a team of skilled enumerators from Turkana County. These enumerators were rigorously selected on a number of criteria including: fluency in Turkana language and ability to discuss climate issues in ngaturkan, knowledge of traditional livelihoods in Turkana, experience with research projects and data collection, and experience using ODK survey tools. All enumerators have received

³We will also include fixed effects for the week in which midline data was collected in the list of control variables considered by Post-Double Selection Lasso to account for any timing effects of when midline was conducted.

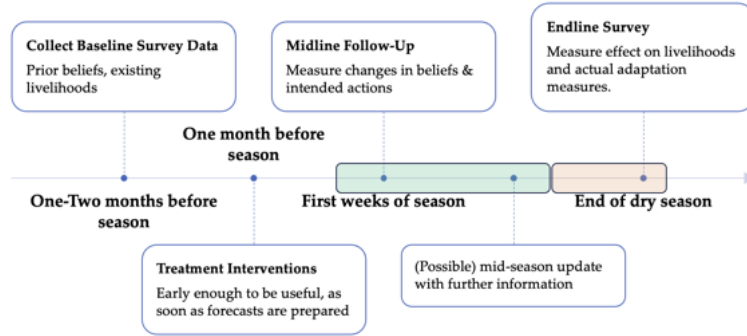


Figure 11: Experiment Timeline

at least 5 days of in-person and hybrid training and across pilot phases of this project have at least twelve days experience in the field collecting data using the survey tools in this project before baseline data collection begins. The baseline survey questionnaire is presented in Appendix E and the midline survey in Appendix F.

This data will be checked for quality in real-time and using backcheck phone surveys. In real-time we will conduct high-frequency checks at the end of every day, checking for enumerators who are spending too little time on sections, where GPS locations are not reasonable, where significant outliers are reported, where “don’t know / missing” answers are being selected, or when unusually few livelihoods are selected to decrease the number of loops. We will also conduct back-checks on questions where we anticipate stability in responses for approximately 5% of the sample.

We will use standard multiple choice and integer questions for most measures of outcomes and covariates. There are a few pieces of information where we depart from standard survey tools to fit our context better. The first is the fact that Turkana generally have low trust of people coming to ask about their livestock herds, given the general fear of raiding and livestock theft. For this reason, households are generally reluctant to give an exact number for the number of animals they own. We therefore instead ask about number of animals owned as a multiple choice selection from a number of bin-sizes, which respondents appear more comfortable answering. In our survey, given the importance of spatial data for migration and managing climate risks, we also make use of geopoints so that pastoralists can identify, using natural features like hills and rivers, where the other households in their extended family live, where they locate their agricultural plots and where they migrate for grazing. The final non-standard form of data we use is measuring expectations using proportional piling exercises. In these exercises, participants are given ten stones to allocate across mutually exclusive categories where more stones indicates greater likelihood of the event with zero stones allocated to a bin indicating certainty it will not happen and ten stones representing certainty it will happen. We use these proportional piling exercises to measure expectations over temperature and rainfall over the bins “below average”, “average / normal”, and “above average”. We also use them to indicate beliefs over the start/end of rainfall, where the bins are instead “early-[month]”, “mid-[month]”, and “late-[month]” indicating the first, middle, or last ten days of each month covering the expected rainfall season from March-June. The sheets with the bins used for this in the pilot are in Appendix F.1.

4.1 Data collection and processing

Refer to appendix E for the exact baseline questionnaire and appendix F for the midline questionnaire used to construct these outcomes.

1. Summary Stats & Descriptive Analysis of information

- (a) Distribution of expectations for rainfall, temperature, and timeline. Compare rainfall and temperature to KMD forecast. Confidence in expectations.
- (b) Livelihoods - income and distribution of income across livelihoods. Number of livestock converted into Tropical Livestock Units (TLU).
- (c) Demographics: Household sizes, location of other households, location of kraals
- (d) Climate Info: Trust, WTP, past bad experiences, access
- (e) Climate Anxiety

2. Outcome Category 1: Manipulation Check (Midline)

(a) Receiving climate information

This outcome is binary, recording whether the respondent answers Yes to survey question *“In the past 3 months have you gotten an official SEASONAL weather forecast (describing expected conditions for the entire March-April-May season) from the Kenya Meteorological Department?”*

(b) Understandable

This outcome is binary, recording whether the respondent answers Yes to the follow-up question *“Can you interpret this information?”*

(c) Timely

This outcome is binary, recording whether the respondent answers Yes to the follow-up question *“Do you get this information in a timely way?”*

(d) Specific source: CHP

This outcome is binary, recording whether the respondent answers Yes to the follow-up question *“Did this forecast come from a Community Health Worker / Promoter / Volunteer?”*

3. Outcome Category 2: Climate Expectations, Deviation from Forecasts and Confidence (Midline). We measure beliefs about the following: 1) Overall level of rainfall over the season (below/average/above) 2) overall temperature for the season (below/average/above) 3) timing of the start of the season (across 10 day windows) and 4) timing of the end of the rainfall season (across 10 day windows).

- (a) Rainfall level, temperature level, rainfall start/end – difference from forecast measured by: absolute deviation, squared deviation, distribution sqr dist for each.

From the proportional piling exercise, we construct the expected rainfall/temperature as follows:

$$\text{Expectation} = (\text{stones in "below average" pile}/10) * 1 + (\text{stones in "average" pile}/10) * 2 + (\text{stones in "above average" pile}/10) * 3$$

We construct the KMD forecast as

$$\text{ForecastKMD} = (\text{KMD Prob of Below Average}) * 1 + (\text{KMD Prob of Average}) * 2 + (\text{KMD Prob of Above Average}) * 3$$

We then construct absolute deviation as

$$\text{ForecastAbsDev}_i = \text{Expectation}_i - \text{ForecastKMD}$$

and squared deviation

$$\text{ForecastSqrDev} = (\text{Expectation}_i - \text{ForecastKMD})^2$$

We then construct distribution squared distance as

$$\begin{aligned} \text{ForecastDistSqr} = & (\text{stones in "below average" pile}/10 - \text{KMD Prob of Below Average})^2 \\ & + (\text{stones in "average" pile}/10 - \text{KMD Prob of Average})^2 \\ & + (\text{stones in "above average" pile}/10 - \text{KMD Prob of Above Average})^2 \end{aligned}$$

We also do the same for rainfall start / end, where start/end are measured over bins of early/mid/late for each month instead of 3 categories (below average / average / above average)

4. Outcome Category 3: Confidence in Beliefs (Midline)

- (a) Self-reported confidence on scale from 1-3 for expectations of rainfall level, temperature level, rainfall start/end. We binarize this for each of the four pieces of information, equal to 1 if the respondent answers “*Very certain about my answer*” when asked about confidence after giving their expectations.

5. Outcome Category 4: Desired Coping Actions (Midline)

- (a) Change in intended actions from baseline to midline.

For each of the possible multiple-choice options, we record whether the respondents binary (Yes/No) answer is the same at midline and baseline, and take the sum of changes to capture the degree of updating of adaptation plans. The full list of anticipatory actions/changes we ask about at both midline and endline is in Appendix B.1. Some of these actions were added only for midline, as they emerged during the qualitative data collection post-baseline.

- (b) Heterogeneity by baseline expectation: good news leads to more ‘good news’ adaptations, bad news to more ‘bad news’ adaptations. The list of actions in Appendix B.1 lists which ones are coded as good-state or bad-state.

Each intended action is measured by whether this action was selected as a response to a multiple choice question *“Have you, or are you planning to, take any of these actions this season?”* asked specifically about agriculture and specifically about pastoralism as well as responses to *“Which anticipatory actions have you taken or do you intend to take?”* for more general behaviours. We construct a set of “good-state” actions for pastoralism and agriculture, and a set of “bad-state” actions, which will be pre-registered prior to collecting midline data. For an index to capture adjustment of plans, we flip all the “bad-state” actions so a more positive value of the index means actions more oriented towards a good state of the world.

6. Outcome Category 5: Actual Coping Actions (Endline)

- (a) Heterogeneity by baseline expectation: good news leads to more ‘good news’ adaptations, bad news to more ‘bad news’ adaptations. The full list of actions is in Appendix B.1. For each, we will construct a backwards-looking measure of whether this action was actually taken at endline.

Each intended action is measured by whether this action was selected as a response to a multiple choice question *“Did take any of these actions this season?”* asked specifically about agriculture and specifically about pastoralism as well as responses to *“Which anticipatory actions have you taken or do you intend to take?”* for more general behaviours. We will complement this at endline with measures of whether these actions actually took place, with one pre-registered objective measure for each behaviour. We construct a set of “good-state” actions for pastoralism and agriculture, and a set of “bad-state” actions, which will be pre-registered prior to collecting midline data. For an index to capture adjustment of plans, we flip all the “bad-state” actions so a more positive value of the index means actions more oriented towards a good state of the world, and combine the self-reported behaviour with a measure of each behaviour where possible. All measures of numeric outcomes (such as land farmed, number of livestock purchased/sold, etc.) will be winsored at the highest 5%, as these variables appear to have a long right tail in the baseline data.

- (b) Livestock Responses: Livestock holdings in Tropical Livestock Units, winsored at top 5% and Livestock holdings in KSH value, winsored at top 5%, distance migrated, winsored at top 5%, whether migrated for grazing, timing of migration.
- (c) Agricultural Responses: Land farmed in acres, winsored at top 5%, inputs purchased in KSH, winsored at top 5%, share of drought-resistant crops by land.
- (d) Other livelihoods responses: investments in other livelihoods, winsored at top 5%, and whether started any new livelihood activities.

7. Outcome 6: Actual Livelihoods & Hardship (Endline)

- (a) Income from each of the following livelihoods (all winsored at top 5%): Livestock sales, livestock products (sale & own-consume), agricultural output (sale

& own-consume), Basketry or Other Weaving, Charcoal Burning, Wage/Casual Labour, Beekeeping / Apiculture, Other Enterprise / Business (NOT including basketry or charcoal burning), Fishing, Begging, Mining, Other (specify)

- (b) Index of other hardships, including climate-related losses to livelihoods, negative health shocks, and hardships related to migration including violence/extortion experienced and theft of livestock. We also ask about behaviours that capture herder-farmer conflict and the potential triggers for this type of conflict, including grazing on farmland.

8. Secondary Outcomes:

- (a) Trust in forecasts and opinion of the KMD (Midline)
- (b) Heterogeneity in expectations and actions by treatment arm - hybrid v. conventional (Midline)
- (c) Optimism Index (Midline)
- (d) Heterogeneity by sedentary v. transhumant pastoralists. The distinction between sedentary v. transhuman pastoralist households is not discrete or fixed, with households changing between migrating and non-migrating for a few years at a time, or with some household members being transhumant while others stay at home. As it might be difficult to have people self-identify as sedentary or transhumant, the best way to capture this is whether, at baseline, they reported having migrated for grazing in the previous March-April-May season.

4.2 Data Collection Timeline

We will first collect baseline data in January - February 2026. Randomization and treatment interventions will be implemented in early February, as soon as the KMD forecasts become available. This will be by February 10th at the latest, as per our MoU. We will then collect midline data, to be completed by the end of March, early-April. This data will then need to be cleaned and midline analysis will begin by the beginning of April. We will then collect endline data during the June-July 2026 dry season that follows the March-April-May rainy season.

5 Analysis

5.1 Statistical methods

This project will be analyzed using standard empirical methods for RCTs, with regression analysis carried out in Stata. For all regressions we will report standard significance tests as well as randomization inference p-values.

5.2 Empirical Specification / Statistical model

The empirical model for most of the main outcomes (manipulation check, expectation deviation from forecasts, and confidence in forecasts, livelihood outcomes) is as follows:

$$Y_{i,v,s,e} = \beta_0 + \beta_1 \cdot \text{AnyTreatment}_{i,v,s} + \Lambda_s + Y_{i,v,s,b} + \varepsilon_{i,v,s} \quad (1)$$

where AnyTreatment_i is an indicator variable for the respondent i in village v in stratum s having been randomly assigned to either a village receiving the (mutually exclusive) Conventional treatment or the Hybrid treatment, Λ_s is a stratum fixed effect, and $Y_{i,v,s,b}$ is the baseline value of the endline outcome. We will use Post-Double Selection Lasso to select additional covariates to include in the regression. Errors $\varepsilon_{i,v,s}$ are clustered at the village level, the unit of assignment.

For the next two outcomes, the effect of interest relies on the baseline value of expectations, to indicate whether a given forecast is ‘good’ or ‘bad’ news. The same forecast will have very different effects for different respondents depending on the direction it causes them to update their beliefs.⁴ We therefore use a different specification that accounts for this for outcomes representing behaviours/actions as follows:

$$Y_{i,v,s,e} = \beta_0 + \beta_1 \cdot \text{AnyTreatment}_{i,v,s} + \beta_2 \cdot \text{Pessimistic}_b + \beta_3 \text{AnyTreatment}_{i,v,s} \times \text{Pessimistic}_b + \Lambda_s + Y_{i,v,s,b} + \varepsilon_{i,v,s} \quad (2)$$

where AnyTreatment_i is an indicator variable for the respondent i in village v in stratum s having been randomly assigned to either a village receiving the Conventional treatment or the Hybrid treatment, Λ_s is a stratum fixed effect, and $Y_{i,v,s,b}$ is the baseline value of the endline outcome. We will use Post-Double Selection Lasso to select additional covariates to include in the regression. Errors $\varepsilon_{i,v,s}$ are clustered at the village level, the unit of assignment. Here Pessimistic_b is whether the respondent’s weighted expected rainfall fell below the median for the sample. The coefficient of interest here is β_3 , the coefficient for the interaction term. We expect this to be positive for actions taken in a good season, and negative for actions taken in a bad season. In a secondary piece of analysis, we will estimate a version of Equation 2 where we replace the binary Pessimistic_b variable with dummy variables for terciles of the prior expectation, as in [Burlig et al. \(2024\)](#).

For the final piece of our analysis, we seek to test whether the effect of the hybrid treatment (and the inclusion of indigenous traditional knowledge) leads to different effects than the conventional-only intervention. For this analysis, we return to a specification similar to Equation 1 but where we disaggregate the two (mutually exclusive) treatment arms as follows:

$$Y_{i,v,s,e} = \beta_0 + \beta_1 \cdot \text{ConventionalTreatment}_{i,v,s} + \beta_2 \cdot \text{HybridTreatment}_{i,v,s} + \Lambda_s + Y_{i,v,s,b} + \varepsilon_{i,v,s} \quad (3)$$

In this specification the test of interest is whether $\beta_1 = \beta_2$, to determine whether we can reject the null hypothesis that the two treatment arms had the same effect.

⁴In particular, we are measuring beliefs about the following: 1) Overall level of rainfall over the season (below/average/above) 2) overall temperature for the season (below/average/above) 3) timing of the start of the season (across 10 day windows) and 4) timing of the end of the rainfall season (across 10 day windows).

5.3 Statistical Power

We analyze statistical power as follows, using both standard tools for power analysis of RCTs and simulations for other outcomes. The study is well-powered to detect reasonable effect sizes smaller than those we find in the pilot results. These power calculations were conducted using baseline data and pilot effect sizes. All power calculations were conducted with a sample size of 800 households in clusters of size 10, with 1/3 in the control group and 1/3 in each treatment arm, using $\alpha = 0.05$. From the results in the table, we are confident the experiment is well-powered to detect economically meaningful effects in line with the effect sizes observed in the pilot. Where we do not observe pilot coefficients, for livestock owned and livestock added, the experiment is powered to detect an effect sized at just under 0.3 standard deviations.

Variable	Specification	Test H_0	ICC	MDE (80% power)	Simulated Effect Size	Simulated Power
Received Seasonal Forecast (1/0)	Equation 1	$\beta_1 = 0$	0.16	0.1611	0.55 (Pilot Coef)	1.00
Rainfall Expectation Very Confident (1/0)	Equation 1	$\beta_1 = 0$	0.07	0.1368	0.271 (Pilot Coef)	0.9999
Rainfall Deviation from Forecast (Abs. Value)	Equation 1	$\beta_1 = 0$	0.12	0.3099	-0.521 (Pilot Coef)	0.9971
Rainfall Deviation from Forecast (Squared)	Equation 1	$\beta_1 = 0$	0.14	0.3225	-0.377 (Pilot Coef)	0.9115
Rainfall Deviation from Forecast (SSD)	Equation 1	$\beta_1 = 0$	0.14	0.3183	-0.386 (Pilot Coef)	0.9317
Livestock Owned (in TLU, w5%, z-score)	Equation 1	$\beta_1 = 0$	0.10	0.2949	.	.
Livestock Added (in TLU, w5%, z-score)	Equation 1	$\beta_1 = 0$	0.14	0.2887	.	.
Plant More Land (1/0)	Equation 2	$\beta_3 = 0$	0.01	.	0.214 (Pilot Coef)	0.99
Migrate Less Far (1/0)	Equation 2	$\beta_3 = 0$	0.01	.	0.537 (Pilot Coef)	1.00
Plant More Land (1/0)	Equation 2	$\beta_3 = 0$	0.01	.	0.2	0.99
Migrate Less Far (1/0)	Equation 2	$\beta_3 = 0$	0.01	.	0.2	0.99
Rainfall Deviation from Forecast (Abs. Value)	Equation 3	$\beta_1 = \beta_2$	0.12	.	-0.371, -0.657	0.6637
Rainfall Deviation from Forecast (Squared)	Equation 3	$\beta_1 = \beta_2$	0.14	.	-0.099, -0.627	0.9862
Rainfall Deviation from Forecast (SSD)	Equation 3	$\beta_1 = \beta_2$	0.14	.	-0.132, -0.63	0.9777

Table 2: Power calculations

5.4 Multiple outcome and multiple hypothesis testing

We will minimize multiple hypothesis testing by creating a single weighted index for each of the 6 main outcomes in Section 4.1, where for intended and actual behaviours, the signs of actions will be flipped so that the index overall can be interpreted as a higher number being more good-state actions and fewer bad-state actions. For these six outcomes we will compute standard errors by using stepdown FWER and FDR p-values.

5.5 Heterogeneous Effects

One potentially important source of heterogeneity is between transhumant and sedentary pastoralists. We will therefore test for heterogeneity by whether the household reported at baseline that anyone in the household migrated for grazing in the previous season. For other heterogeneous effects, we will use the data driven Conditional Average Treatment Effect (CATE) methodology as in [Athey and Imbens \(2016\)](#), [Athey and Wager \(2018\)](#), [Athey and Wager \(2019\)](#).

6 Interpreting Results

If the coefficient for $\text{AnyTreatment}_{i,v,s}$ in equation 1 is positive and significant for outcome 1, we interpret this as evidence that the treatment had the intended effect and improved the delivery of seasonal climate information to households. This serves as a straightforward manipulation check to ensure that the interventions did successfully deliver climate information. Next, for hypothesis 2, we expect a negative effect of $\text{AnyTreatment}_{i,v,s}$, which would indicate that the intervention didn't just deliver climate information to households, but that this information actually had an effect on household expectations, and that it acted to *reduce* the gap between forecasts and expectations, measured in multiple ways. For hypothesis 3, we expect a positive and significant coefficient on $\text{AnyTreatment}_{i,v,s}$, which we interpret as climate information interventions leading to greater confidence in expectations. This is important as, even if expectations may not change if the forecast and the baseline expectations are similar, the forecasts may still increase the confidence people have in their expectations. We also expect a positive coefficient for $\text{AnyTreatment}_{i,v,s}$ on hypothesis/outcome 6, which corresponds to actual livelihood outcomes. We interpret this as meaning that the interventions improve information and that this improves livelihood outcomes and reduces negative shocks.

For hypothesis/outcome 4, we interpret the results of the interaction-term model Equation 2. Here we interpret a positive coefficient on $\text{AnyTreatment}_{i,v,s} \times \text{Pessimistic}_b$ as meaning that a good-news forecast made a given action/behaviour more likely. We therefore expect a positive effect on intentions to take good-state of the world actions like planting more land or migrating less far with herds, and a negative effect on intentions to take bad-state of the world actions like destocking. We interpret these results similarly for hypothesis/outcome 5, where at endline we measure the actual actions/behaviours to test if households were able to implement their intended plans as in hypothesis/outcome 4.

Finally, if we observe a significant difference between β_1 and β_2 in Equation 3, we will interpret this as evidence that the hybrid intervention had a different effect than the conventional treatment alone. If the effect of the hybrid intervention is larger, this would indicate that traditional knowledge has a beneficial effect over and above the conventional scientific forecasts.

7 Pilot Analysis

In Appendix A we present the results from a small-sample pilot conducted during the June-July-August short rains season which covers parts of Turkana. This was a small pilot including six villages and 72 households, with two villages assigned to each treatment arm. As this is only a pilot, with a small sample, the results should be interpreted with some significant reservations, but the overall pattern of results is consistent with our hypotheses and is encouraging for the main study.

