



Mercy Corps

Energy-Water-Food Nexus Assessment and Benchmarking Tool for Food for Peace Programs

Nexus Benchmarking Study Plan

By Federico S. Fische and Jude Deus Kiwanuka

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Contact:

Shanti Kleiman, Energy-Water-Food Nexus Benchmarking Study, 1111 19th Street NW, Suite 650, Washington, DC 20036, skleiman@dc.mercycorps.org

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ACRONYMS

AWTID	Abim Women Together In Development
CAHWS	Community Health Workers
CU2	Children Under 2 years old
ESMAP	Energy Sector Management Assistance Program
FFP	USAID Office of Food for Peace
FGD	Focus Group Discussions
FTF	Feed the Future Initiative
GHG	Growth, Health, and Governance Program
HH	Household
IDI	In-Depth Interviews
IRENA	International Renewable Energy Agency
KAPDA	Kaabong Peace and Development Agency
M&E	Monitoring and Evaluation
MTT	Multi-Tier Tool
PLW	Pregnant and Lactating Women
TOPS	Technical and Operational Performance Support (as in The TOPS Program)
UCSU/SACCO	Uganda Cooperative Savings and Credit Union Limited/ Savings and credit Cooperative Societies

Context

The Northern Karamoja Growth, Health and Governance Project

The Northern Karamoja Growth, Health and Governance (GHG) project was designed to capitalize on this pivotal moment through a range of economic, health, and governance initiatives that will cement the gains from increased security and build a foundation for broader self-sufficiency, while well targeted food aid for pregnant and lactating women and children under the age of two hastens the process of transition from decades of food aid by filling nutrition deficits in highly food insecure households. GHG's geographical focus includes the northernmost three Karamojong districts of Kaabong, Kotido and Abim, home to approximately 540,000 individuals.

Energy-Water-Food Nexus Benchmarking

The Energy-Food-Water Nexus Benchmarking project will complement a 5-year Food For Peace (FFP) project, GHG, currently being implemented in Northern Karamoja, which aims to improve peace and food security through an integrated, gender-sensitive approach. Activities under GHG strengthen Karamojong livelihoods, support child health and nutrition, and bolster local capacity to improve governance and mitigate conflict. The GHG team has recognized the need to enhance energy access in order to meet the wider goals of the project, and have identified the opportunity to take a 'nexus' approach that links energy to water access and ultimately to the food system.

Purpose of the Energy-Water-Food Nexus Assessment and Benchmarking Tool

The Energy-Water-Food Nexus Benchmarking aims to test a practical survey instrument to benchmark energy access for productive use that can be used throughout the global food security community for design, baseline, and benchmarking of Nexus activities to achieve food security goals, while also adding practical value to the GHG program. ESMAP (Energy Sector Management Assistance Program) has already developed a robust multi-tier methodology for household lighting and cooking access and is now in the process of developing modules for productive use.

This project will use three ESMAP MTT (Multi-Tier Tools) modules through the existing GHG program, being implemented by Mercy Corps and consortium partners in Northern Karamoja. Following piloting of the tool a final design workshop on findings will be held with GHG consortium partners to incorporate findings into practical piloting of nexus activities via the GHG FFP program. This entire process will be documented and the findings and methodology report will be shared with Food for Peace Uganda Mission, GHG partners World Vision, Feinstein International Center, Pastoralism and Poverty Frontiers, and Kaabong Peace and Development Agency, and key organizations, like ACDI-VOCA, who actively implement food security programs in Uganda. The final report and methodology

will also be disseminated through the TOPS network and to the SE4All Energy Practitioners network.

Goal of the Nexus Benchmarking Study

Improve impact of food security program through better integration of energy-water-food “Nexus” design into existing and future Food for Peace programs. Objectives:

- Test energy for productive use baseline and benchmarking tool for use within Food For Peace programs
- Disseminate methodology and findings to global food security and energy access communities, and
- Provide concrete and actionable recommendations for GHG program activities based on the project findings.