First, in Table 3 we show the interventions were implemented as intended, with participants being significantly more likely to report receiving a seasonal forecast (by 55.8 percentage points, or *pp*), receiving a timely forecast (by 67.9 *pp*), and receiving a forecast they trusted (by 47.1 *pp*). These results all tell us that the intervention had a signifi-

cant effect on the likelihood of participants to have received quality seasonal climate information from the Kenya Meteorological Department and suggests that the intervention successfully resolved the barriers to access discussed above. In Table 4 we show that the interventions had a negative effect on the gap between household expectations and the KMD forecasts, which suggests that the information was trusted and was understood correctly by households, with expectations shifting closer to the forecasts they received. We also show this shift in expectations graphically in Figure 12 where the expectations of the treatment groups shift towards the forecast more than those of the control group. Next, in Table 5 we show an increase in the likelihood of respondents in the treatment groups to have self-reported high confidence in their expectations. Turning to Table 6, we look at how intention to carry out different coping actions for livestock and agricultural livelihoods change according whether the forecasts were good or bad news. Overall, the pattern of results appears sensible. For agricultural livelihood changes, the interaction term of $\text{AnyTreatment}_{i,v,s} \times \text{Pessimistic}_b$ had the strongest effects on the actions Planting More Land, Planting Earlier, and Other Action, leading to increases in all three. All of these are consistent with a scenario of households receiving good news, given that most of those who mentioned other actions described something related to land clearing or preparation. For pastoralism outcomes, by far the strongest effect of $\text{AnyTreatment}_{i,v,s} \times \text{Pessimistic}_b$ was on the action Migrate Less Far for Grazing. This too is consistent with a good news scenario, where people receive a positive forecast and anticipate that they will need to migrate less far than originally expected. Again, these are early-season self-reported intentions to do an action and, in the main study, we will follow up during the dry season after the rainy season to see whether households acted on these intentions and, if not, what prevented them from doing so. Finally, we show pilot results where the effect of the hybrid treatment on the expectation-forecast gap in rainfall is much larger in magnitude than the effect of the conventional treatment. This is, again, analysis of a small-sample pilot, but it does suggest that the hybrid treatment does have a larger effect on expectations and suggests that there is some additional benefit of blending conventional and scientific data in these interventions.

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A Pilot Results

Table 3: Manipulation Check

	Received Seasonal Forecast (1/0)	Received Timely Forecast (1/0)	Received Trusted Forecast (1/0)
Any Climate Info Treatment (1/0)	0.558 (0.088)***	0.679 (0.155)***	0.471 (0.137)**
Control mean	0.333	0.190	0.333
Num. Observations	67	67	67
R^2	0.330	0.440	0.212

Note: Outcomes are binary, coefficients are percentage points linear probability. Standard errors clustered at village level. These results indicate that the interventions successfully reaches households, in a timely and trustworthy manner.

Table 4: Expectations

	Abs. Value (Expectation - Forecast)	(Expectation - Forecast) ²	Difference in Distributions
Any Climate Info Treatment (1/0)	-0.521 (0.566)	-0.377 (0.599)	-0.375 (0.536)
Num. Observations	67	67	67
R^2	0.069	0.032	0.039

(a) Deviation of Rainfall Expectation from Forecast

	Abs. Value (Expectation - Forecast)	(Expectation - Forecast) ²	Difference in Distributions
Any Climate Info Treatment (1/0)	-0.393 (0.562)	-0.407 (0.536)	-0.382 (0.573)
Num. Observations	67	67	67
R^2	0.089	0.120	0.065

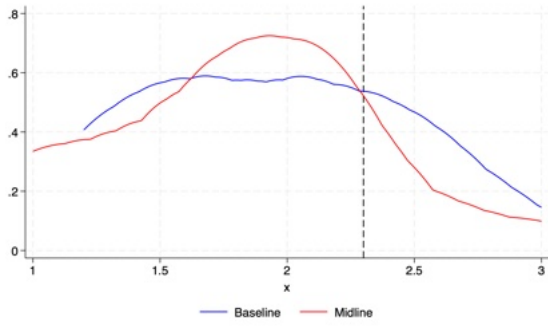
(b) Deviation of Temperature Expectation from Forecast

Note: All outcomes standardized, coefficients interpreted as standard deviations. Control: baseline value of outcome. Standard errors clustered at village level. These outcomes all measure in different ways the distance between household expectations and the KMD's probabilistic forecast of rainfall/temperature level. These results suggest that the pilot intervention did close this gap, but is not statistically significant for this sample size.

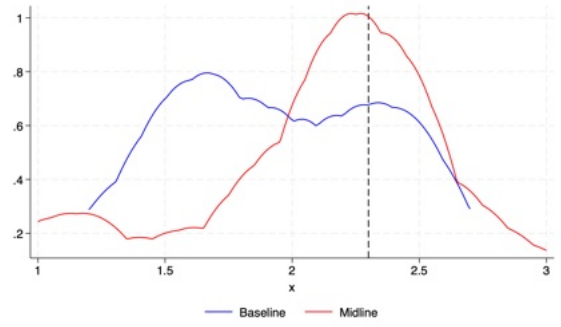
Table 5: Confidence in Expectations

	High Confidence in Rainfall Expectation (1/0)	High Confidence in Temperature Expectation (1/0)
Any Climate Info Treatment (1/0)	0.271 (0.095)**	0.115 (0.189)
Control mean	0.381	0.429
Num. Observations	67	67
R^2	0.064	0.011

Note: Outcomes are binary, coefficients are percentage points linear probability. Standard errors clustered at village level. These results indicate binary outcomes for whether a respondent self-reported the highest of three options for their confidence in rainfall/temperature expectations. These results suggest a large positive effect of the intervention on confidence in expectations.



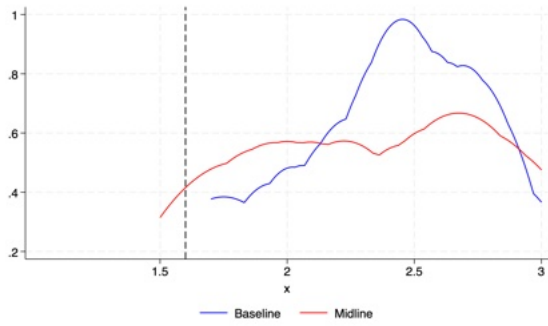
(a) Control



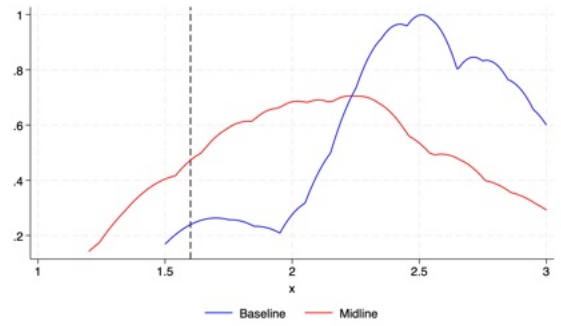
(b) All treatments

Figure 12: Expected Rainfall Level

Dashed line indicates Kenya Met Department forecast.



(a) Control



(b) All treatments

Figure 13: Expected Temperature Level

Dashed line indicates Kenya Met Department forecast.

Table 6: Intended/In-Progress Actions

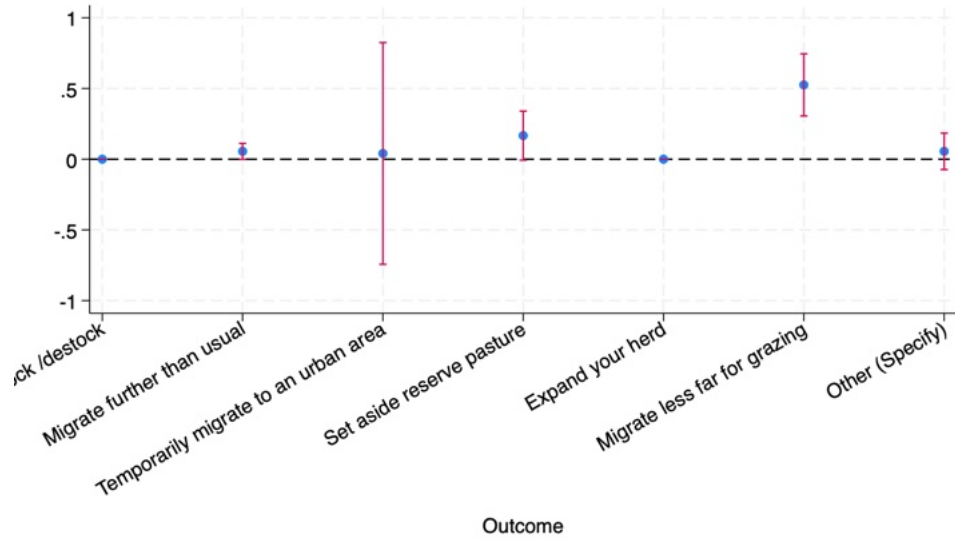
	Plant different crops	Plant less land	Plant more land	Plant earlier	Plant later	Invest in irrigation	Other Change
Treatment \times Pessimistic	-0.060 (0.103)	0.018 (0.097)	0.214 (0.064)**	0.407 (0.186)*	0.200 (0.125)	0.433 (0.223)	0.175 (0.057)**
Any Climate Info Treatment (1/0)	-0.136 (0.141)	0.000 (0.162)	0.000 (0.045)	-0.318 (0.271)	-0.182 (0.149)	-0.273 (0.225)	0.182 (0.101)
Pessimistic (1/0)	-0.102 (0.094)	-0.239 (0.023)***	-0.273 (0.013)***	-0.420 (0.062)***	-0.148 (0.049)**	-0.239 (0.100)*	0.000 (0.000)
Constant	0.727 (0.130)***	0.364 (0.078)***	0.273 (0.013)***	0.545 (0.169)**	0.273 (0.130)*	0.364 (0.208)	0.000 (0.000)
Control mean	0.684	0.263	0.158	0.368	0.211	0.263	0.000
Num. Observations	55	55	55	55	55	55	55
R^2	0.043	0.063	0.051	0.100	0.036	0.080	0.138

(a) Agriculture

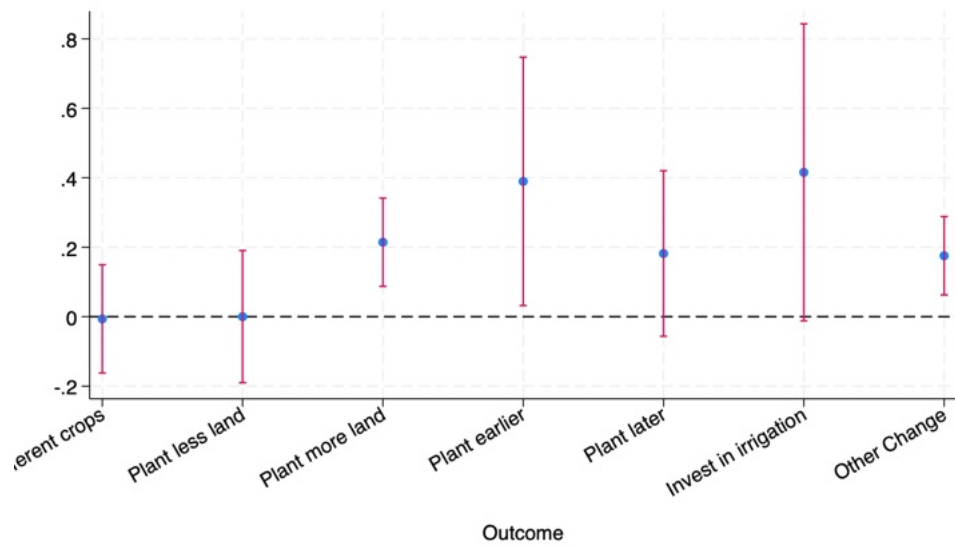
	Destock	Migrate further	Temporarily migrate to urban	Set aside reserve pasture	Expand herd	Migrate less far	Other
Treatment \times Pessimistic	0.000 (0.000)	0.056 (0.028)*	0.070 (0.394)	0.167 (0.087)	0.000 (0.000)	0.537 (0.105)***	0.056 (0.065)
Any Climate Info Treatment (1/0)	0.000 (0.000)	-0.000 (0.000)**	-0.292 (0.131)*	0.000 (0.000)	0.000 (0.000)	-0.426 (0.139)**	-0.000 (0.000)
Pessimistic (1/0)	0.000 (0.000)	-0.000 (0.000)***	-0.152 (0.388)	-0.167 (0.087)	0.000 (0.000)	-0.470 (0.022)***	-0.000 (0.000)
Constant	0.000 (0.000)	0.000 (0.000)	0.818 (0.039)***	1.000 (0.000)	0.000 (0.000)	0.636 (0.065)***	0.000 (0.000)
Control mean	0.000	0.000	0.765	0.941	0.000	0.471	0.000
Num. Observations	54	54	54	54	54	54	54
R^2	.	0.038	0.080	0.151	.	0.129	0.038

(b) Pastoralism

Note: All outcomes standardized, coefficients interpreted as standard deviations. Control: baseline value of outcome. Standard errors clustered at village level. The key coefficient here is the coefficient on the interaction term Treatment \times Pessimistic which captures the effect of being in either treatment group and also being someone whose expected rainfall was below the mean. The forecast for the pilot season was relatively positive, so these suggestive results indicate that, as one would expect, households who received good news adjusted their plans towards actions taken in the good state of the world, like migrating less far, planting more land, or planting earlier.



Note: Outcomes are binary, coefficients are percentage points likelihood of taking that action. Standard errors clustered at village level. Coefficient presented is β_3 from: $Y_i = \beta_0 + \beta_1 \text{Pessimistic}_i + \beta_2 \text{AnyTreat}_i + \beta_3 \text{Pessimistic}_i \times \text{AnyTreat}_i + \varepsilon_{i,v}$



Note: Outcomes are binary, coefficients are percentage points likelihood of taking that action. Standard errors clustered at village level. Coefficient presented is β_3 from: $Y_i = \beta_0 + \beta_1 \text{Pessimistic}_i + \beta_2 \text{AnyTreat}_i + \beta_3 \text{Pessimistic}_i \times \text{AnyTreat}_i + \varepsilon_{i,v}$

Table 7: Results: Hybrid v. Conventional

	Abs. Value (Expectation - Forecast)	(Expectation - Forecast) ²	Difference in Distributions
Conventional Treatment (1/0)	-0.371 (0.650)	-0.099 (0.695)	-0.132 (0.533)
Hybrid Treatment (1/0)	-0.657 (0.541)	-0.627 (0.541)	-0.630 (0.541)
Conventional = Hybrid			
pvalue	0.489	0.299	0.140
F	0.542	1.291	2.885
Num. Observations	67	67	67
R ²	0.081	0.072	0.076

Note: All outcomes standardized, coefficients interpreted as standard deviations. Control: baseline value of outcome. Standard errors clustered at village level. Here we unbundle the two mutually exclusive treatment arms and run a ‘horse-race’ regression, testing whether the treatment effects are different. While not statistically significant, from this pilot intervention it appears that a hybrid indigenous-conventional forecast has a larger effect to reduce the gap between expectations and KMD forecast of rainfall level.

B Anticipatory Actions/Changes

Here we list all the specific actions we ask about, including which are coded as good or bad - state actions.

- General Household
 - Reduce the number of meals eaten each day (bad state action)
 - Request more food aid (bad state action)
 - Rely on assistance from others (bad state action)
 - Pull children otherwise in school, out of school (bad state action)
 - Increase non-livestock livelihoods (bad state action)
 - Decrease non-livestock livelihoods (good state action)
 - Increase livestock livelihoods (good state action)
 - Decrease livestock livelihoods (bad state action)
 - Produce and sell more charcoal (bad state action)
 - Produce and sell less charcoal (good state action)
 - Send family members to look for work elsewhere (bad state action)
 - Bring family members back from elsewhere (good state action)
 - Did not do anything different
 - Buy more food on credit (good state action)⁵
 - Buy less food on credit (bad state action)
 - Rely more on others (bad state action)
 - Rely less on others (good state action)
 - Keep children in school (good state action)
 - Pull children out of school (bad state action)
 - Clear waterways and prepare home for flood (good state action)
 - Repair roof & prepare for heavy rainfall (good state action)
 - Marry daughters earlier than planned for bridewealth (bad state action)
 - Pay dowry/bridewealth and add wives for men in your family (good state action)
 - Gather and store firewood, fuel, or charcoal (good state action)
 - Buy mosquito nets (good state action)
 - Move home to higher ground, further from river (good state action)

⁵While buying more food on credit may seem counterintuitive as a good state action but in this context, where the October-November-December rains performed very poorly, buying more food on credit can be a sign of optimism and confidence in the season, as well as a way to smooth consumption and avoid negative coping actions like reducing meals or relying on others.

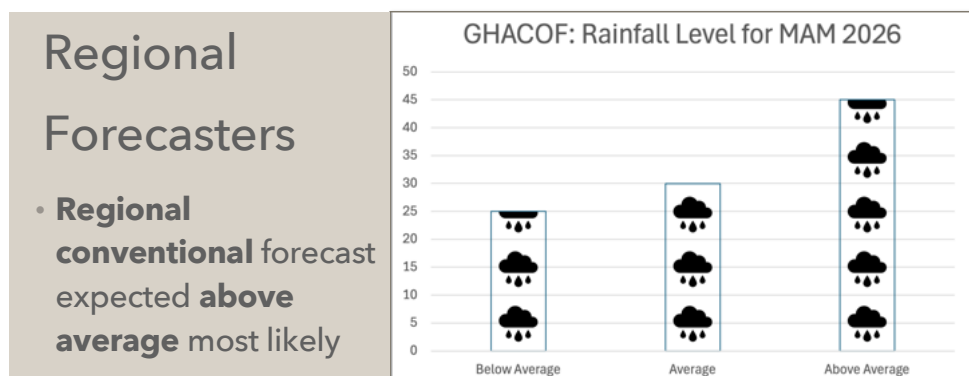
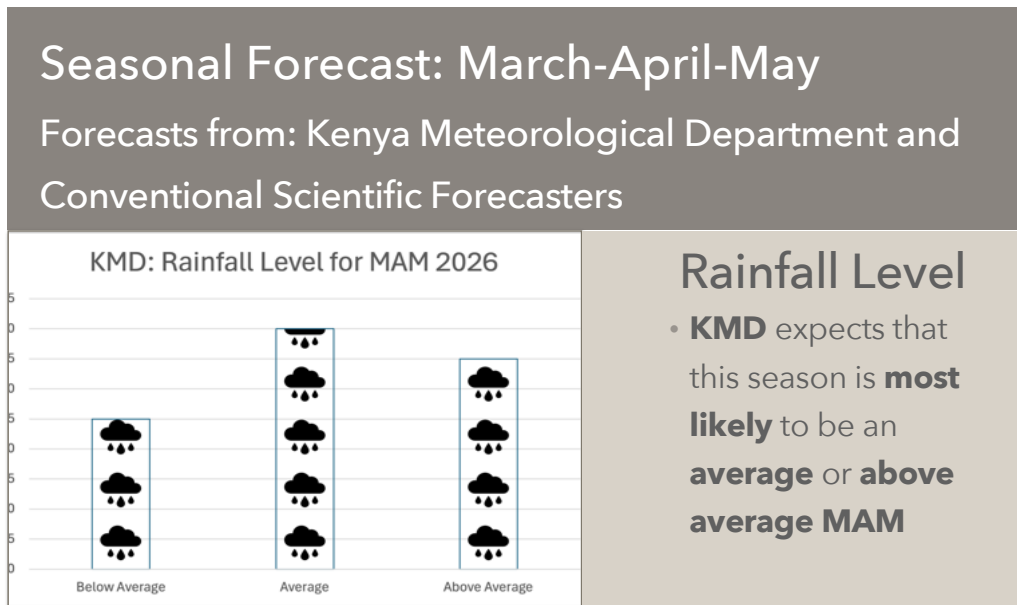
- Move home closer to the river (bad state action)
- Pastoralism
 - Migrate further (bad state action)
 - Migrate less (good state action)
 - Sell more livestock (bad state action)
 - Sell fewer livestock (good state action)
 - Slaughter more livestock
 - Slaughter less livestock
 - Buy more forage or water (bad state action)
 - Buy less forage or water (good state action)
 - Buy more veterinary services (bad state action)
 - Buy less veterinary services (good state action)
 - Visit intended migration areas for planning / negotiation (bad state action)
 - Store animal feeds
 - Reserve grass for grazing when dry (bad state action)
 - Plan migration to far places (e.g. store food, etc.) (bad state action)
 - Plant fodder crops (bad state action)
 - Shift to more drought-tolerant animals (bad state action)
 - Collect livestock feeds (good state action)
 - Repair Livestock Pens at Homestead (good state action)
 - Restocking / increase herd size (good state action)
 - Destocking / decrease herd size (bad state action)
 - Any migration (bad state action)
 - Distance of migration target from homestead (further = bad state action)
 - Duration of migration (longer = bad state action)
 - Timing of migration (later = good state action)
- Agriculture
 - Plant more drought-resistant crops (bad state action)
 - Plant less drought-resistant crops (good state action)
 - Start preparing farm earlier than usual (good state action)
 - Start preparing farm later than usual (bad state action)
 - Start planting earlier than usual (good state action)
 - Start planting later than usual (bad state action)
 - Prepare/invest in irrigation

- Clear extra land (good state action)
- Plant more land (good state action)
- Plant less land (bad state action)
- Buy more planting materials (good state action)
- Buy less planting materials (bad state action)
- Grow more fodder crops for animals
- Grow fewer fodder crops for animals
- Shift land from food production to fodder/pasture
- Shift land from fodder/pasture to food production
- Move farms closer to the river (bad state action)
- Move farms further from the river (good state action)
- Borrowing & Saving:
 - Save more money (bad state action)
 - Save less money (good state action)
 - Borrow more money (good state action)
 - Borrow less money (bad state action)
- Migration:
 - Current urban migrants return dates closer (good state action)
 - Current rural migrants return dates closer (good state action)
 - Current rural (grazing) migrants return dates closer (good state action)

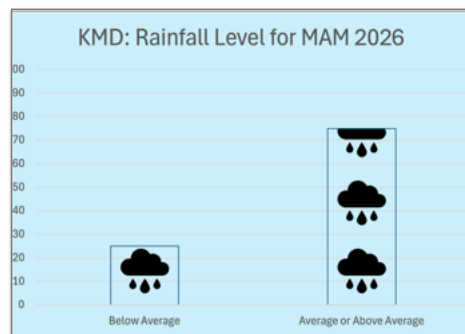
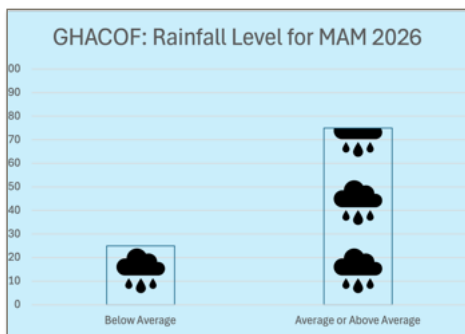
B.1

C Main Study Handouts

C.1 Main Study Conventional Handout

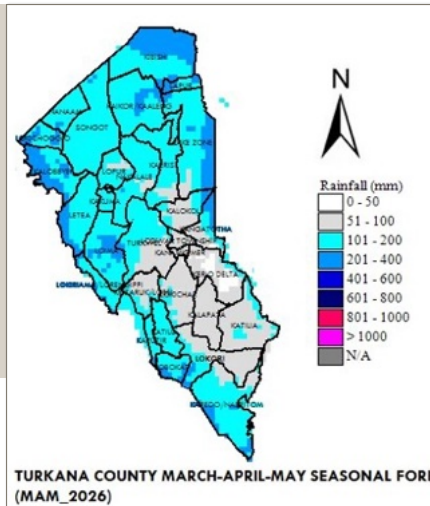


• **Regional** and **KMD** forecasters agree that **Average** or **Above Average** is far more likely than **Below Average**



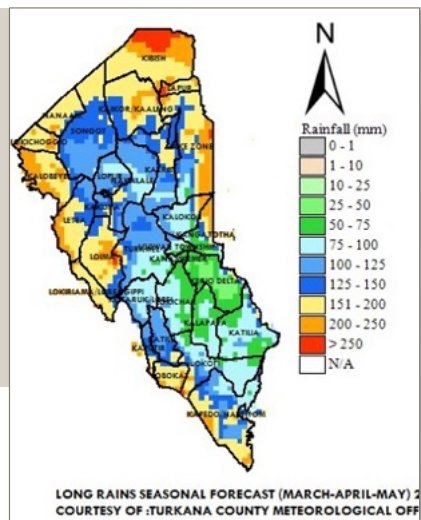
Rainfall Distribution

- The west of Loima County has high predicted rainfall
- Areas along the borders of Turkana are predicted



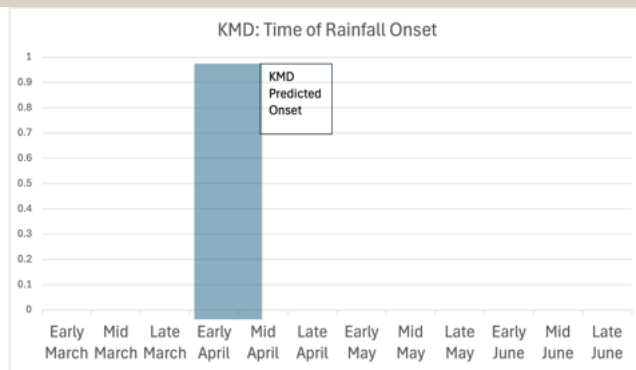
Detailed Rainfall

- Weaker rainfall in central parts of Turkwel into Kerio
- Some parts of Loima have heavy rainfall



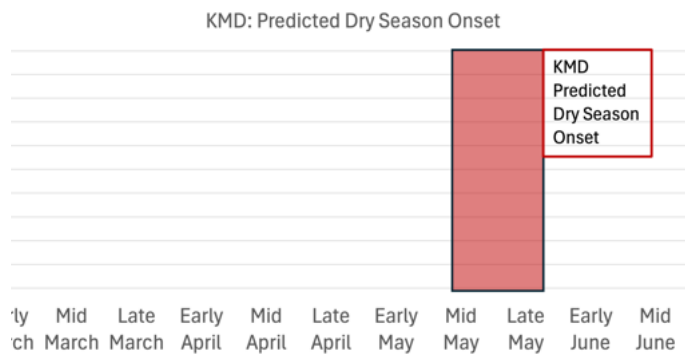
Rainfall Onset

- **KMD** expects first week of consecutive rains in **first** or **second** week of April



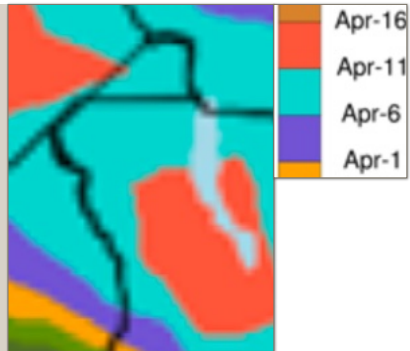
Dry Season Onset

- **KMD** expects **major rains** to end in **third** or **fourth** week of May



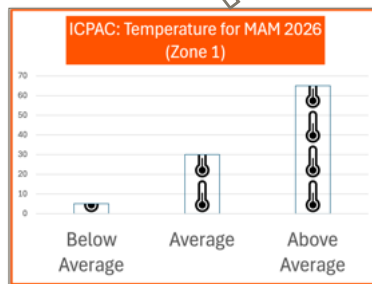
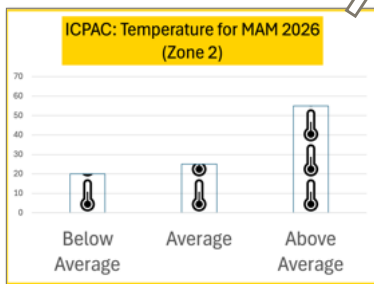
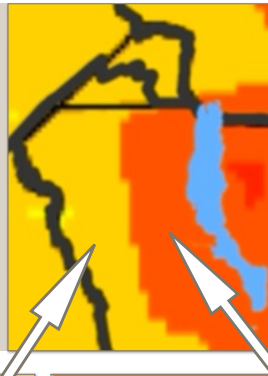
Regional Forecast of Rainfall Onset

- Regional Forecast also predicts most of Turkana to have onset between April 6-11
- Closer to the Lake onset between April 11-16



Regional Forecast of Temperature

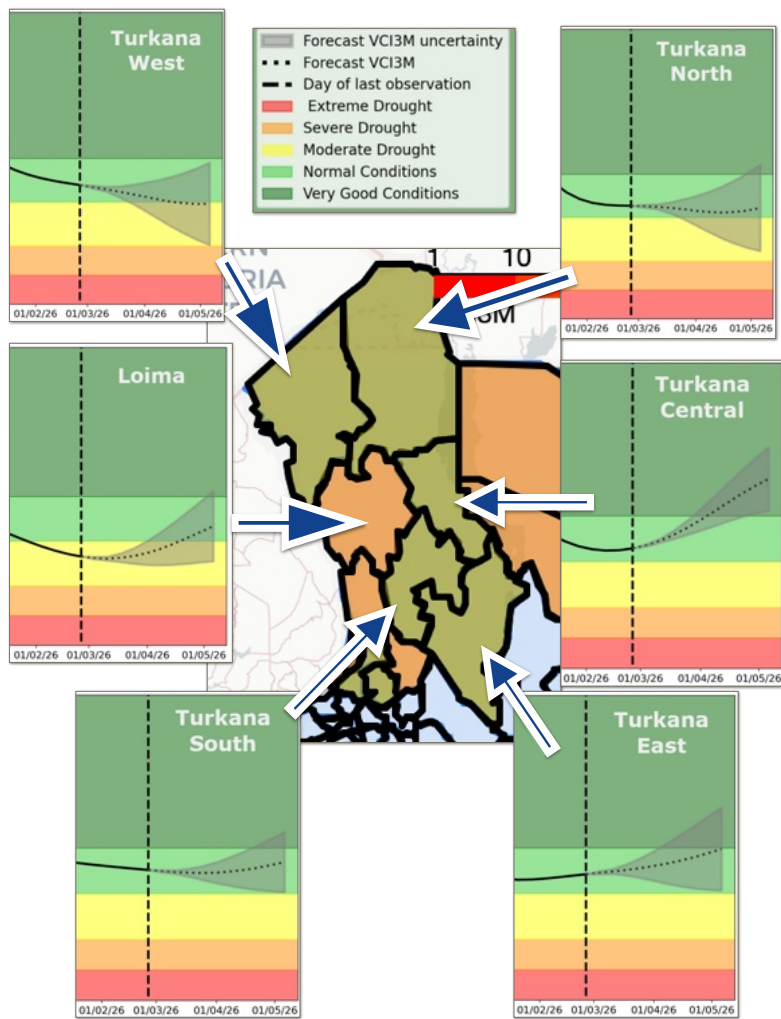
- Predicted Temperature is **above average**
- High temperatures especially likely near Lake Turkana



Vegetation

Forecast

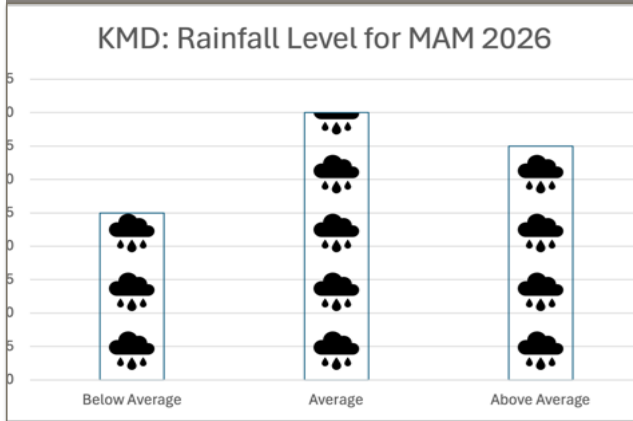
Turkana Central expected to have **very good** conditions through the end of **May**



C.2 Main Study Conventional Handout (translated)

Seasonal Forecast: March-April-May

Forecasts from: Kenya Meteorological Department and Conventional Scientific Forecasters



Alalau Akiru

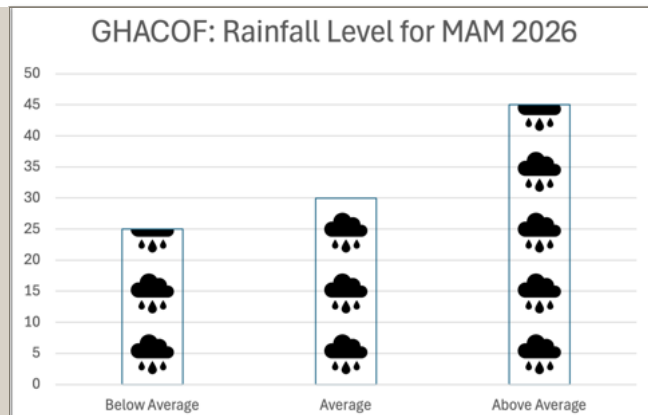
- Ebala **KMD** epedori akiru **nakechiatan** kori **nakaalan** totep nqilapio lua **MAM**

Ngikachwaak

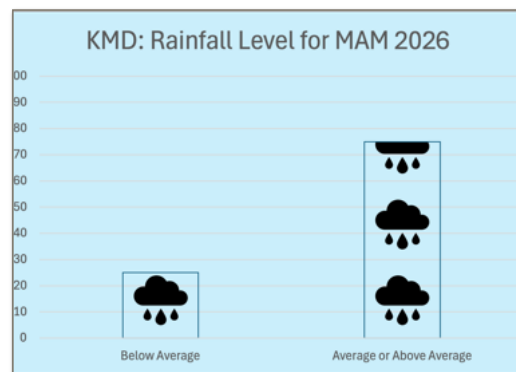
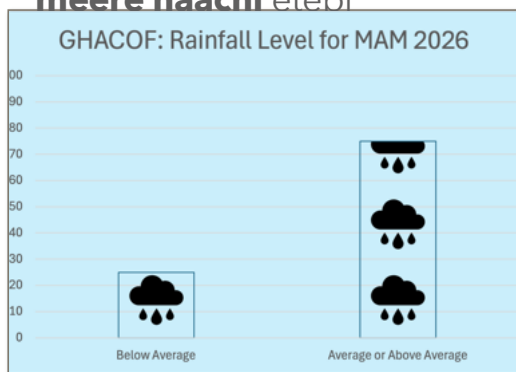
angakwapin

anakidunvet

- Ebalasi ngichwaak luchye anangolenyang epedori **akiru nakaalan**

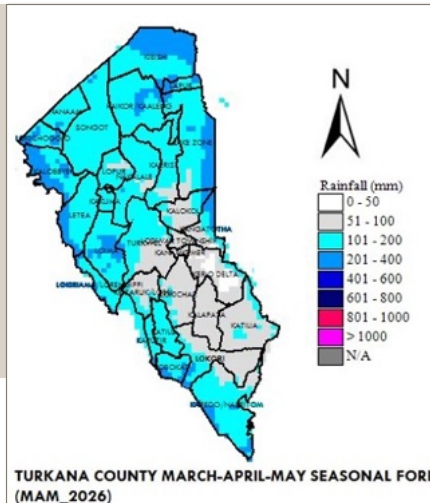


- Ngikachwaak angakopin** ka **KMD** echamam anamurounit kech atamar epedori Akiru **Nakechiatan** kori **Nakaalan** totep na **meere naachi** etepi



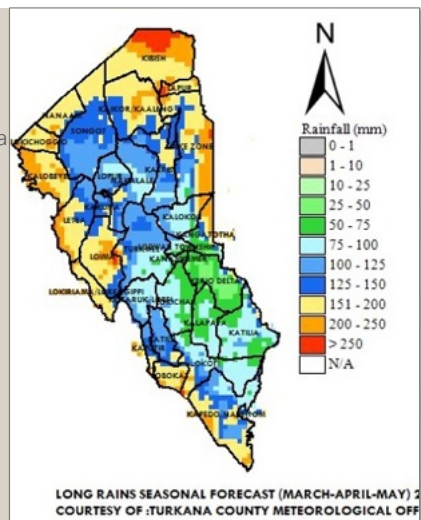
Apetakina Akiru

- To Loima eanyuni akiru nakaalan
- Ng'akwapin nu eyia lopakae aloturkwan eanyunete akiru nakaalan



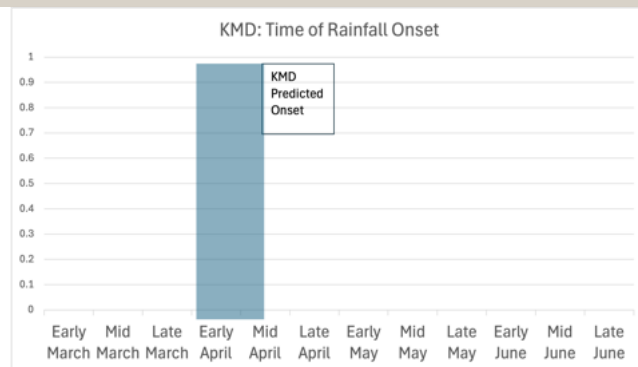
Apetara akiru aoyau

- Ngakwapin nu kata Turkwel ka Kerio nu eyoa kidding aloturkwan eanyunete akiru naedit
- Ngakwapin ngachie aLoima eanyunete akiru nakaalan



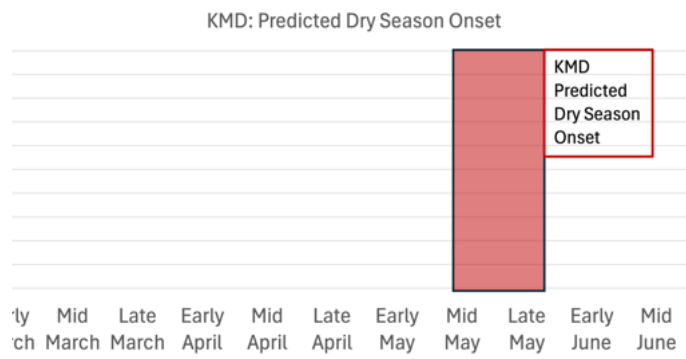
Akisieki n akiru

- **KMD** ebala **aukit na ilamunia** elap loa nguomwon inuchuruchuwansi na nwa lu etenia akiru



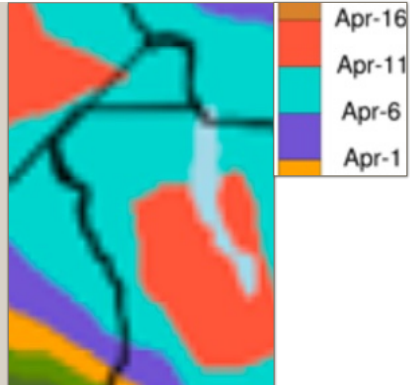
Akisieki n akamu

- **KMD** ebala epedori **akiru kikwaa** aukit na **ngauni** kori na **nguomwon** a elap a ngikan



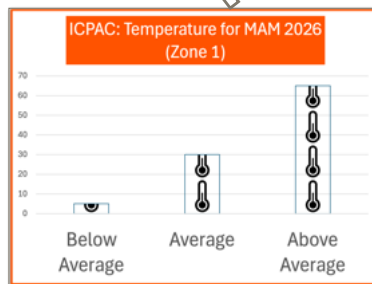
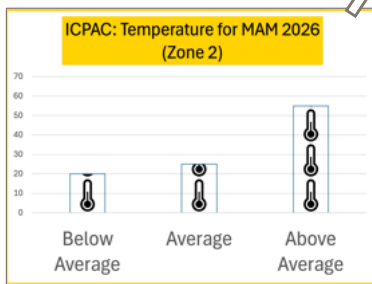
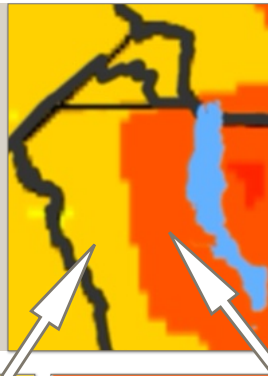
Akisiekin akiru anakwapin

- Turkwan elulung kisiek aanyun akiru elap loa nguomwon ngataree 6-11
- Ngakwapin nu eyia die anam epedori akiru kisiek ngataree 11-16 elap



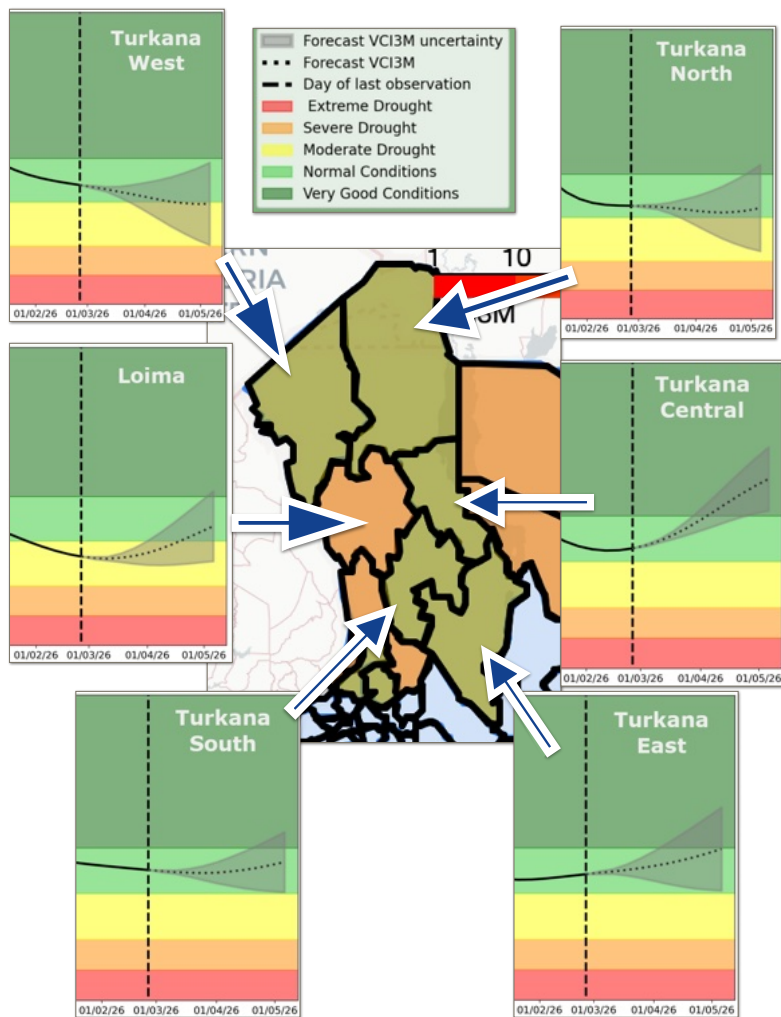
Ariraree angakwapin

- Epedori akwap **torirau**
- Ngakwapin nu alodie anam kechi epedorete toriraata noi



Ekoi loa angirupei

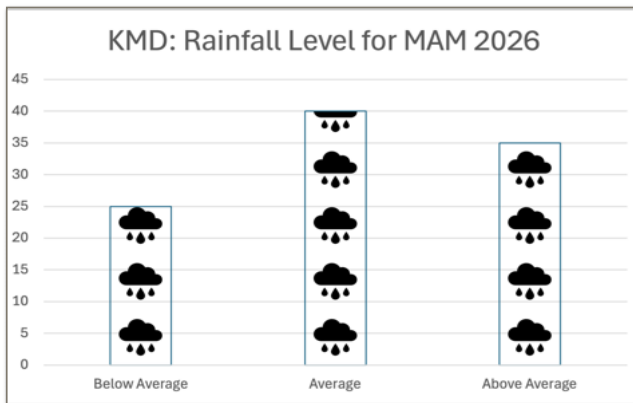
- Turkana Central epedorete ngirupei **luajokok** tomino tananga **niedaunor elap angikan**



C.3 Main Study Hybrid Handout

Seasonal Forecast: March-April-May

Forecasts from: Kenya Meteorological Department and Indigenous and Traditional Knowledge Experts