Benchmarking Methodology

This Study plan proposes a three-stage approach to developing the complex inter-relatedness of the Energy-Water- Food nexus with a base consideration of the Karamoja context and GHG program activities strategically specific to the FFP and FTF (Feed the Future Initiative) Standard indicators.

Energy Access

The Energy Household Survey

The ESMAP MTT will be used to look into the quantitative nature of assessment for energy access through its following modules:

- 1) Use of Electricity Services
- 2) Use of Cooking Solutions
- 3) Productive Uses of Energy

Modules are presented in Appendix 1a and associated survey in Appendix 1a

Water Access and Use

Water Household Survey

This short survey with an attributes structure similar to those of ESMAP’s MTT, to look into the qualitative aspects of assessment for water access and use through its following attributes:

- 1) Water Source
- 2) Reliability
- 3) Quality of Service
- 4) Affordability
- 5) Legality
- 6) Convenience
- 7) Health

Appendix 2 presents the Water HH (Household) Survey Interview questionnaire

Nexus Correlation Tool

The correlation of energy and water access for productive uses will seek to bring to the forefront aspects of the Karamoja food and value chain for farm productivity in order to highlight response actions for the GHG Program in Karamoja.

The GHG objectives define the scope of the M&E mechanisms: the scope of their three strategic objectives: i) Pro-poor market development ii) Healthcare and Nutrition ii) Conflict mitigation structuring.

The correlation tool will be based on a value chain analysis. This approach looks into institutional analysis and development and how people interact with each other and use their resources, which in turn would create the socio-economical interactions for the nexus. This approach also provides for cultural and geographical sensitivities. The value chain analysis will be developed based on the initial set of information collected during the survey phase.

Conclusion

This Energy-Water-Food Nexus Benchmarking aims to test a practical survey instrument to benchmark energy access for productive use that can be used throughout the global food security community for design, baseline, and benchmarking of Nexus activities to achieve food security goals, while also adding practical value to the GHG program. The methodological approach to this is the utilization of an hybrid system which:

- 1) Benchmark Access to energy using ESMAP MTTs.¹
- 2) Develop a short and simple survey on access and use of water, which will produce outputs that can be presented as tiers
- 3) Formulate a correlation tool for the GHG program, to allow drawing conclusions with potential lessons for the Food for Peace initiative.

ESMAP has already developed a robust multi-tier methodology for access to electricity services, cooking solutions and energy for productive use. These tools are fully tested and validated in Uganda. The three proposed tools will provide the GHG program with data to measure the impact of energy, or the lack of, in residential and commercial settings. This will allow the GHG program to design additional activities associated to the value chain related activity and sanitary interventions at residential and institutional levels in Karamoja.

The MTT is focused on access, mainly on the “what.” Meaning, *what you can measure as a level of access*: solar home system, grid connection for x hours, etc. etc. While the water nexus module will focus on the impact of such access. Therefore, rather than using the

¹ The adopted MTTs were copied from ESMAP’s Multi-tier Tools for Implementation

multitier, we will be using a short survey focused on some basic qualitative indicator assessments related to the water access, use and linkages to the food chain.

A value chain analysis will provide the correlation between the three elements of the nexus.

In Early 2015, IRENA (International Renewable Energy Agency) published a document looking into the Renewable Energy in the Water, Energy and Food Nexus. This is a technical document developed in support of a 2050 goal for the water-energy-food nexus. It presents the complexities of measuring this nexuses at national level mainly for policy decision-making purposes. While the reviewed division-making tools do not apply to our case, the proposed approach is consistent with IRENA's justification for tools selection²:

- The tool should cover at least two of the three elements of the nexus. In our case we focus on energy and water
- It allows for policy analysis at national, regional or local levels to guide their decision. In our case we focus on regional and local levels.
- It is widely accessible and ready for use, or is open access. While a hybrid, the proposed tool will be easily accessible by the potential end-user, the implementing partners of the Food for Peace initiative.