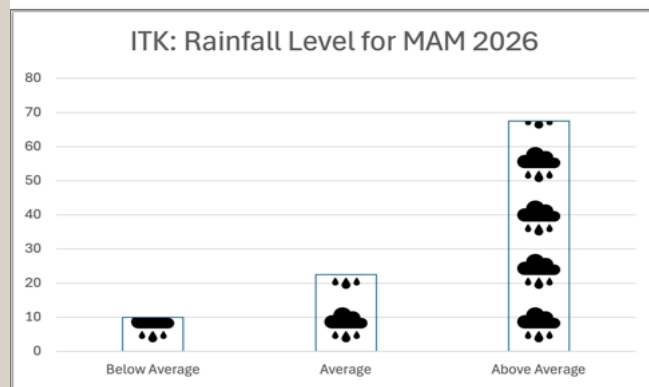


Rainfall Level

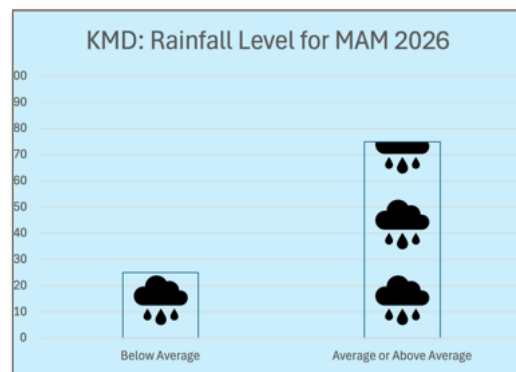
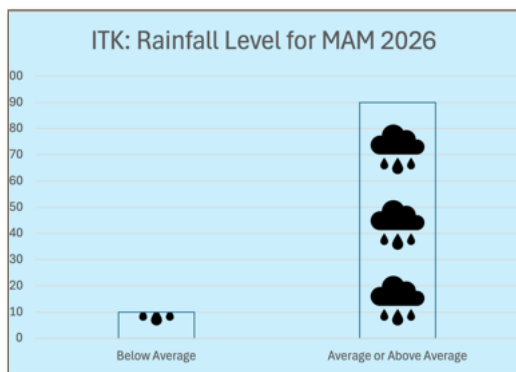
- **KMD** expects that this season is **most likely** to be an **average** or **above average MAM**

Indigenous Forecast

- **Emurons** were confident that this season will have **above average** rainfall

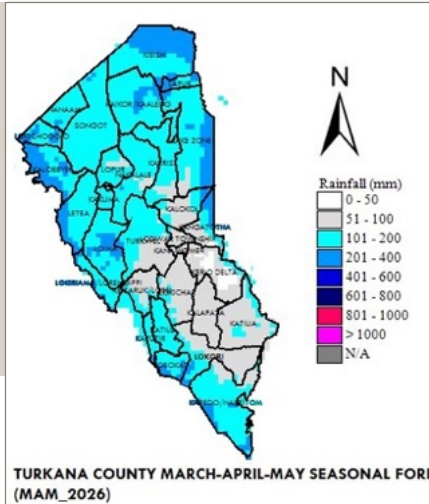


- **Indigenous** and **Conventional** forecasters agree that **Average** or **Above Average** is far more likely than **Below Average**



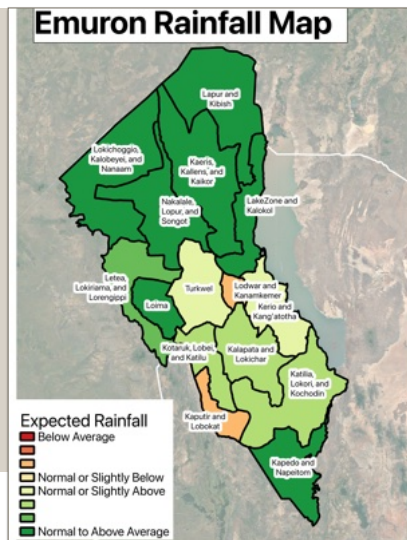
Rainfall Distribution

- The west of Loima County has high predicted rainfall
- Areas along the borders of Turkana are predicted



ITK Rainfall Distribution

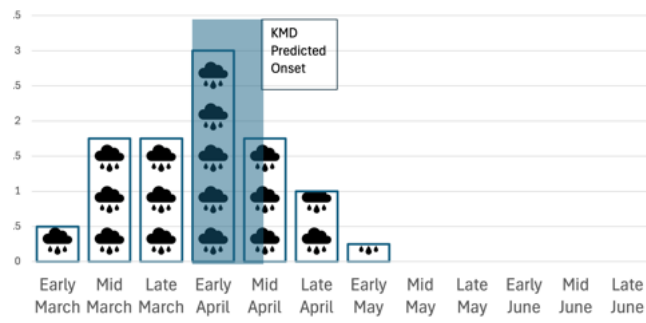
- Indigenous Forecasters also predict strong rainfall in the north and along the borders of Turkana
- Weaker rainfall in central parts of Turkwel into Kerio



Rainfall Onset

- ITK predict light rains through March with **major rains** to begin in early April
- **KMD** expects first week of consecutive rains in **first** or **second** week of April

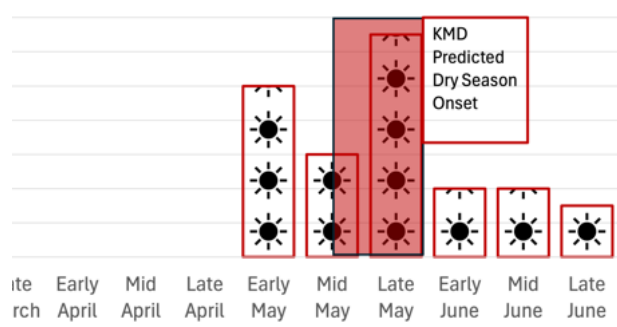
ITK & KMD: Time of Rainfall Onset



Dry Season Onset

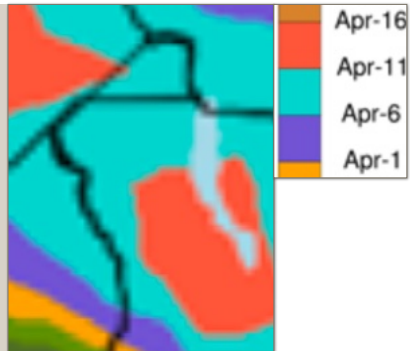
- KMD expects **major rains** to end in **third** or **fourth** week of May
- **ITK** expect end of rains and dry season to begin in **Late May**

ITK & KMD: Predicted Dry Season Onset



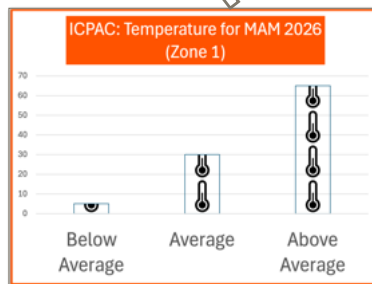
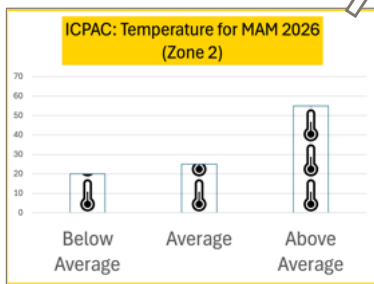
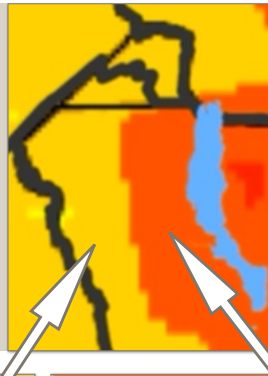
Regional Forecast of Rainfall Onset

- Regional Forecast also predicts most of Turkana to have onset between April 6-11
- Closer to the Lake onset between April 11-16



Regional Forecast of Temperature

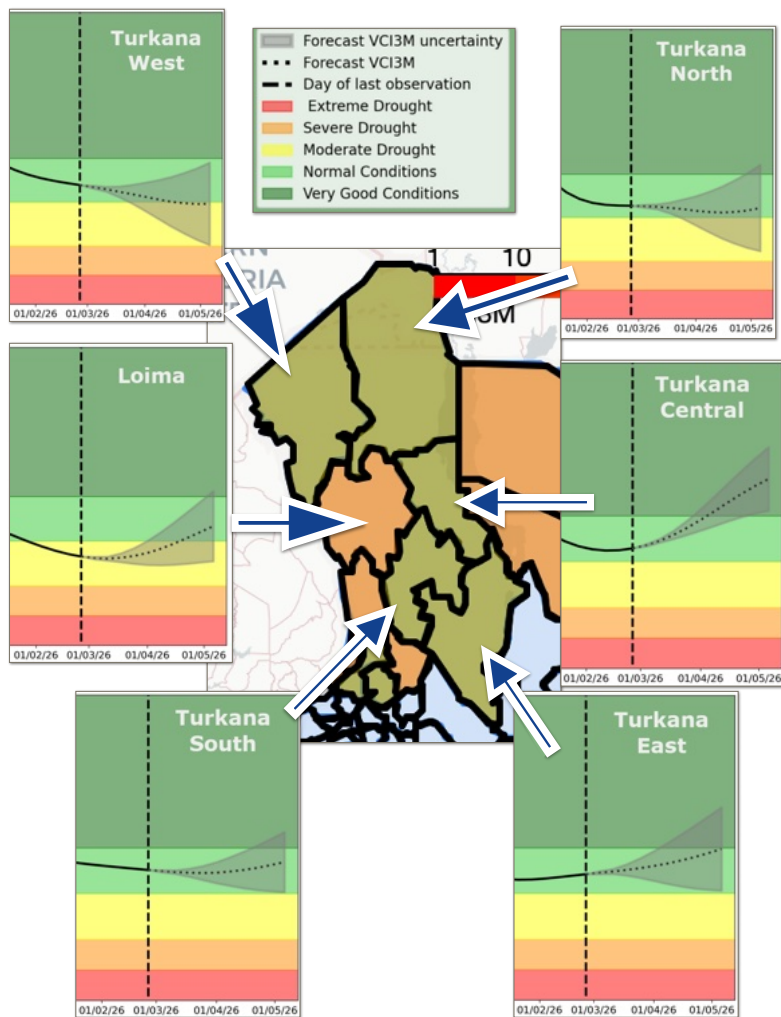
- Predicted Temperature is **above average**
- High temperatures especially likely near Lake Turkana



Vegetation

Forecast

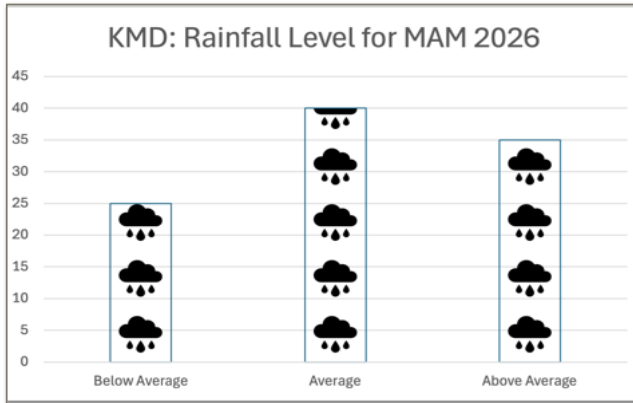
Turkana Central expected to have **very good** conditions through the end of **May**



C.4 Main Study Hybrid Handout (translated)

Seasonal Forecast: March-April-May

Forecasts from: Kenya Meteorological Department and Indigenous and Traditional Knowledge Experts



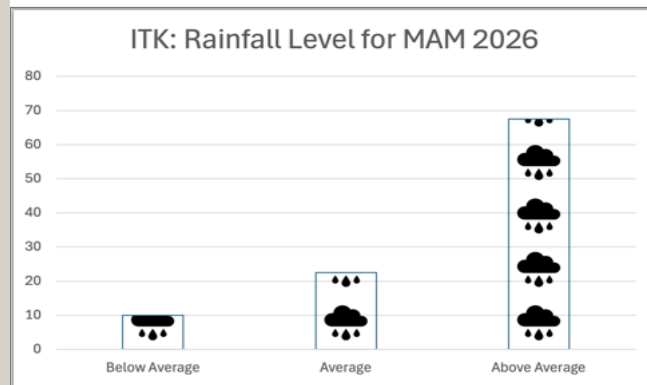
Alalau Akiru

- Ebala **KMD** epedori akiru **nakechiatan** kori **nakaalan** totep ngilapio lua **MAM**

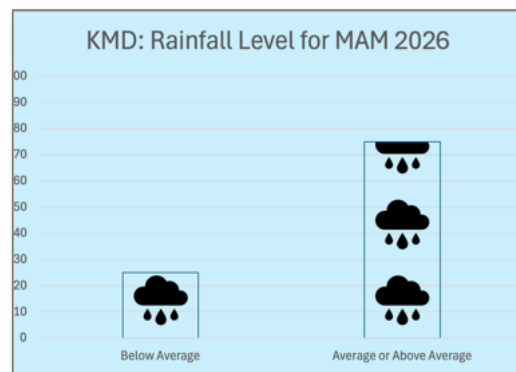
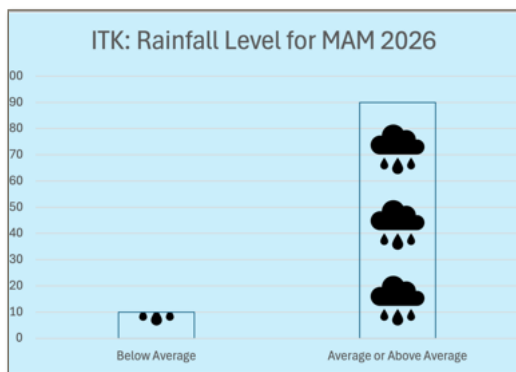
Amuronot

Naturkanait

- Enupito ngimurok atamar akiru na ebunit elal idwangit

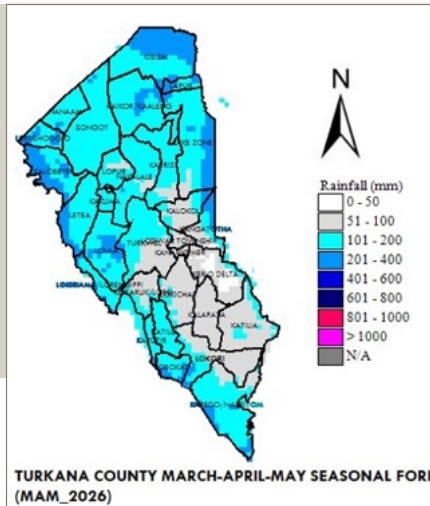


- **Ngimurok** ka **angolenyang** echamam atamar akiru **nakechiatan** kori **nakaalan** etepuni moi alalau meere **naachi**



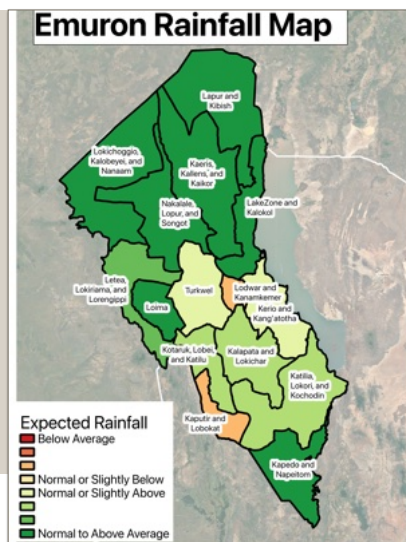
Apetakina

- To Loima eanyuni akiru nakaalan
- Ng'akwapin nu eyia lopakae aloturkwan eanyunete akiru nakaalan



Apetara akiru anamalteny

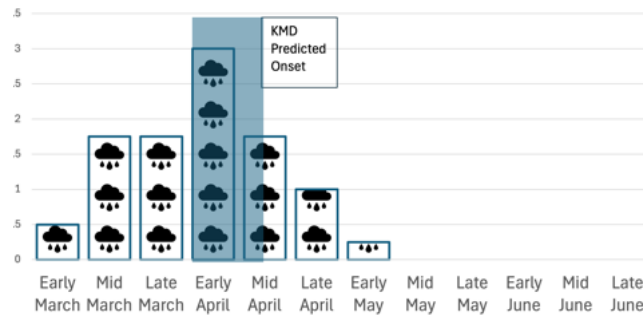
- Ebaasi ngimurok Emini akiru nakaalan nakwapin nakata Lapur ka lupakae aloturkwan
- Etepi akiru naachi ngakwapin nua alokiding Turkwan to Turkwel ka



Akisieki n akiru

- ITK emurounit atamar iendeleari akiru akicheeres elap loa nguuni daang ani elomuni loa nguomwon **totep jik**
- **KMD** ebala **aukit na ilamunia** elap loa nguomwon

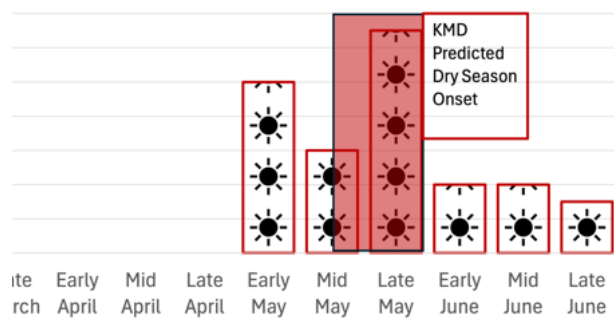
ITK & KMD: Time of Rainfall Onset



Akisieki n

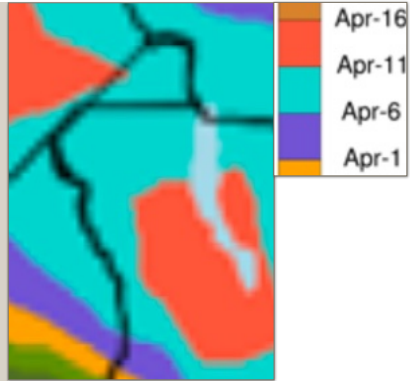
- KMD ebala epedori **akiru kikwaa** aukit na **ngauni** kori na **nguomwon** a elap a ngikan
- **ITK** ebala epedori akiru todaun ka kisieki akamu **edaun elap angikan.**

ITK & KMD: Predicted Dry Season Onset



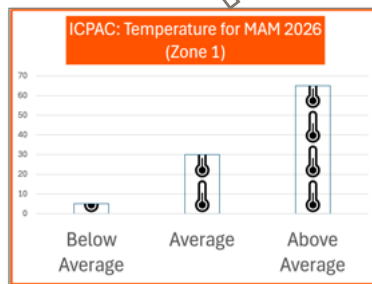
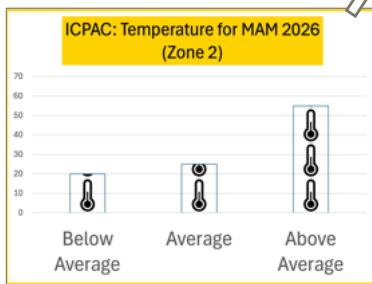
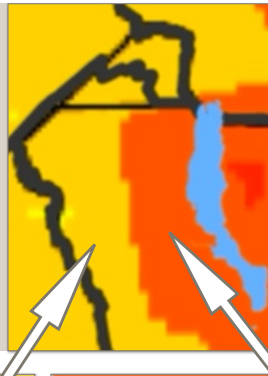
Akisiekin akiru anakwapin anakidunvet

- Turkwan elulung kisiek aanyun akiru elap loa nguomwon ngataree 6-11
- Ngakwapin nu eyia die anam epedori akiru kisiek ngataree 11-16 elap



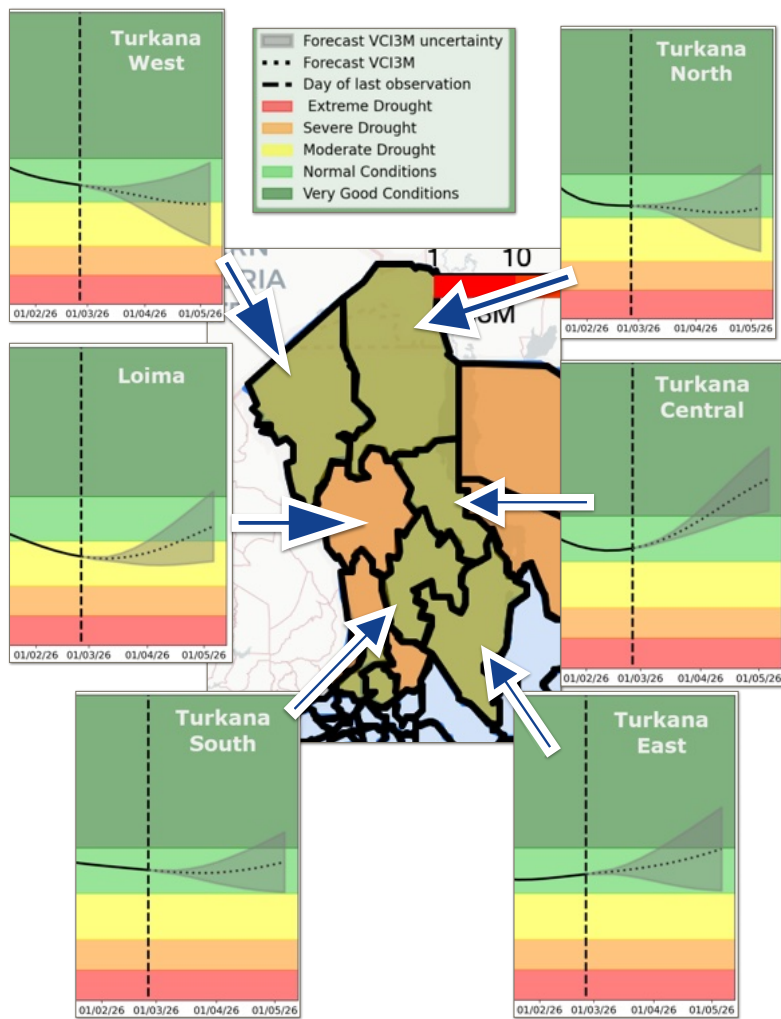
Ariraree angakwapin

- Epedori akwap **torirau**
- Ngakwapin nu alodie anam kechi epedorete toriraata noi



Ekoi loa angirupei

- Turkana Central epedorete ngrupepe **luajokok** tomimo tananga **niedaunor elap angikan**

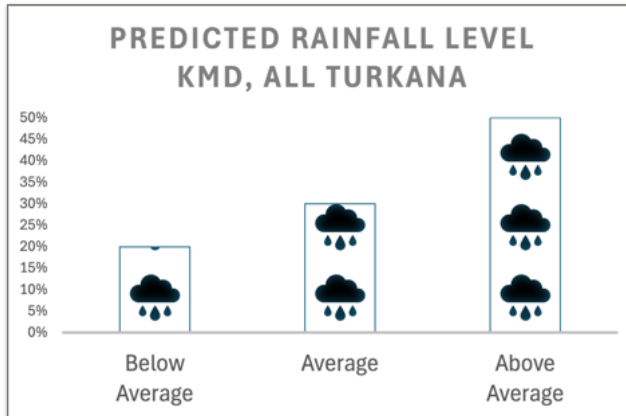


D Pilot Study Handouts

D.1 Pilot Conventional Handout

Seasonal Forecast: July-August-September

Forecasts from: Kenya Meteorological Department

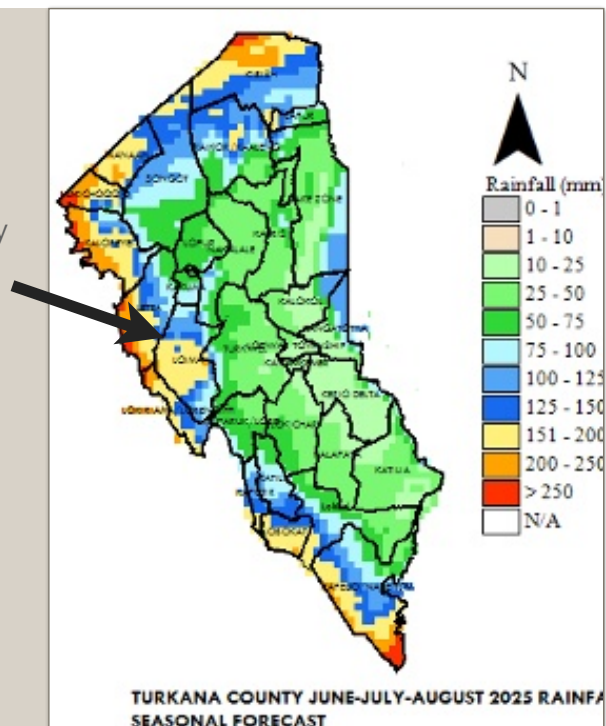


Rainfall Level

- **Below average** rainfall is the least likely outcome.
- **Above average** rainfall is more than twice as likely as **below average** rainfall.

Rainfall Distribution

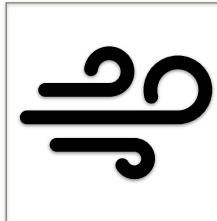
- The west of Loima County is in **yellow** and **blue** indicating high predicted rainfall
- Areas along the borders of Turkana are predicted to receive high rainfall
- Rain to peak in **July** and cease in **late August**





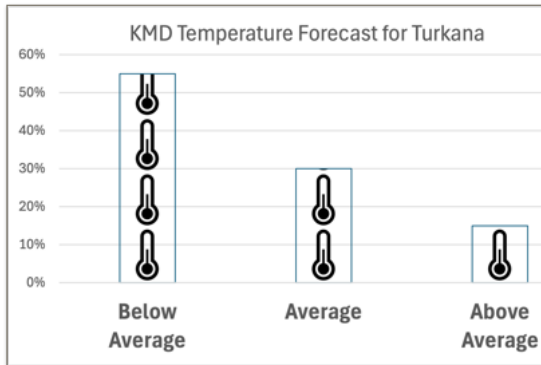
River Flooding

Region along the Turkwel River is **blue** indicating it is at risk of **river flooding**



High Winds

- Winds will reach **90km / hour**



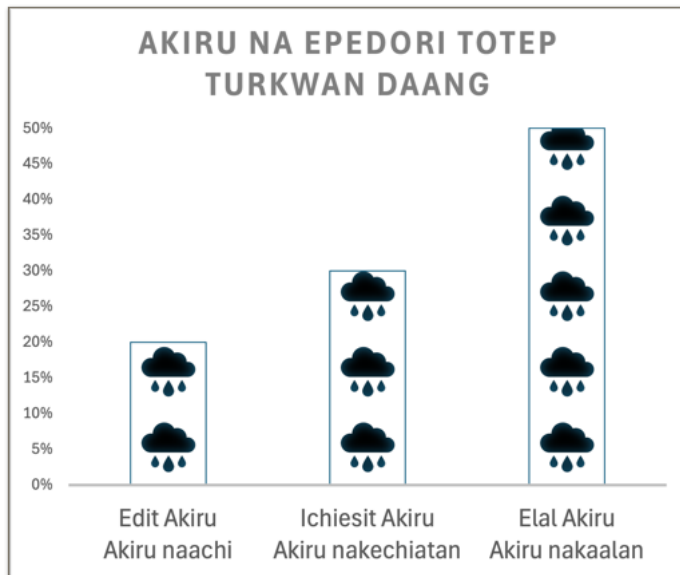
Temperature

- **Below average** temperature is the **most likely** outcome
- **Below average** rainfall is more than three times as likely as **above average heat.**

D.2 Pilot Conventional Handout (translated)

Seasonal Forecast: July-August-September

Ekoi lo eyaunit ang'olenyang na Kenya Meteorological Department

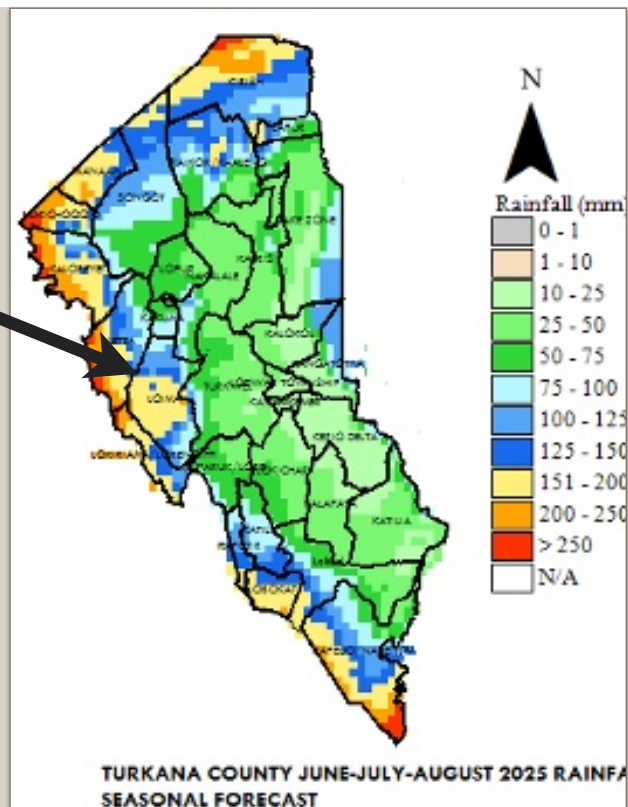


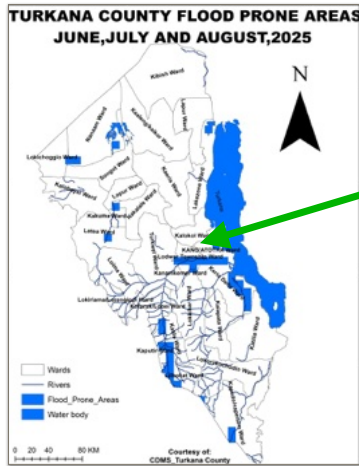
Atiakau akiru

- Akiru naachi anikaalan nyepedori totep
- Epedori akiru nakaan totep aalau nitiidwang'it akiru naachi.

Apetara aakiru

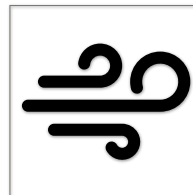
- Kuju kori to Loima ni enyang'aana ka niepuseana idodiunit atamar elal akiru naemini inaa.
- Ng'akwapin na eyia loboda epedorete taanyut akiru nakaan
- Akiru nakaan etepi elap ang'ikan kaarei ka todaun aloa ang'ikan kauni.





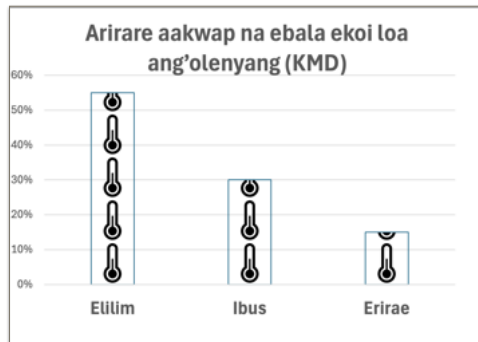
River Flooding

Akwap na ekwaas ang'olol niepuseena idodiunit atamar epedori ang'olol tolelek



Ekuwom lokaalan

- Epedori ekuwom loapolon bu lo ekusi noi lopit amotoga



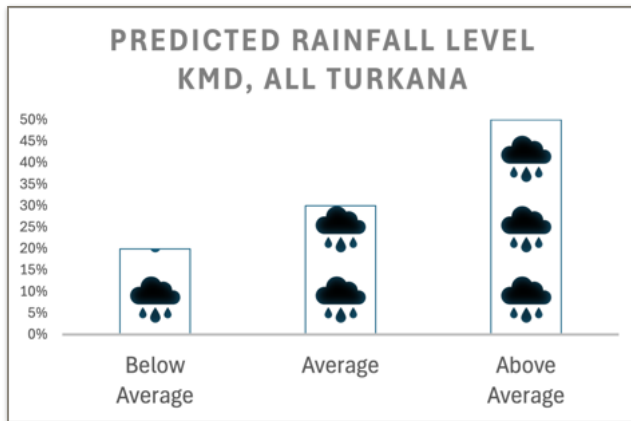
Temperature

- Alilim akwap ng'esi epedori tomin anikaalan
- Alilim idwang'it arirare aakwap ng'akinyiakinet ng'auni

D.3 Pilot Hybrid Handout

Seasonal Forecast: July-August-September

Forecasts from: Kenya Meteorological Department and Indigenous Knowledge Experts

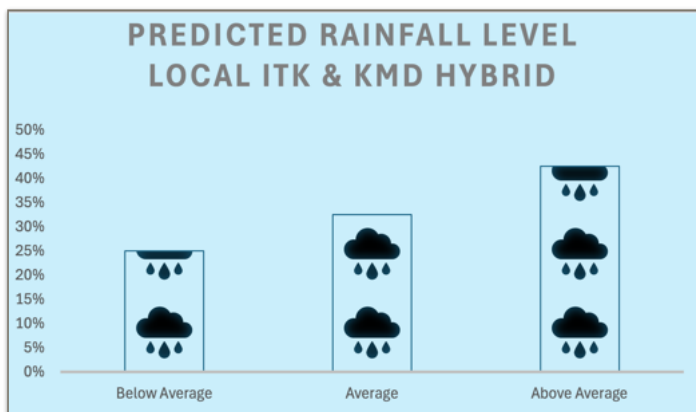
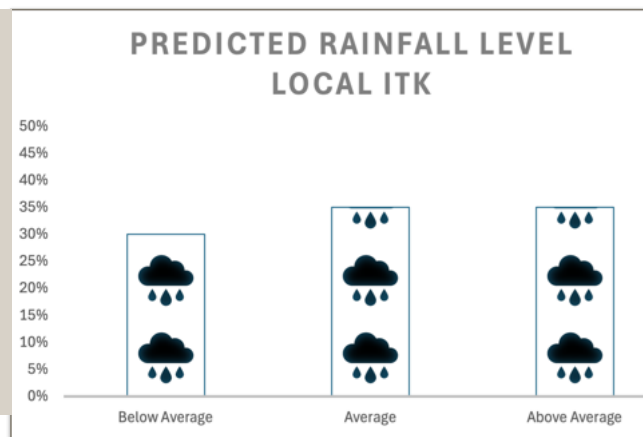


Rainfall Level: KMD

- **Below average** rainfall is the least likely outcome.
- **Above average** rainfall is more than twice as likely as **below average** rainfall.

Rainfall Level: ITK

- **Below average** rainfall is the least likely outcome.
- **Above average** or **Average** rainfall most likely options

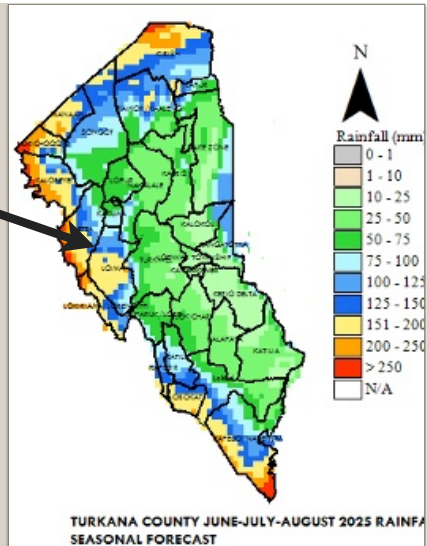


Rainfall: Hybrid

- **Below average** rainfall is the least likely outcome.
- **Above average** rainfall is almost twice as likely as **below average** rainfall.

Rainfall Distribution

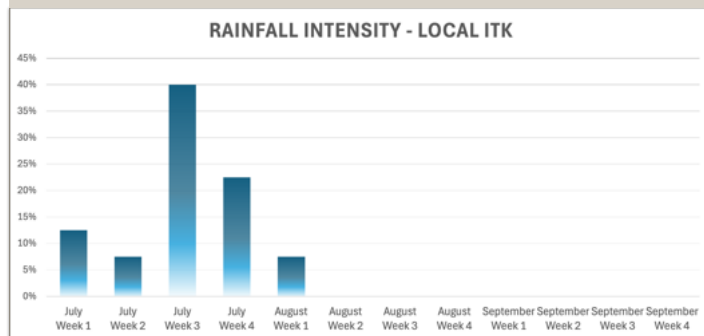
- The west of Loima County is in **yellow** and **blue** indicating high predicted rainfall
- Areas along the borders of Turkana are predicted to receive high rainfall
- Rain to **peak in July** and **end in late August**



Rainfall Timing

ITK & KMD: Rainfall to **peak in July**

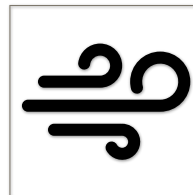
KMD: Rains end in late August, local ITK: Rains end in Early August





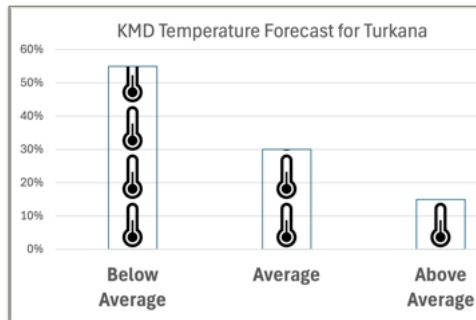
River Flooding

Region along the Turkwel River is **blue** indicating it is at risk of **river flooding**



High Winds

• Winds will reach **90km / hour**



Temperature

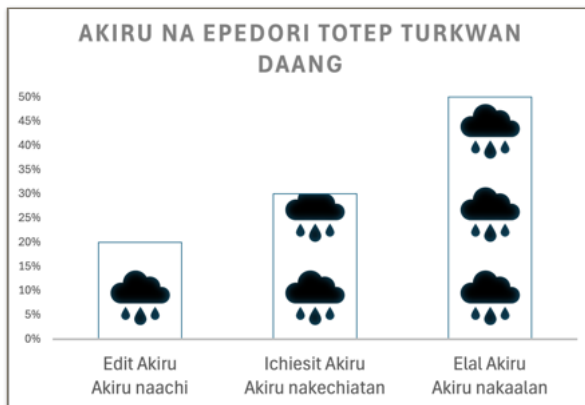
• **Below average** heat is the **most likely** outcome

• **Below average** heat is more than **three times as likely** as above average heat.

D.4 Pilot Hybrid Handout (translated)

Seasonal Forecast: July-August-September

Ekoi lo eyaunit ang'olenyang na Kenya Meteorological Department ka loa angimurok kori ng'ikasukou lu eswamete ng'amalteny

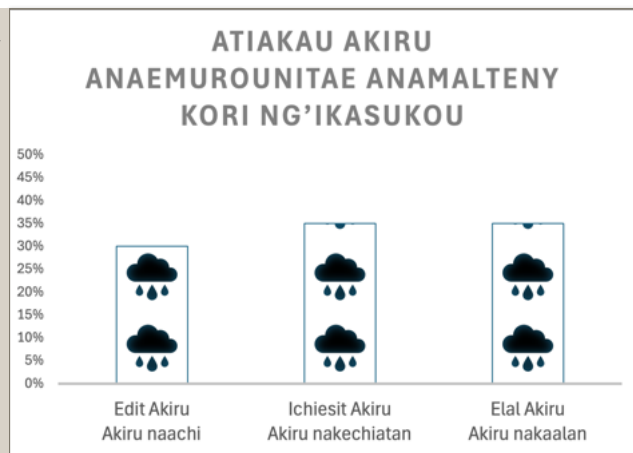


Akiru Aniang'olenyang'

- Akiru naachi anikaalan nyepedori totep
- Epedori akiru nakaalan totep aalau nitiidwang'it akiru naachi ng'akinyiagakineteta ng'aarei.

Akiru: aniang'amalteny kori alomurok

- Akiru naachi anikaalan nyepedori totep
- Akiru nakaalan kori nakechiatan ng'esi alimunitoe ng'esi epedori



AKIRU NA EBALASI NG'AMALTENY KA ANG'OLENYANG

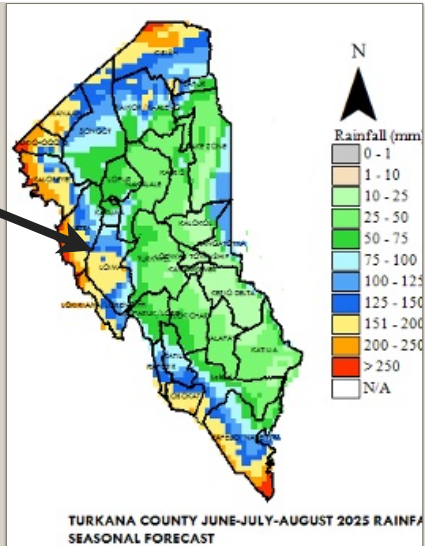


Ng'amalteny ka ang'olenyang imorikinitae

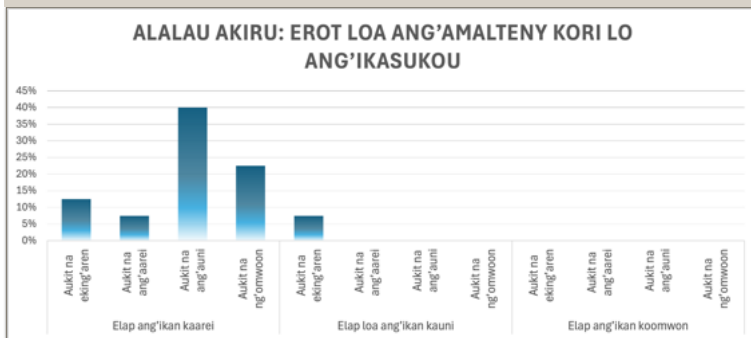
- Akiru naachi anikaalan nyepedori totep
- Epedori akiru nakaalan totep aalau nitiidwang'it akiru naachi ng'akinyiagakineteta anaeloose araun ng'aarei

Apetara aakiru

- Kuju kori to Loima ni enyang'aana ka niepuseana idodiunit atamar elal akiru naemini inaa.
- Ng'akwapin na eyia loboda epedorete taanyut akiru nakaalan
- Akiru nakaalan etepi elap ang'ikan kaarei ka todaun aloa ang'ikan kauni.



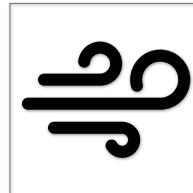
- ## Ng'irwa lu ebunio akiru
- Ebala ang'olenyang' edaun akiru elap ang'ikan kauni
 - Ng'amalteny ka ang'olenyang ebaasi elalaar akiru elap ang'ikan kaarei
 - Ebalasi ng'ikaswamak ng'amalteny edaun akiru akisiekinet a elap ang'ikan kauni





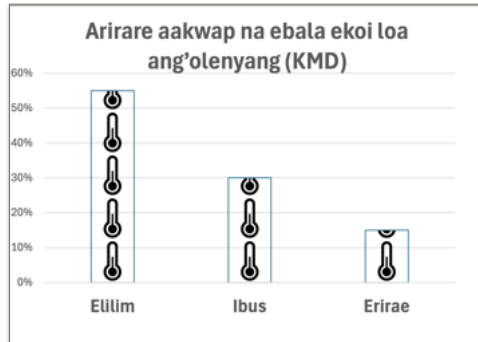
River Flooding

Akwap na ekwaas ang'olol
 niepuseena idodiunit
 atamar epedori ang'olol
 tolelek



Ekuwom
 lokaalan

- Epedori ekuwom loapolon bu lo ekusi noi lopit amotoga



Temperature

- Alilim akwap ng'esi epedori tomin anikaalan
- Alilim idwang'it arirare aakwap ng'akinyiagakinet ng'auni

E Baseline Survey Questionnaire

climateforal_baseline

Administrative Information

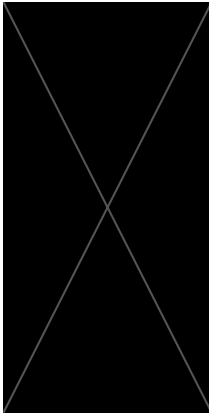
Fill as much of section A as you can before you start the interview.

Time of interview

hh:mm

Date of interview

Enumerator name



Enumeration Area Sub-County

- Turkana Central
- Loima
- Turkana West
- Turkana North

Ward / Cluster Name

Community Health Unit / Village Name

SurveyID

Confirm: SurveyID

Did the respondent read the information sheet, and sign and agree the terms on the consent form?

- Yes
- No

Will you be available for a midline interview in October?