Survey Methodology

Survey Instruments

Access to Energy

ESMAP developed a survey tool for their MTTs. For the purpose of the nexus benchmarking, this survey has been shortened to focus on the three multi-tier matrix (See Appendix 1b). Therefore, survey on access to energy can utilize the codebook developed by ESMAP.

Access to Water

Based on the attributes mentioned above, a short survey with simple qualitative questions has been developed (See Appendix 2). Most of the questions are very diverse and thorough in their investigation of Water access, usage, perceptions and how it impacts on the food sector. A separate codebook will be generated for the Water access survey.

Survey Sampling

Approach

The total population size of the GHG program in three Karamoja districts are 540,000 individuals and the direct beneficiaries according to GHG figures are 340,104 residents. The nexus benchmarking study exercise will sample from the direct beneficiaries using a

² Adapted from Box 3.2 "justification of the criteria used for the election of tools" Renewable Energy in the Water, Energy & Food Nexus, IRENA, January 2015

stratified purposeful sampling strategy to look into characteristics of particular subgroups of interest involved in the GHG Program in Karamoja.

The groups will be stratified based on Age, Sex and District to look into the representation of the GHG activities based on their strategic objectives on the ground which are:

- **S01: Poor-Poor Market Development** – focused on building local capacity to provide vital products and services on a commercially sustainable basis to vulnerable households;
- **S02: Nutritional Status among Children under Five Improved** – focused on improving local public and private healthcare, promoting improved household food consumption, and improving water infrastructure and sanitation and hygiene behaviours;
- **S03: Reduced Incidences of Conflict** – focused on helping local conflict mitigation structures adapt to the current conflict dynamic, while supporting traditional authority structures and male and female youth to play more constructive roles in improving security.

We plan to conduct In-depth Interviews (IDI) for the ESMAP MTTs to bring out the quantitative variables of the Study and use FGD (Focus Group Discussions) on the Water Survey for the qualitative feedback. The ESMAP code book will be used for the ESMAP MTTs and a code book for the water survey will be compiled during testing.

A correlation tool will be developed with the ESMAP support to measure and analyze the Energy-Water- Food linkages and synergies of the qualitative and quantitative variables of the Study. Showing the tier representations and nexus dependencies in the GHG Program in Karamoja.

Sampling Methodology

A purposive sampling strategy will be used to select the participants of the study. The list from which we sample includes the known and relevant GHG Program groups, categories and social strata. The sample therefore will be a cross-section of diverse GHG Program affected groups, such as these on the below relevant GHG topics which will be stratified according to Age, Sex and District:

- 1) Productive Engagement – Local Implementers (AWOTID, KAPDA, UCSU SACCOs), Household Head
- 2) Access to Clean Cooking – CAHWS, Health Workers (Health centre 2,3)
- 3) Water for Drinking and Cooking – PLW (Pregnant Lactating Women), CU2 (Children under 2 years old)
- 4) Water for Farming – VHTs
- 5) Nutrition – Health Workers (Health centre II & III in 3 districts)

Given the characteristics associated to water access and use, we will conduct FGD the Water Survey participants and derive key informants for In-depth Interviews using the ESMAP MTTs.

Sample Size

Considering the time constraints and goal of the Nexus Benchmarking Study, we will conduct 10 to 20 FGD's of 10 to 15 individuals for the Water Survey until we reach saturation. During the FGD (Focus Group Discussion) sessions, we will identify and derive 5 key informants from each FGD for In-depth Interviews using the ESMAP MTTs.

Key informants will be interviewed at household level in order to meet the design requirements of the ESMAP Energy Access survey with different target populations and HHs including local implementers of the GHG Program activities. The representative GHG program groups in Abim, Kotido and Kaabong for our sampling consideration are:

- 1) Pregnant and Lactating Women
- 2) Caregivers of Children under 2 years old
- 3) Local Implementers (AWOTID, KAPDA, Peace Committees)
- 4) House Hold Heads

In the case that saturation for FGDs is reached at 20 sessions, this will give us a total of 300 interviewees from the three districts and that sample size should be sufficient for pilot testing the nexus study.