- Yes
 No

Will you be available for an endline interview in January/February?

- Yes
 No

What is your age?

What is your name?

What is your phone number?

IGNORE LEADING ZERO

Is there an alternate phone number we can use to reach you?

- Yes
 No

What is an alternate phone number we can use to reach you?

IGNORE LEADING ZERO

Whose phone number is this?

- Other member of same household
 Neighbour
 Family in other household
 Village leadership
 CHV
 Other

Specify OTHER

What best describes your role in the household?

- head of household
 Senior woman / wife
 Junior wife
 Adult man
 Adult son
 Adult daughter
 Younger Son
 Younger Daughter
 Child

Which of the following best described your household?

- Monogamous household
 Polygamous household
 Divorced / widowed woman
 Divorced man / widower
 Other (specify)

How many wives are in this family? (i.e. how many wives does the husband have)

» Other Homestead Location Geopoint

Specify other

What is the total number of people in the household?

How many adult men live in this household?

How many adult women live in this household?

How many boy children live in this household?

How many girl children live in this household?

Is anyone in your household disabled?

- Yes
 No
 Refused

Are there members of another family homestead or extended family staying with you temporarily?

- Yes
 No

Why are they staying with you temporarily?

- Work
 No food / income to support them at normal home
 Access medical care
 Other (specify)

Specify OTHER

Demographics

We will now ask you about the people in your household. Here, when we say "household" we include all the people that have taken most of their meals together in this house for at least the last six months.

What is your gender?

- Male
 Female
 Non-Binary
 Other
 Refuse to answer

What is the highest level of education you completed?

- Lower primary school
 Upper primary school
 Secondary school
 University
 Vocational school/trade school
 None

How well can you read in Turkana language / Ngaturkan?

- Not at all
 A little bit
 A moderate amount
 Quite well
 Fully fluent
 Refuse to answer

How well can you speak/understand Swahili?

- Not at all
 A little bit
 A moderate amount
 Quite well
 Fully fluent
 Refuse to answer

How well can you read Swahili?

- Not at all
 A little bit
 A moderate amount
 Quite well
 Fully fluent
 Refuse to answer

What type of work are they doing?

- Working in town
 Working in fishery
 Working in mining
 Working in agriculture
 Other work (specify)

What type of (OTHER) work are they doing?

Is this a result of seasonal conditions like rainfall, temperature, or pasture?

- Yes
 No

Are there people who would normally be part of your household who are temporarily staying at another family homestead or with extended family?

- Yes
 No

Why are they staying there temporarily?

- Work
 No food / income to support them at normal home
 Access medical care
 Other (specify)

Specify OTHER

What type of work are they doing?

- Working in town
 Working in fishery
 Working in mining
 Working in agriculture
 Other work (specify)

Is this a result of seasonal conditions like rainfall, temperature, or pasture?

- Yes
 No

We will now ask you about the livelihoods supporting your household, and all the different economic activities you do regularly.

We want to remind you that we are researchers and will not be giving out gifts or support or assistance based on your income. We will not be sharing information that identifies you with the government or NGOs, so nothing you tell us will impact your likelihood of getting assistance or relief.

What livelihoods are practiced by people in this household?

For agropastoralists, check both "pastoralism" and "crop farming"

- Pastoralism
- Crop Farming
- Basketry or Other Weaving
- Charcoal Burning
- Wage/Casual Labour
- Beekeeping / Apiculture
- Other Enterprise / Business (NOT including basketry or charcoal burning)
- Fishing
- Other (specify)

Specify OTHER

Are you *SURE* they don't practice at least one of these livelihoods?

- Yes
- No

Which livelihood contributes most to the livelihood of this household?

Pastoralism

Which animals does your household have this season?

Ask what animals and let them respond first, instead of prompting for each item option.

- Cattle (including calves)
- Camels
- Sheep
- Goats
- Donkeys
- Birds (chickens, ducks, ...)
- Other (specify)

Specify Other

For research purposes, we want to understand the size and health of your herd to understand things that affect your livelihood.

» **Livestock Type Loop**

Do you have a *kraal* away from the homestead where you go to stay and graze your animals?

This only refers to a place they go and temporarily live/sleep. If they do zero grazing during the day near the homestead, answer NO.

- Yes
- No

Which animals did you take to graze away from the homestead?

- Cattle (including calves)
- Camels
- Sheep
- Goats
- Donkeys
- Birds (chickens, ducks, ...)
- Other (specify)

Did you face any challenges?

- No pasture where we went
- Livestock disease
- Ran out of food
- Lack of water
- Had internal conflict (with other Turkana)
- Had to pay tax/extortion to locals for access to land, water, etc.
- Had external conflict (with non-Turkana)
- Border restrictions, foreign governments
- Theft
- Other (specify)

What was the OTHER challenge?

What was this "tax" you had to pay?

Do you have a plan for when and where you will be migrating for grazing this season?

This includes making a decision NOT to migrate. Only answer NO if they are completely uncertain about their grazing plans. If they are certain they are NOT migrating, answer YES to this question and NO to the next one.

- Yes
- No

Is there a chance you will be migrating to graze this season?

- Yes
- No

Why did you make this decision? (What were the key reasons?)

How did you make this decision? (What information did you use? Who did you talk to? Did you make this decision by yourself?)

Is your kraal the farthest away from the homestead you plan to graze your animals this October-November-December season?

- Yes
- No

Where is the furthest from homestead you currently plan to graze animals this October-November-December season?

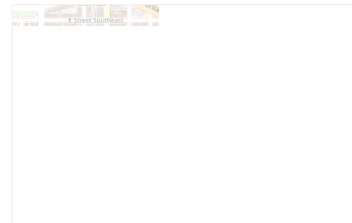
Please locate the site on the map.

latitude (x,y °)

longitude (x,y °)

altitude (m)

accuracy (m)



Was this kraal the farthest away from the homestead where you went to graze your animals last October-November-December season?

- Yes
- No

In the last October-November-December season, did you spend any nights away from your homestead while grazing animals?

- Yes
- No

In the last October-November-December season, where was the furthest from homestead you went to graze animals?

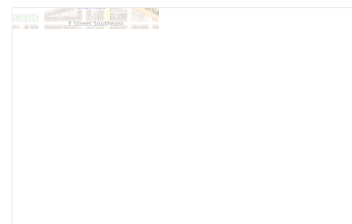
Please locate the site on the map.

latitude (x,y °)

longitude (x,y °)

altitude (m)

accuracy (m)



How many weeks were you grazing animals more than a day's walk away from your homestead? (How many weeks were you not sleeping at your normal homestead in order to graze?)

This only refers to grazing where they spend the night away from their home.

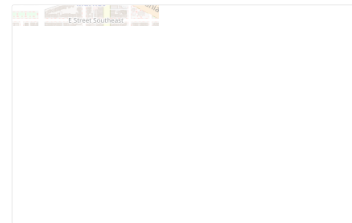
Please locate the site on the map.

latitude (x,y °)

longitude (x,y °)

altitude (m)

accuracy (m)



What is the name of this site?

How many weeks do you expect you will be grazing animals more than a day's walk away from your homestead?

When do you expect to begin this grazing migration?

What information do you use to decide if/when to migrate for grazing?

Which animals do you plan to take this season?

- Cattle (including calves)
- Camels
- Sheep
- Goats
- Donkeys
- Birds (chickens, ducks, ...)
- Other (specify)

Have you, or are you planning to, take any of these actions this season?

- Sell livestock / destock
- Migrate further than usual
- Temporarily migrate to an urban area
- Set aside reserve pasture
- Expand your herd
- Migrate less far for grazing
- Grow crops that can be used as animal feed
- Change herd composition
- Other (Specify ALL other actions)

Specify OTHER:

» **Reasons for changes**

Are you a member of a larger kraal grazing group?

- Yes
 No

How many households are in this kraal?

What is the name of this kraal?

Agriculture

For research purposes, we want to understand the land you farm, the crops you grow, and the challenges you face with agriculture.

How many plots / shambas / gardens does your household INTEND to plant during the October-November-December season?

» Plot-Level Loop

Have you, or are you planning to, take any of these actions this season?

- Plant different crops
 Plant less land
 Plant more land
 Plant earlier
 Plant later
 Invest in irrigation
 Move agricultural land from food crops to animal pasture
 Move agricultural land from food crops to fodder crops
 Other planned change (specify)

Specify OTHER:

» Reasons for changes

Basketry and Weaving

For research purposes, we want to understand your major livelihoods so we will now ask about Basketry and weaving.

What are your normal average monthly profits from this weaving?

In the last year, did your weaving suffer from any climate / weather shocks?

- Drought
 High Rain
 Flooding
 Pests
 Extreme heat
 High winds
 Other
 No weather shocks

How many people in the household work on this?

Who in the household works on basketry?

- Senior Men
 Senior Women
 Young Men
 Young Women

Why do you choose to do weaving, compared to other livelihoods?

Charcoal Burning

For research purposes, we want to understand your major livelihoods so we will now ask about any charcoal burning your household does.

What are your normal average monthly profits from producing charcoal?

How many KGs of charcoal do you normally produce per month?

In the last year, did your charcoal burning suffer from any climate / weather shocks?

- Drought
 High Rain
 Flooding
 Pests
 Extreme heat
 High winds
 Other
 No weather shocks

How many people in the household work on this?

What are the average monthly profits from this enterprise?

In the last year, did this enterprise suffer from any climate / weather shocks?

- Drought
 High Rain
 Flooding
 Pests
 Extreme heat
 High winds
 Other
 No weather shocks

Does any member of your household own a trading business on a street or in a market?

- Yes
 No

» Enterprise or Non-Farm Self-Employment Loop

Enterprise description

What are the average monthly profits from this enterprise?

In the last year, did this enterprise suffer from any climate / weather shocks?

- Drought
 High Rain
 Flooding
 Pests
 Extreme heat
 High winds
 Other
 No weather shocks

Does any member of your household offer any service or sold anything on a street or in a market, including curios, construction timber, woodpoles, traditional medicine, bricks, cane furniture, etc.?

NOTE: BASKETRY INCLUDED HERE

- Yes
 No

» Enterprise or Non-Farm Self-Employment Loop

Enterprise description

Are you a member of a larger kraal grazing group?

- Yes
 No

How many households are in this kraal?

What is the name of this kraal?

Agriculture

For research purposes, we want to understand the land you farm, the crops you grow, and the challenges you face with agriculture.

How many plots / shambas / gardens does your household INTEND to plant during the October-November-December season?

» Plot-Level Loop

Have you, or are you planning to, take any of these actions this season?

- Plant different crops
 Plant less land
 Plant more land
 Plant earlier
 Plant later
 Invest in irrigation
 Move agricultural land from food crops to animal pasture
 Move agricultural land from food crops to fodder crops
 Other planned change (specify)

Specify OTHER:

» Reasons for changes

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- Drought
 High Rain
 Flooding
 Pests
 Extreme heat
 High winds
 Other
 No weather shocks

How many people in the household work on this?

Who in the household works on basketry?

- Senior Men
 Senior Women
 Young Men
 Young Women

Why do you choose to do weaving, compared to other livelihoods?

Charcoal Burning

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In the last year, did your charcoal burning suffer from any climate / weather shocks?

- Drought
 High Rain
 Flooding
 Pests
 Extreme heat
 High winds
 Other
 No weather shocks

How many people in the household work on this?

What are the average monthly profits from this enterprise?

In the last year, did this enterprise suffer from any climate / weather shocks?

- Drought
 High Rain
 Flooding
 Pests
 Extreme heat
 High winds
 Other
 No weather shocks

Does any member of your household own a trading business on a street or in a market?

- Yes
 No

» Enterprise or Non-Farm Self-Employment Loop

Enterprise description

What are the average monthly profits from this enterprise?

In the last year, did this enterprise suffer from any climate / weather shocks?

- Drought
 High Rain
 Flooding
 Pests
 Extreme heat
 High winds
 Other
 No weather shocks

Does any member of your household process and sell any agricultural byproducts, including flour, starch, juice, beer, jam, oil, seed, bran, etc., but excluding livestock by-products, fresh/processed fish?

- Yes
 No

» Enterprise or Non-Farm Self-Employment Loop

Enterprise description

What are the average monthly profits from this enterprise?

In the last year, did this enterprise suffer from any climate / weather shocks?

- Drought
 High Rain
 Flooding
 Pests
 Extreme heat
 High winds
 Other
 No weather shocks

Does any member of your household own a professional office or offered professional services from home as a doctor, accountant, lawyer, translator, private tutor, midwife, mason, etc?

- Yes
 No

» Enterprise or Non-Farm Self-Employment Loop

Enterprise description

What are the average monthly profits from this enterprise?

In the last year, did this enterprise suffer from any climate / weather shocks?

- Drought
 High Rain
 Flooding
 Pests
 Extreme heat
 High winds
 Other
 No weather shocks

Does any member of your household drive a household-owned taxi or pick-up truck to provide transportation or moving services?

- Yes
 No

» Enterprise or Non-Farm Self-Employment Loop

Enterprise description

Are you planning on expanding an existing non-pastoralism, non-agriculture enterprise this season?

- Yes
 No

What enterprise or enterprises?

Apiculture / Beekeeping

For research purposes, we want to understand your major livelihoods so we will now ask about Apiculture, Beekeeping, and Honey Production

How many beehives do you keep?

What would it cost to buy the equivalent to these beehives?

How often do you harvest honey?

- Day
 Week
 Month
 Other

Specify Other

Give the unit for gathering honey each .

- 500 ml jar
 1 L bottle
 Other

What is the unit?

What quantity of honey do you normally gather each ?

What is the market price for one of honey?

Casual / Wage Labour

We are now keen to learn about your employment. Please complete the loop once for each household member who has worked at least one hour over the past two weeks.

» Casual / Wage Job Loop

Is this work regularly scheduled, or casual irregular work?

- Regularly Scheduled
 Irregular / Casual

What are the average monthly profits from this enterprise?

In the last year, did this enterprise suffer from any climate / weather shocks?

- Drought
 High Rain
 Flooding
 Pests
 Extreme heat
 High winds
 Other
 No weather shocks

Does any member of your household own a bar or restaurant?

- Yes
 No

» Enterprise or Non-Farm Self-Employment Loop

Enterprise description

What are the average monthly profits from this enterprise?

In the last year, did this enterprise suffer from any climate / weather shocks?

- Drought
 High Rain
 Flooding
 Pests
 Extreme heat
 High winds
 Other
 No weather shocks

Are you planning on starting a new non-pastoralism, non-agriculture enterprise this season?

- Yes
 No

What enterprise or enterprises?

Is this work paid with money/MPESA or in-kind (with other goods)?

- Money / MPESA
 In-kind (with other goods, food, etc.)

What kind of work do you normally do at this job?

(Describe in more than two but less than ten words).

What is the main good / service their employer produces?

(Describe in more than two but less than ten words).

How many hours does this person normally work in a week?

Are they paid by the ...

- Hour
 Day
 Week
 Month
 Year
 Other (specify)

How much are they paid per ?

What is the value of the goods they compensated with per ? (If they sold at local market.)

Fisheries

We are now keen to learn about your work fishing.

Who is this household participates in fishing?

- Senior Men
 Senior Women
 Young Men
 Young Women

How many household members participate in fishing?

How many days per month do people from this household participate in fishing?

How many months per year does your household do fishing?

1

1

1

1

What equipment do you use for fishing?

- Nets
- Boats
- Fishing Rods
- Fish traps
- Log rafts

Which of this equipment do you own?

- Nets
- Boats
- Fishing Rods
- Fish traps
- Log rafts

What is the approximate market value of fishing equipment you own?

How much does it cost per month to rent/lease your fishing equipment?

After paying for fuel and equipment, how much profit do you make from fishing per month?

Has anyone in your family suffered a crocodile attack in the last 6 months?

- Yes
- No

Other Income: Govt, NGO, Remittance

In the last 6 months, did you receive any in-kind assistance from NGOs or the government?

- Yes
- No

If you could ask the **government** for one service or assistance this season, what would it be?

If you could ask **NGOs** for one service or assistance this season, what would it be?

In the last 6 months, did you receive any cash transfer, payments, or remittances?

- Yes
- No

Who sent you this transfer?

- Government
- NGOs
- Religious Institution
- Extended Family
- Family members temporarily living away from home (who normally live here)
- Other households in village

... Management and investment in non-livestock economic activity?

- Senior Men
- Senior Women
- Young Men
- Young Women
- People outside household
- Decision not relevant for this household

... Income from non-livestock economic activity?

- Senior Men
- Senior Women
- Young Men
- Young Women
- People outside household
- Decision not relevant for this household

... Fertility decisions? (Whether to have more children)

- Senior Men
- Senior Women
- Young Men
- Young Women
- People outside household
- Decision not relevant for this household

... Household (food, clothing, etc.) consumption decisions?

- Senior Men
- Senior Women
- Young Men
- Young Women
- People outside household
- Decision not relevant for this household

Section 6: Climate Information

Now we would be keen to know about the climate information you do and don't have access to and what you do with this information. We are also keen to hear if we have missed anything important about climate information in your life.

Is access to climate or weather information a priority in your life?

- Yes
- No
- Refused

Why is it not a priority?

- I am not very vulnerable to weather changes
- I can't afford to react to any forecasts I get
- I am not capable of carrying out the actions I would need to act
- It is a minor challenge compared to other challenges I have
- Other

» Transfers Received

Household Decisionmaking

Who in the household is responsible for making decisions about ... How to spend income from large livestock (cattle and camels)?

- Senior Men
- Senior Women
- Young Men
- Young Women
- People outside household
- Decision not relevant for this household

Who in the household is responsible for making decisions about ... How to spend income from small livestock (goats, sheep, etc.)?

- Senior Men
- Senior Women
- Young Men
- Young Women
- People outside household
- Decision not relevant for this household

Who in the household is responsible for making decisions about ... Herding, migration, and livestock management?

- Senior Men
- Senior Women
- Young Men
- Young Women
- People outside household
- Decision not relevant for this household

... Farm management, planting decisions, and spending on farm inputs?

- Senior Men
- Senior Women
- Young Men
- Young Women
- People outside household
- Decision not relevant for this household

... Income from agriculture?

- Senior Men
- Senior Women
- Young Men
- Young Women
- People outside household
- Decision not relevant for this household

Specify other.

» Seasonal and monthly forecasts

In the past 3 months have you gotten an official SEASONAL weather forecast (describing expected conditions for the entire October-November-December season) from the Kenya Meteorological Department?

NOTE: This is only for SEASONAL or LONG-RUN forecasts describing the entire October-November-December (not daily weather updates)

This question ONLY refers to SEASONAL long-run forecasts, not daily/weekly forecasts.

- Yes
- No

Where do you get this information from (can select multiple format and source)?

- Radio
- TV
- Newspaper or magazine
- Mobile phone
- Spouse
- Family (not spouse)
- Community meeting
- Community group
- Women's group
- NGO (e.g. Red Cross, CARE, FAO etc)
- Friend, co-worker or neighbour
- Government worker (local government, national agencies like development agents, extension workers etc.)
- Government bulletin, leaflet, poster
- Religious institution (church, masjid, temple)
- Social media (facebook, telegram, whatsapp etc.)
- Educational institution (school, madrassa)
- Extension worker
- Disaster risk management committee (CMDRR ... etc)
- NDMA
- Traditional forecaster/emuron
- Kenya Met Department (directly)
- Other

Specify other.

What language is this forecast in?

- Turkana
- Swahili
- English
- Other

Can you interpret this information?

- Yes
- No
- Don't know

Why not?

- It isn't in a language I understand
- It isn't specific to where I live
- I don't know what the forecast means even though it is in the language I use
- Other

Specify other.

Do you trust this information?

- Yes
- No
- Refused

Agree / Disagree: "Information from the Kenya Meteorological Department fits well with my local culture and traditions."

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

Agree / Disagree: "You should always follow advice from the Kenya Meteorological Department."

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

Agree / Disagree: "The Kenya Meteorological Department is the legitimate authority on weather and climate information."

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

Did you share the information with other household members?

- Yes
- No

Do you know why you don't receive this information?

- I don't have a phone
- I don't have a radio
- I don't have a television
- I am not capable of going to meetings
- I am not allowed to go to meetings
- No one will share it with me
- I do not seek or want this information
- Other

Specify other.

Based on this information, have you made any decision in regard to...

- Paying for water
- Changing your water source
- Livestock
- Farming
- Migration or moving from where you live
- Education or taking your children from school
- Borrowing
- Other

Specify other.

Do you use this information to plan in advance?

- Yes
- No

Which anticipatory actions have you taken?

- Start preparing farm
- Prepare irrigation
- Prepare home for heavy rainfall
- Clear farm waterways
- Prepare crop storage facility
- Store food for migration
- Plant drought-tolerant crops
- Plan migration to far places
- Set aside grass for grazing
- Store animal feeds
- Visit intended migration areas for planning / negotiation
- Mobilize funds early for farming / irrigation inputs
- Buy planting materials
- Collect reeds for weaving/basketry prior to rains
- Start moving animals for pasture/water
- OTHER (specify)

Who in your household do you share it with?

- Wife
- Husband
- Son
- Daughter
- Mother
- Father
- Aunt
- Uncle
- Workers
- Everyone
- Other

Specify other.

Did you share the information with people outside the household?

- Yes
- No

How many peers did you share this with overall?

How many women outside your household did you share this with?

How many disabled people did you share this with?

How many pastoralists did you share this with?

How many youth did you share this with?

How many elderly people did you share this with?

Did you share the information with people in a neighbouring village?

- Yes
- No

Do you get this information in a timely way?

- Yes
- No

» » Additional "Other" Anticipatory Action

What other anticipatory / planning actions have you done?

Even if you didn't receive any of this information, would any of this information be useful to you for any reason?

- Yes
- No

Would you use it to make any decisions in regard to...

- Paying for water
- Changing your water source
- Livestock
- Farming
- Migration or moving from where you live
- Education or taking your children from school
- Borrowing
- Other

Specify other.

Would you use it to plan in advance?

- Yes
- No

» » Additional "Other" Anticipatory Action

What anticipatory / planning ahead would you (the household) do?

In the past, has a forecast from the Kenya Meteorological Department ever been incorrect or misled you?

- Yes
- No

What was the effect on you?

We are now interested in how much you value Climate Information from the KMD. We will be asking how much you would be willing to pay to have someone come to your house and deliver timely climate forecasts from the KMD in language you can easily understand.

To do this, we will ask you whether you are willing to pay different amounts.

Explain this forecast would have a long-term horizon and describe the entire October-November-December season.

If offered KMD climate information delivery at a price of , would you be willing to pay this?

- Yes
- No

If offered KMD climate information delivery at a price of , would you be willing to pay this?

- Yes
 No

If offered KMD climate information delivery at a price of , would you be willing to pay this?

- Yes
 No

If offered KMD climate information delivery at a price of , would you be willing to pay this?

- Yes
 No

If offered KMD climate information delivery at a price of , would you be willing to pay this?

- Yes
 No

If offered KMD climate information delivery at a price of , would you be willing to pay this?

- Yes
 No

If offered KMD climate information delivery at a price of , would you be willing to pay this?

- Yes
 No

» Monthly Forecasts

In the past 3 months have you gotten an official MONTHLY weather forecast from the met department or county government?

- Yes
 No

» Weekly Forecasts

In the past 3 months have you gotten an official WEEKLY OR DAILY forecast from the met department or county government?

- Yes
 No

» Warnings about extremes

In the past 12 months have you received alerts/warnings about extreme events? (E.g. rainfall, drought, or heat events)

- Yes
 No

Which extremes did you receive warnings about?

- Rainfall
 Flooding
 Drought
 Heat
 I didn't receive any

What method is used to create the information?

- Goat entrails
 Other livestock
 Animals that aren't livestock
 Plants
 Trees
 Stars
 Clouds
 Other methods (specify)

What is the other method?

When did you last receive this information? (approximate date is fine)

Can you interpret this information?

- Yes
 No
 Don't know

Why not?

- It isn't in a language I understand
 It isn't specific to where I live
 I don't know what the forecast means even though it is in the language I use
 Other

Specify other.

Do you trust this information?

- Yes
 No
 Refused

Agree / Disagree: "Information from indigenous sources fits well with my local culture and traditions."

- Strongly disagree
 Disagree
 Neutral
 Agree
 Strongly agree

Agree / Disagree: "You should always follow advice from indigenous and traditional knowledge source."

- Strongly disagree
 Disagree
 Neutral
 Agree
 Strongly agree

Where do you get this information from (can select multiple format and source)?

- Radio
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 Government worker (local government, national agencies like development agents, extension workers etc.)
 Government bulletin, leaflet, poster
 Religious institution (church, masjid, temple)
 Social media (facebook, telegram, whatsapp etc.)
 Educational institution (school, madrasa)
 Extension worker
 Disaster risk management committee (CMDRR ... etc)
 NDMA
 Traditional forecaster/emuron
 Kenya Met Department (directly)
 Other

Specify other.

How often do you tend to get this information?

- Once a season
 Once a month
 Every few weeks
 Only at the start of the wet season
 Daily

» Traditional or indigenous climate information

In the past 3 months have you received climate information from indigenous or traditional sources?

- Yes
 No

Agree / Disagree: "Indigenous and Traditional sources are the legitimate authority on weather and climate information."

- Strongly disagree
 Disagree
 Neutral
 Agree
 Strongly agree

Does this information come with other information that isn't about weather?

- Yes
 No

What other kind of information?

- Health information
 Information about conflict
 Investment information
 Adaptation advice
 Agricultural information
 None
 Other

Specify other.

Did you share the information with other household members?

- Yes
 No

Does these indigenous sources of information also solve the problems they foresee?

- Yes
 No

Have you ever received a charm or amulet from an indigenous knowledge expert to help solve a problem?

- Yes
 No

Did you have to pay, provide an animal, or provide any other goods to have them solve the problem?

- Yes
 No

What is the approximate cost of this solution?

Who in your household do you share it with?

- Wife
- Husband
- Son
- Daughter
- Mother
- Father
- Aunt
- Uncle
- Workers
- Everyone
- Other

Specify other.

Did you share the information with people outside the household?

- Yes
- No

Do you get this information in a timely way?

- Yes
- No

Do you know why you don't receive this information?

- I don't have a phone
- I don't have a radio
- I don't have a television
- I am not capable of going to meetings
- I am not allowed to go to meetings
- No one will share it with me
- I do not seek or want this information
- Other

Specify other.

Based on this information, have you made any decision in regard to...

- Paying for water
- Changing your water source
- Livestock
- Farming
- Migration or moving from where you live
- Education or taking your children from school
- Borrowing
- Other

Specify other.

For example, here we have SIX stones on the "Above Average Rainfall" square, THREE on the "Average Rainfall Square", and ONE on the "Below Average Rainfall" square. This would indicate a strong belief that there will be above average rainfall.

For example, here we have ONE stone on the "Above Average Rainfall" square, EIGHT on the "Average Rainfall Square", and ONE on the "Below Average Rainfall" square. This would indicate a very strong belief that there will be AVERAGE rainfall this season.

For example, here we have THREE stones on the "Above Average Rainfall" square, FOUR on the "Average Rainfall Square", and THREE on the "Below Average Rainfall" square. This would indicate a belief that AVERAGE rainfall is most likely this season, but there is a large chance of more extreme outcomes.

Finally, here we have ONE stone on the "Above Average Rainfall" square, FOUR on the "Average Rainfall Square", and FIVE on the "Below Average Rainfall" square. In ASK THE RESPONDENT WHAT THIS MEANS. If they can explain roughly that it indicates that BELOW AVERAGE or AVERAGE is most likely with a small chance of above average rains this season, proceed.

Did the respondent answer the check of understanding correctly?

- Yes
- No

Using the rainfall level sheet ask participants to allocate stones according to the likelihood of each outcome.

How many stones were allocated on the "below average" square?

How many stones were allocated on the "average" square?

How many stones were allocated on the "above average" square?

How certain are you of the answers about rainfall?

- Not certain at all about answer
- Some confidence in my answer
- Very certain about my answer

Now, we will ask about what you expect TEMPERATURE to be like this season. We will be using an exercise where you pile stones according to how likely something is. More stones on an item means you think that item is more likely to happen.

Using the temperature sheet ask participants to allocate stones according to the likelihood of each outcome.

How many stones were allocated on the "below average" square?

How many stones were allocated on the "average" square?

How many stones were allocated on the "above average" square?

Do you use this information to plan in advance?

- Yes
- No

» » Additional "Other" Anticipatory Action

What anticipatory / planning actions have you done?

Even if you didn't receive any of this information, would any of this information be useful to you for any reason?

- Yes
- No

Would you use it to make any decisions in regard to...

- Paying for water
- Changing your water source
- Livestock
- Farming
- Migration or moving from where you live
- Education or taking your children from school
- Borrowing
- Other

Specify other.

Would you use it to plan in advance?

- Yes
- No

» » Additional "Other" Anticipatory Action

What anticipatory / planning ahead would you (the household) do?

In the past, has a forecast from an indigenous Traditional Knowledge Expert ever been incorrect or misled you?

- Yes
- No

What was the effect on you?

Expectations about Upcoming Season

For research purposes, we want to understand what you expect to happen in the upcoming season and how this impacts your planning and actions. First, we will ask about what you expect RAINFALL to be like this season. We will be using an exercise where you pile stones according to how likely something is. More stones on an item means you think that item is more likely to happen.

How certain are you of the answers about temperature?

- Not certain at all about answer
- Some confidence in my answer
- Very certain about my answer

Start of Rainfall

Use the rainfall timeline sheet.

Now we are asking when they think the rains will START. More stones means they think it is *more likely* that the start of the OND rains will happen at this time.

For example: If we put SIX stones on Mid-October, TWO stones on Late October, and TWO stones on Early November, this means we think the rains will probably start in mid-late October or a small chance it will begin in early November.

If we instead put ONE stone on Early November, FOUR stones on Mid November, and FIVE stones on Late November, this means we think the rains will probably begin in mid-late November.

Now - if instead we put TWO stones on early October, SEVEN stones on Mid October, and ONE stone on Late October, what does that mean?

Check the respondent can understand that this means the rains will come early and the rainy season is highly likely to happen in Mid-October.

Then - clear the stones from the board and ask them to tell us what they expect to happen. If they aren't sure, we can show them

Did the respondent answer the check of understanding correctly?

- Yes
- No

How many stones were allocated to Early October?

How many stones were allocated on ... Mid-October?

How many stones were allocated on ... Late October?

How many stones were allocated on ... Early November?

How many stones were allocated on ... Mid-November?

How many stones were allocated on ... Late November?

How many stones were allocated on ... Early December?

How many stones were allocated on ... Mid December?

How many stones were allocated on ... Late December?

How many stones were allocated on ... Early January ?

How many stones were allocated on ... Mid January?

How many stones were allocated on ... Late January?

How certain are you of the answers about the timing of the rain beginning?

- Not certain at all about answer
 Some confidence in my answer
 Very certain about my answer

What conditions signal to you that the seasonal rains have started?

- when it rains more often than it is dry
 when there is a strong rainfall event or a storm
 when it rains and this is not followed by a long dry spell (rains again within a week)
 when the soil stays wet (not dry) for a period of time
 when there are rain clouds in the sky
 when it rains and the local winds decrease
 it doesn't seem like there is a season of rains - just individual storms or rainfall events - so there isn't a start to a season

End of Rainfall

Use the **rainfall timeline sheet**.

Now we are asking when they think the rains will *STOP* and the *DRY SEASON BEGINS*. More stones means they think it is *more likely* that the end of the rains and the beginning of the dry will happen at this time.

For example: If we put FIVE stones on Late December, THREE stones on early January, and TWO stones on Mid January, this means we think the rains will probably end in late December or early January.

If we instead put ONE stone on Early January, FOUR stones on Mid January, and FIVE stones on Late January, this means we think the rains will probably continue until mid-late January before the dry season comes.

Now - if instead we put FIVE stones on late November, THREE stones on Early December, and ONE stone on Mid December, what does that mean?

Check the respondent can understand that this means the rains will end early and the dry season will likely come by early December.

Then - clear the stones from the board and ask them to tell us what they expect to happen. If they aren't sure, we can show them

What conditions signal to you that the seasonal rains have ended?

- the soil becomes consistently dry again
 there are no more strong rainfall events or storms
 there is no rain and it becomes windy
 there is no rain and it becomes hot
 it doesn't seem like there is a season of rains - just individual storms or rainfall events - so there isn't an end to a season

Use the **rainfall timeline sheet** and ask them to allocate stones by when they think the rainy season will hit its **PEAK**. More stones on a period means it is more likely that that period receives the **MOST RAIN** during the **OND**. A large number of stones means this period is likely to have the **HIGHEST RAINFALL** of the season.

How many stones were allocated to Early October ?

How many stones were allocated on ... Mid-October ?

How many stones were allocated on ... Late October ?

How many stones were allocated on ... Early November ?

How many stones were allocated on ... Mid-November ?

How many stones were allocated on ... Late November ?

How many stones were allocated on ... Early December ?

How many stones were allocated on ... Mid December?

How many stones were allocated on ... Late December?

How many stones were allocated on ... Early January ?

How many stones were allocated on ... Mid January?

How many stones were allocated on ... Late January?

Did the respondent answer the check of understanding correctly?

- Yes
 No

How many stones were allocated to Early October ?

How many stones were allocated on ... Mid-October ?

How many stones were allocated on ... Late October ?

How many stones were allocated on ... Early November ?

How many stones were allocated on ... Mid-November ?

How many stones were allocated on ... Late November ?

How many stones were allocated on ... Early December ?

How many stones were allocated on ... Mid December?

How many stones were allocated on ... Late December?

How many stones were allocated on ... Early January ?

How many stones were allocated on ... Mid January?

How many stones were allocated on ... Late January?

How certain are you of the answers about the timing of the dry seasons?

- Not certain at all about answer
 Some confidence in my answer
 Very certain about my answer

How certain are you of the answers about rainfall peak timing?

- Not certain at all about answer
 Some confidence in my answer
 Very certain about my answer

Using the **KMD / Emuron sheet** to ask participants to allocate stones according to which source they prefer.

How many stones were allocated on the Emuron square?

How many stones were allocated on the KMD square?

Section 7: Climate Anxiety

» We would like to know how you feel about climate change in your life and where you live. These questions are about how you feel so there are no good or bad answers here.

Are you worried that climate change threatens people and the planet.

- Not worried
 A little
 Moderately
 Extremely

Does climate change make you feel any of the following?

- Sad
 Helpless
 Anxious
 Afraid
 Optimistic
 Angry
 Guilty
 Ashamed
 Hurt
 Depressed
 Despair
 Grief
 Powerless
 Indifferent

My feelings about climate change negatively affect my daily life (at least one of the following: Eating, concentrating, work, school, sleeping, spending time in nature, playing, having fun, relationships).

- Yes
 No

Does climate change make you think any of the following?

- I'm hesitant to have children
- Humanity is doomed
- The future is frightening
- I won't have access to the same opportunities that my parents had
- My family's security will be threatened (e.g. economic, social, physical security)
- The things I most value will be destroyed
- People have failed to take care of the planet

When I try to talk about climate change other people have ignored or dismissed me.

- Yes
- No
- I don't talk to other people about climate change

I am reassured by governments' action on climate change.

- Not at all
- A little
- Moderately
- Very
- Completely reassured

In relation to climate change I believe that my government is ...

- Taking my concerns seriously enough
- Doing enough to avoid a climate catastrophe
- Dismissing people's distress
- Acting in line with climate science
- Protecting me, the planet and/or future generations
- Can be trusted
- Lying about the effectiveness of the actions they are taking
- Falling young people across the world
- Betraying me and/or future generations

When I think about how my government is responding to climate change I feel:

- Anguished
- Abandoned
- Afraid
- Hopeful
- Angry
- Valued
- Ashamed
- Belittled
- Protected

I have been directly affected by climate change

- Never
- Rarely
- Sometimes
- Often
- Almost always

I know someone who has been directly affected by climate change

- No people
- Very few people
- A few people
- Many people
- Very many people

I have noticed a change in a place that is important to me due to climate change

- Never
- Rarely
- Sometimes
- Often
- Almost always

Closing

Thank you very much. We've reached the end of the survey. All of your responses will be very helpful.

THE FOLLOWING QUESTIONS ARE TO BE ANSWERED BY THE ENUMERATOR BEFORE LEAVING THE RESPONDENT'S PRESENCE

The roof of this house is made of:

- Metal sheets
- Brick
- Thatch / Palm leaf
- Roofing tiles
- Other

Specify other.

The walls of the house are made of:

- Tin
- Brick
- Mud
- Concrete
- Other

Specify other.

Was the respondent alone during the interview?

- Alone for entire interview
- Alone for at least 50% of interview
- In the presence of other family members or friends for more than 50% of the interview.

Did the respondent have trouble understanding survey questions?

- Yes, many times
- Yes, a few times
- No

Did it take more than one interview for the respondent to complete the questionnaire?

- Yes
- No

Do you want to enter GPS coordinates manually or automatically?

- Automatic
- Manual

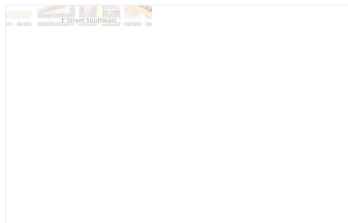
Collect GPS Coordinates(Latitude and Longitude)

latitude (x,y °)

longitude (x,y °)

altitude (m)

accuracy (m)



Enter GPS Coordinates: Latitude

Enter GPS Coordinates: Longitude

F Midline Survey Questionnaire

climateforal_midline

<https://enketo.ona.io/x/E02Ere9b>

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Administrative Information

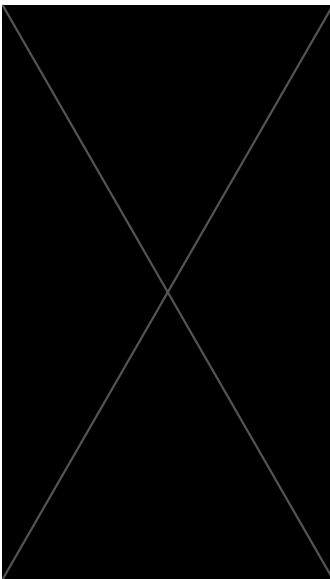
Fill as much of section A as you can before you start the interview.

Time of interview

hh:mm

Date of interview

Enumerator name



Enumeration Area Sub-County

- Turkana Central
- Loima

SurveyID

Does the respondent live in ward?

- Yes
 No

Does the respondent live in village?

- Yes
 No

Is the respondent's name ?

- Yes
 No

Do they live in the same household as ?

- Yes
 No

What is this respondent's name?

What is your age?

Did the respondent read the information sheet, and sign and agree the terms on the consent form?

- Yes
 No

Will you be available for an endline interview in June/July?

- Yes
 No

What is your phone number?

IGNORE LEADING ZERO

Is there an alternate phone number we can use to reach you?

- Yes
 No

What is an alternate phone number we can use to reach you?

IGNORE LEADING ZERO

Whose phone number is this?

- Other member of same household
 Neighbour
 Family in other household
 Village leadership
 CHV
 Other

Specify OTHER

What is your gender?

- Male
 Female
 Non-Binary
 Other
 Refuse to answer

What is the highest level of education you completed?

- Lower primary school
 Upper primary school
 Secondary school
 University
 Vocational school/trade school
 None

How well can you read in Turkana language / Ngaturkan?

- Not at all
 A little bit
 A moderate amount
 Quite well
 Fully fluent
 Refuse to answer

How well can you speak/understand Swahili?

- Not at all
 A little bit
 A moderate amount
 Quite well
 Fully fluent
 Refuse to answer

How well can you read Swahili?

- Not at all
 A little bit
 A moderate amount
 Quite well
 Fully fluent
 Refuse to answer

Do you own a cell phone?

- Yes
 No

Do you own a radio?

- Yes
 No

Demographics

We will now ask you about the people in your household. Here, when we say "household" we include all the people that have taken most of their meals together in this house for at least the last six months.

Are there people who would normally be part of your household who are temporarily away from the household?

- Yes
 No

Where are they staying?

- Urban Area / City
 Rural area (for non-grazing activity)
 Rural area (for grazing)

For people staying in an URBAN area ... Why are they staying there temporarily?

- Work
 No food / income to support them at normal home
 Access medical care
 Other (specify)

Specify OTHER

For people staying in an URBAN area ... Is this a result of seasonal conditions like rainfall, temperature, or pasture?

- Yes
 No

Which CITY / TOWN are they staying in?

How many household members are temporarily in URBAN areas?

Who from the household is temporarily in URBAN areas?

- Senior Men
 Senior Women
 Young Men
 Young Women
 Boy Children
 Girl Children

Approximately when did they leave for the URBAN area?

Do you expect them to come back from the URBAN area in the next six months?

- Yes
 No

Approximately when do you expect them to RETURN from the URBAN area?

How many household members are temporarily away for grazing?

Who from the household is temporarily away for grazing?

- Senior Men
 Senior Women
 Young Men
 Young Women
 Boy Children
 Girl Children

Approximately when did they leave for for grazing?

Approximately when do you expect them to RETURN from grazing?

For people staying in another RURAL area Why are they staying there temporarily?

- Work
 No food / income to support them at normal home
 Access medical care
 Other (specify)

Specify OTHER

For people staying in another RURAL area What type of work are they doing?

- Working in town
 Working in fishery
 Working in mining
 Working in agriculture
 Other work (specify)

For people staying in another RURAL area Is this a result of seasonal conditions like rainfall, temperature, or pasture?

- Yes
 No

We will now ask you about the livelihoods supporting your household, and all the different economic activities you do regularly.

We want to remind you that we are researchers and will not be giving out gifts or support or assistance based on your income. We will not be sharing information that identifies you with the government or NGOs, so nothing you tell us will impact your likelihood of getting assistance or relief.

What livelihoods are practiced by people in this household?

For agropastoralists, check both "pastoralism" and "crop farming".

Remind people to answer for the WHOLE HOUSEHOLD not just themselves.

- Pastoralism
 Crop Farming
 Basketry or Other Weaving
 Charcoal Burning
 Wage/Casual Labour
 Beekeeping / Apiculture
 Other Enterprise / Business (NOT including basketry or charcoal burning)
 Fishing
 Begging
 Mining
 Other (specify)

Specify OTHER

Are you **SURE** they don't practice at least one of these livelihoods?

- Yes
 No

Pastoralism

We now want to ask about any migration your household does for grazing.

Please tell us about migration by ANY MEMBER OF YOUR HOUSEHOLD, not just the respondent themselves.

Are there people who would normally be part of your household who are temporarily away from the household?

- Yes
 No

How many household members are temporarily away for grazing?

Who from the household is temporarily away for grazing?

- Senior Men
 Senior Women
 Young Men
 Young Women
 Boy Children
 Girl Children

Approximately when did they leave for for grazing?

Where are they? (Location Name)

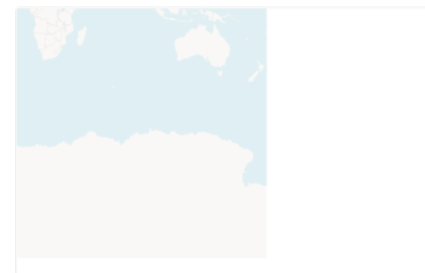
Please locate the site on the map.

latitude (x.y °)

longitude (x.y °)

altitude (m)

accuracy (m)



Approximately when do you expect them to RETURN from grazing?

Do you have a kraal or satellite camp away from the homestead where your household goes to stay and graze animals?

This includes the ENTIRE HOUSEHOLD not just this respondent personally.

This only refers to a place they go and temporarily live/sleep. If they do zero grazing during the day near the homestead, answer NO.

- Yes
 No

Do you have a plan for when and where your household will be migrating for grazing this season?

Ask about the ENTIRE HOUSEHOLD not just this respondent.

This includes making a decision NOT to migrate. Only answer NO if they are completely uncertain about their grazing plans. If they are certain they are NOT migrating, answer YES to this question and NO to the next one.

- Yes
 No

Is there a chance anyone from your household will be migrating to graze this season?

- Yes
 No

Why did your household make this decision? (What were the key reasons?)

How did your household make this decision? (What information did you use? Who did you talk to? Did you make this decision by yourself?)

How would you decide where to migrate?

Is your kraal the farthest away from the homestead your household plans to graze animals this March-April-May season?

- Yes
 No

Where is the furthest from homestead your household currently plans to graze animals this March-April-May season?

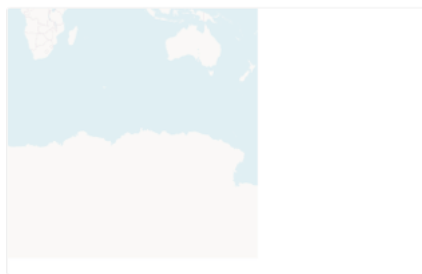
Please locate the site on the map.

latitude (x,y °)

longitude (x,y °)

altitude (m)

accuracy (m)



What is the name of this site?

How many weeks do you expect someone from your household will be grazing animals more than a day's walk away from your homestead?

Ask about the ENTIRE HOUSEHOLD not just this respondent.

When do you expect to begin this grazing migration?

What information does your household use to decide if/when to migrate for grazing?

Which animals do you plan to take this season?

- Cattle (NOT including calves)
 Calves
 Camels
 Adult Sheep
 Adult Goats
 Young Sheep & Goats
 Donkeys
 Birds (chickens, ducks, ...)
 Other (specify)

Do you and your household WANT TO TAKE any of these actions this season?

Ask about the ENTIRE HOUSEHOLD not just this respondent.

- Migrate further
 Migrate less
 Sell more livestock
 Sell fewer livestock
 Slaughter more livestock
 Slaughter less livestock
 Buy more forage or water
 Buy less forage or water
 Buy more veterinary services
 Buy less veterinary services
 Visit intended migration areas for planning / negotiation
 Store animal feeds
 Reserve grass for grazing when dry
 Plan migration to far places (e.g. store food, etc.)
 Plant fodder crops
 Shift to more drought-tolerant animals
 Collect livestock feeds
 Repair Livestock Pens at Homestead
 Restocking / increase herd size
 Destocking / decrease herd size
 None
 Other (Specify if other)

Specify OTHER:

» Reasons for changes

Agriculture

For research purposes, we want to understand the land you farm, the crops you grow, and the challenges you face with agriculture.

We want to know about your household's TOTAL agriculture, not just the plots you plant. Please tell us about all farming done by this household.

Would you and your household WANT TO take any of these actions this season?

- Plant more drought-resistant crops
 Plant less drought-resistant crops
 Start preparing farm earlier than usual
 Start preparing farm later than usual
 Start planting earlier than usual
 Start planting later than usual
 Prepare/invest in irrigation
 Clear extra land
 Plant more land
 Plant less land
 Buy more planting materials
 Buy less planting materials
 Grow more fodder crops for animals
 Grow fewer fodder crops for animals
 Shift land from food production to fodder/pasture
 Shift land from fodder/pasture to food production
 Move farms closer to the river
 Move farms further from rivers
 None
 Other (Specify if other)

Specify OTHER:

» Reasons for changes

Basketry and Weaving

For research purposes, we want to understand your major livelihoods so we will now ask about Basketry and weaving.

Please tell us about Basketry and Weaving done by the ENTIRE household.

Have you begun storing / gathering basketry materials?

- Yes
 No

Would your household LIKE TO change how much basketry/weaving you do?

- Yes
 No

How would your household WANT TO change your basketry/weaving activities?

- INCREASE
 DECREASE
 Not Sure / Didn't Respond

Charcoal Burning

For research purposes, we want to understand your major livelihoods so we will now ask about any charcoal burning your household does.

Please tell us about Charcoal Burning done by the ENTIRE household.

What are your household's normal average monthly profits from producing charcoal?

Ask about the ENTIRE HOUSEHOLD not just this respondent.

How many KGs of charcoal does your household normally produce per month?

Ask about the ENTIRE HOUSEHOLD not just this respondent.

Would your household LIKE TO change how much your household burns/produces charcoal?

- Yes
 No

How will your household WANT TO change your burning / production of charcoal?

- INCREASE
 DECREASE
 Not Sure / Didn't Respond

Non-Farm Self-Employment

For research purposes, we want to understand your major livelihoods so we will now ask about any enterprises your household does.

Would your household LIKE TO start a new non-pastoralism, non-agriculture enterprise this season?

- Yes
 No

What enterprise or enterprises?

Would your household LIKE TO expand an existing non-pastoralism, non-agriculture enterprise this season?

- Yes
 No

What enterprise or enterprises?

Would your household LIKE TO stop/decrease an existing non-pastoralism, non-agriculture enterprise this season?

- Yes
 No

What enterprise or enterprises?

Apiculture / Beekeeping

For research purposes, we want to understand your major livelihoods so we will now ask about Apiculture, Beekeeping, and Honey Production

Please tell us about Beekeeping done by the ENTIRE household not just you personally.

Would your household LIKE TO change how much your household earns from apiculture / beekeeping?

- Yes
 No

How would your household LIKE TO change your beekeeping activities?

- INCREASE
 DECREASE
 Not Sure / Didn't Respond

Casual / Wage Labour

We are now keen to learn about your casual/wage employment.

Would your household LIKE TO change how much your household earns from casual / wage labour?

- Yes
 No

How would your household LIKE TO change your casual/wage labour activities?

- INCREASE
 DECREASE
 Not Sure / Didn't Respond

Fisheries

We are now keen to learn about your household's work fishing.

Please tell us about Fishing done by the ENTIRE household not just you personally.

Would your household LIKE TO change how much your household earns from fisheries?

- Yes
 No

How would your household LIKE TO change your fishing activities?

- INCREASE
 DECREASE
 Not Sure / Didn't Respond

Begging

We are now keen to learn about your money received from begging / asking for money.

Please tell us about Begging done by the ENTIRE household not just you personally.

Would your household LIKE TO change how much your household earns from begging?

- Yes
 No

How would your household LIKE TO change your begging activities?

- INCREASE
 DECREASE
 Not Sure / Didn't Respond

Mining

We are now keen to learn about your work mining.

Please tell us about Mining done by the ENTIRE household not just you personally.

Would your household LIKE TO change how much your household earns from mining?

- Yes
 No

How would your household LIKE TO change your mining activities?

- INCREASE
 DECREASE
 Not Sure / Didn't Respond

Other Income: Govt, NGO, Remittance

We are now going to ask about income received through transfers.

Please tell us about Transfers Received by the ENTIRE household not just you personally.

If you could ask **the government** for up to 3 services or assistance this season, what would it be?

- Cash Transfers
- Relief Food
- Capital/grants for business
- Irrigation inputs/investment
- Livestock medication
- Improved health facilities
- School and scholarships
- Water
- Animal feed
- Water boreholes
- Restocking
- Canal clearing
- Farm inputs (seeds, equipment, pesticide, etc.)
- Mining equipment
- Access to more land
- Motorbike
- No Aid required
- Other (Specify)

Specify OTHER

If you could ask **NGOs** for up to 3 services or assistance this season, what would it be?

- Cash Transfers
- Relief Food
- Capital/grants for business
- Irrigation inputs/investment
- Livestock medication
- Improved health facilities
- School and scholarships
- Water
- Animal feed
- Water boreholes
- Restocking
- Canal clearing
- Farm inputs (seeds, equipment, pesticide, etc.)
- Mining equipment
- Access to more land
- Motorbike
- No Aid required
- Other (Specify)

Specify OTHER

What support do you need to implement your coping / adaptation plan for this season?

Household Savings

Are you planning to change how much your household saves over the next month?

- Yes
- No

How will your household change your savings?

- The household will save MORE
- The household will save LESS
- Not Sure / Didn't Respond

Are you planning to change how much your household borrows over the next month?

- Yes
- No

How will your household change your borrowing?

- The household will borrow MORE
- The household will borrow LESS
- Not Sure / Didn't Respond

Section 6: Climate Information

Now we would be keen to know what anticipatory actions your household would WANT to take this season.

Please tell us about YOUR HOUSEHOLD as a WHOLE not just you personally.

Which anticipatory actions would your household WANT to take?

Ask about the ENTIRE HOUSEHOLD not just this respondent.

- Reduce the number of meals eaten each day
- Request more food aid
- Rely on assistance from others
- Pull children otherwise in school, out of school
- INCREASE non-livestock livelihoods
- DECREASE non-livestock livelihoods
- INCREASE livestock livelihoods
- DECREASE livestock livelihoods
- Produce and sell MORE charcoal
- Produce and sell LESS charcoal
- Send family members to look for work elsewhere
- Bring family members back from elsewhere
- Did not do anything different
- Buy more food on credit
- Buy less food on credit
- Rely more on others
- Rely less on others
- Keep children in school
- Pull children out of school
- Clear waterways and prepare home for flood
- Repair roof & prepare for heavy rainfall
- Marry daughters earlier than planned for bridewealth
- Pay dowry/bridewealth and add wives for men in your family
- Gather and store firewood, fuel, or charcoal
- Buy mosquito nets
- Move home to higher ground, further from river
- Move home closer to the river
- None
- Other (Specify if other)

What type of work do you expect people to do?

- Working in town
- Working in fishery
- Working in mining
- Working in agriculture
- Other work (specify)

» Additional "Other" Anticipatory Action

What other anticipatory / planning actions would your household LIKE to do?

What are the biggest challenges you face implementing these actions?

Now we would be keen to know about the climate information you do and don't have access to and what you do with this information. We are also keen to hear if we have missed anything important about climate information in your life.

We want to know about the climate information received by your WHOLE HOUSEHOLD not just you personally.

» Seasonal and monthly forecasts

In the past 3 months has your gotten an official SEASONAL weather forecast (describing expected conditions for the entire March-April-May season) from the Kenya Meteorological Department?

NOTE: This is only for SEASONAL or LONG-RUN forecasts describing the entire March-April-May (not daily weather updates)

This question ONLY refers to SEASONAL long-run forecasts, not daily/weekly forecasts.

- Yes
- No

Did this forecast come from a Community Health Worker / Promoter / Volunteer?

This question ONLY refers to SEASONAL long-run forecasts, not daily/weekly forecasts.

- Yes
- No

Where do you get this information from (can select multiple format and source)?

- Radio
- TV
- Newspaper or magazine
- Mobile phone
- Spouse
- Family (not spouse)
- Community meeting
- Community group
- Women's group
- NGO (e.g. Red Cross, CARE, FAD etc)
- Friend, co-worker or neighbour
- Government worker (local government, national agencies like development agents, extension workers etc.)
- Government bulletin, leaflet, poster
- Religious institution (church, masjid, temple)
- Social media (facebook, telegram, whatsapp etc.)
- Educational institution (school, madrassa)
- Extension worker
- Disaster risk management committee (CMDRR ... etc)
- NDMA
- Traditional forecaster/emuron
- Kenya Met Department (directly)
- Other

Specify other.

What language is this forecast in?

- Turkana
- Swahili
- English
- Other

Can you interpret this information?

- Yes
- No
- Don't know

Why not?

- It isn't in a language I understand
- It isn't specific to where I live
- I don't know what the forecast means even though it is in the language I use
- Other

Specify other.

Do you trust this information?

- Yes
- No
- Refused

Agree / Disagree: "Information from the Kenya Meteorological Department fits well with my local culture and traditions."

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

Agree / Disagree: "You should always follow advice from the Kenya Meteorological Department."

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

Agree / Disagree: "The Kenya Meteorological Department is the legitimate authority on weather and climate information."

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

Did you share the information with other household members?

- Yes
- No

Who in your household do you share it with?

- Wife
- Husband
- Son
- Daughter
- Mother
- Father
- Aunt
- Uncle
- Workers
- Everyone
- Other

Specify other.

Did you share the information with people outside the household?

- Yes
- No

Did you share the information with people in a neighbouring village?

- Yes
- No

Do you get this information in a timely way?

- Yes
 No

Based on this information, have you made any decision in regard to...

- Paying for water
 Changing your water source
 Livestock
 Farming
 Migration or moving from where you live
 Education or taking your children from school
 Borrowing
 Other

Specify other.

Which part of the forecast was most useful for you?

- Start date of rainfall
 End date of rainfall
 Estimated rainfall level
 Temperature level
 Rainfall Map
 Pasture Condition Map
 Not sure
 Other (specify)

Which other part was most useful?

Do you use this information to plan in advance?

- Yes
 No

» Monthly Forecasts

In the past 3 months have you gotten an official MONTHLY weather forecast from the met department or county government?

- Yes
 No

» Weekly Forecasts

In the past 3 months have you gotten an official WEEKLY OR DAILY forecast from the met department or county government?

- Yes
 No

Expectations about Upcoming Season

For research purposes, we want to understand what you expect to happen in the upcoming season and how this impacts your planning and actions. First, we will ask about what you expect RAINFALL to be like this season. We will be using an exercise where you pile stones according to how likely something is. More stones on an item means you think that item is more likely to happen.

When we say AVERAGE we mean the AVERAGE conditions over the last thirty years.

For example, here we have SIX stones on the "Above Average Rainfall" square, THREE on the "Average Rainfall Square", and ONE on the "Below Average Rainfall" square. This would indicate a strong belief that there will be above average rainfall.

For example, here we have ONE stone on the "Above Average Rainfall" square, EIGHT on the "Average Rainfall Square", and ONE on the "Below Average Rainfall" square. This would indicate a very strong belief that there will be AVERAGE rainfall this season.

For example, here we have THREE stones on the "Above Average Rainfall" square, FOUR on the "Average Rainfall Square", and THREE on the "Below Average Rainfall" square. This would indicate a belief that AVERAGE rainfall is most likely this season, but there is a large chance of more extreme outcomes.

Finally, here we have ONE stone on the "Above Average Rainfall" square, FOUR on the "Average Rainfall Square", and FIVE on the "Below Average Rainfall" square.

ASK THE RESPONDENT WHAT THIS MEANS. If they can explain roughly that it indicates that BELOW AVERAGE or AVERAGE is most likely with a small chance of above average rains this season, proceed.

Did the respondent answer the check of understanding correctly?

- Yes
 No

Using the rainfall level sheet ask participants to allocate stones according to the likelihood of each outcome.

How many stones were allocated on the "below average" square?

0

How many stones were allocated on the "average" square?

0

How many stones were allocated on the "above average" square?

0

How certain are you of the answers about rainfall?

- Not certain at all about answer
 Some confidence in my answer
 Very certain about my answer

Now, we will ask about what you expect TEMPERATURE to be like this season. We will be using an exercise where you pile stones according to how likely something is. More stones on an item means you think that item is more likely to happen.

Using the temperature sheet ask participants to allocate stones according to the likelihood of each outcome.

How many stones were allocated on the "below average" square?

0

How many stones were allocated on the "average" square?

0

How many stones were allocated on the "above average" square?

0

How certain are you of the answers about temperature?

- Not certain at all about answer
 Some confidence in my answer
 Very certain about my answer

Start of Rainfall

Use the rainfall timeline sheet.

Now we are asking when they think the rains will START. More stones means they think it is more likely that the start of the MAM rains will begin at this time.

For example: If we put SIX stones on Mid-March, TWO stones on Late March, and TWO stones on Early April, this means we think the rains will probably start in mid-late March or a small chance it will begin in early April.

If we instead put ONE stone on Early April, FOUR stones on Mid April, and FIVE stones on Late April, this means we think the rains will probably begin in mid-late April.

Now - if instead we put TWO stones on early March, SEVEN stones on Mid March, and ONE stone on Late March, what does that mean?

Check the respondent can understand that this means the rains will come early and the rainy season is highly likely to begin in Mid-March.

Then - clear the stones from the board and ask them to tell us what they expect to happen. If they aren't sure, we can start by asking them the EARLIEST time it might begin, and the LATEST time it might begin to place stones marking the range, then prompt them to think about the last few years to start filling in the other stones.

Did the respondent answer the check of understanding correctly?

- Yes
 No

How many stones were allocated to Early March ?

0

How many stones were allocated on ... Mid-March ?

0

How many stones were allocated on ... Late March ?

0

How many stones were allocated on ... Early April ?

0

How many stones were allocated on ... Mid-April ?

0

How many stones were allocated on ... Late April ?

0

How many stones were allocated on ... Early May ?

0

How many stones were allocated on ... Mid May?

0

How many stones were allocated on ... Late May?

0

How many stones were allocated on ... Early June ?

0

How many stones were allocated on ... Mid June?

0

How many stones were allocated on ... Late June?

0

How certain are you of the answers about the timing of the rain beginning?

- Not certain at all about answer
- Some confidence in my answer
- Very certain about my answer

What conditions signal to you that the seasonal rains have started?

- when it rains more often than it is dry
- when there is a strong rainfall event or a storm
- when it rains and this is not followed by a long dry spell (rains again within a week)
- when the soil stays wet (not dry) for a period of time
- when there are rain clouds in the sky
- when it rains and the local winds decrease
- it doesn't seem like there is a season of rains - just individual storms or rainfall events - so there isn't a start to a season
- Other (specify)

What is the other signal?

End of Rainfall

Use the **rainfall timeline sheet**.

Now we are asking when they think the rains will *STOP* and the *DRY SEASON BEGINS*. More stones means they think it is *more likely* that the end of the rains and the beginning of the dry will happen at this time.

For example: If we put FIVE stones on Late May, THREE stones on early June, and TWO stones on Mid June, this means we think the rains will probably end in late May or early June.

If we instead put ONE stone on Early June, FOUR stones on Mid June, and FIVE stones on Late June, this means we think the rains will probably continue until mid-late June before the dry season comes.

Now - if instead we put FIVE stones on late April, THREE stones on Early May, and ONE stone on Mid May, what does that mean?

Check the respondent can understand that this means the rains will end early and the dry season will likely come by early May.

Then - clear the stones from the board and ask them to tell us what they expect to happen. If they aren't sure, we can show them

Did the respondent answer the check of understanding correctly?

- Yes
- No

How many stones were allocated to Early March ?

0

How many stones were allocated on ... Mid-March ?

0

How many stones were allocated on ... Late March ?

0

How many stones were allocated on ... Early April ?

0

How many stones were allocated on ... Mid-April ?

0

How many stones were allocated on ... Late April ?

0

How many stones were allocated on ... Early May ?

0

How many stones were allocated on ... Mid May?

0

How many stones were allocated on ... Late May?

0

How many stones were allocated on ... Early June ?

0

How many stones were allocated on ... Mid June?

0

How many stones were allocated on ... Late June?

0

How certain are you of the answers about the timing of the dry seasons?

- Not certain at all about answer
- Some confidence in my answer
- Very certain about my answer

What conditions signal to you that the seasonal rains have ended?

- the soil becomes consistently dry again
- there are no more strong rainfall events or storms
- there is no rain and it becomes windy
- there is no rain and it becomes hot
- it doesn't seem like there is a season of rains - just individual storms or rainfall events - so there isn't an end to a season
- Other (specify)

What is the other signal?

Section 7: Climate Anxiety

» We would like to know how you feel about climate change in your life and where you live. These questions are about how you feel so there are no good or bad answers here.

Are you worried that climate change threatens people and the planet.

- Not worried
- A little
- Moderately
- Extremely

Does climate change make you feel any of the following?

- Sad
- Helpless
- Anxious
- Afraid
- Optimistic
- Angry
- Guilty
- Ashamed
- Hurt
- Depressed
- Despair
- Grief
- Powerless
- Indifferent

Closing

Thank you very much. We've reached the end of the survey. All of your responses will be very helpful.

THE FOLLOWING QUESTIONS ARE TO BE ANSWERED BY THE ENUMERATOR BEFORE LEAVING THE RESPONDENT'S PRESENCE

Was the respondent alone during the interview?

- Alone for entire interview
- Alone for at least 50% of interview
- In the presence of other family members or friends for more than 50% of the interview.

Did the respondent have trouble understanding survey questions?

- Yes, many times
- Yes, a few times
- No

Did it take more than one interview for the respondent to complete the questionnaire?

- Yes
- No

Any comments on this interview? (Optional)**Do you want to enter GPS coordinates manually or automatically?**

- Automatic
- Manual

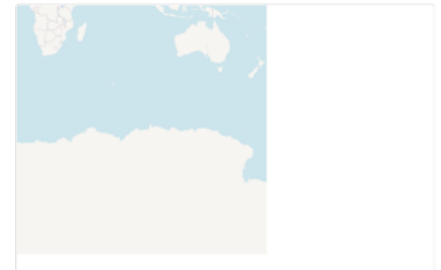
Collect GPS Coordinates(Latitude and Longitude)

latitude (x,y °)

longitude (x,y °)

altitude (m)



accuracy (m)



Enter GPS Coordinates: Latitude



Enter GPS Coordinates: Longitude

F.1 Proportional Piling Sheets

 Alalau a akiru ekaru lo
(Amount of Rainfall this season) 

<p>Adit noi (Below Average)</p>	<p>Echiethit (Average)</p>	<p>Alal cha (Above Average)</p>
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Figure 14: Sheet Used for Eliciting Rainfall Level Expectation

 Arirau aakwap/ Amonith ang'ilapio
(Temperature / Heat this season) 

<p>Adit noi (Below Average)</p>	<p>Echiethit (Average)</p>	<p>Alal cha (Above Average)</p>
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Figure 15: Sheet Used for Temperature Level Expectation

Atia alalau a akiru alokaru ai
(Amount of Rainfall over time)

Atia alalau a akiru alokaru ai
(Amount of Rainfall over time)



Figure 16: Sheets Used for Eliciting Rainfall Timeline Expectation