Five FGDs with PLW & CU2s and five FGDs with household heads will be held. These will cover the sub-groups identified in Table 2. One focus group with each PLW & CU2s and household heads will be held in each sub-county across Abim, Kotido and Kaabong. Half of the sub-counties will have a Health Center and Pumped Water Source and half will have no Health Center and no Pumped Water source in order to have diverse responses to water access issues. Amongst the PLW & CU2 caregiver focus groups, three will be held with mothers over 30 years and two with mothers under 30 years. Amongst the household heads focus groups, three will be held with men and two with women.

Table 1. Sampling matrix for community FGDs

PLW & CU2 Caregivers					HOUSE HOLD HEADS				
<30 years		>30 years			Female		Male		
SC1*	SC2	SC3	SC4	SC5	SC1	SC2	SC3	SC4	SC5
HCPW	NHCPW	HCPW	NHCPW	HCPW	NHCPW	HCPW	NHCPW	HCPW	NHPW
<i>FGD1</i>	<i>FGD2</i>	<i>FGD3</i>	<i>FGD4</i>	<i>FGD5</i>	<i>FGD6</i>	<i>FGD7</i>	<i>FGD8</i>	<i>FGD9</i>	<i>FGD10</i>

*SC refers to sub-county. Numbers will be randomly allocated to sub-counties in Abim, Kotido and Kaabong

**HCPW refers to sub-counties with Health centers and Pumped water. NHCPW refers to sub counties with no Health centers or Pumped Water.

In-depth Interviews

We plan to conduct in-depth interviews using the ESMAP MTTs with key informants from the GHG Facilitative Strategy groups and household heads who have been impacted by the GHG strategic objectives for a minimum one year after roll-out. The purpose of the IDIs is to collect Energy access information on how the GHG program activities intervention was,

or was not, enacted / adopted / resisted / adapted in practice and its interaction to the three components of the nexus benchmarking tool (Energy-Food-Water).

The interviews will explore the expected and unexpected levels of the FFP and FTF Standard Indicators, which will explicitly aim to discuss perceptions of relevance as well as capture contextual issues that may have shaped the nexus interaction with, access of and use of Energy. IDIs are an appropriate method to understand these issues because they enable narratives of individuals to be elicited, such that the interviewer can explore what was meaningful to individuals who were expected to respond to the ESMAP MTT adopted tools.

Focus Group Discussions

As outlined in Table 2, FGDs involving community members will be stratified into different target groups who may have different responses to the inquiries of the water access survey and who may be more likely to discuss topics openly together than if groups were mixed. FGDs involving PLWs and CU2 caregivers will be divided into groups of younger PLW & CU2 caregivers (usually women) vs. older PLW & CU2 caregivers, while those with heads of household will be divided into groups by gender (males vs. females).

These community focus groups will also be divided into sub-counties where Health center facilities and Pumped water are present and sub-counties with no health facilities or pumped water. FGDs involving PLWs & CU2 caregivers will be divided into groups by age and will cover the different levels of health facility in each district. FGDs will be held until no new information is gained, which will determine the total number of FGDs conducted.

Table 2. Target populations

Target group	Definitions	FGD characteristics
CU2 Caregivers	Person primarily responsible for CU2s (generally female)	Groups to be stratified into younger caregivers (< 30 years) vs. older caregivers (≥ 30 years) Each sub-county Sub-counties with Vs without health facilities and Pumped water
Heads of households	Decision-makers and resource controllers for households and livelihoods.	Groups to be stratified by gender (males vs. females) Each sub-county Sub-counties with Vs without health facilities and Pumped water.
PLWs	Person seeking health care at a public health facility and in need of Nutritious foods.	Groups to be randomly selected by level of health center (HC II, III or IV) and by Sub-counties with Vs. without health facilities and Pumped water.

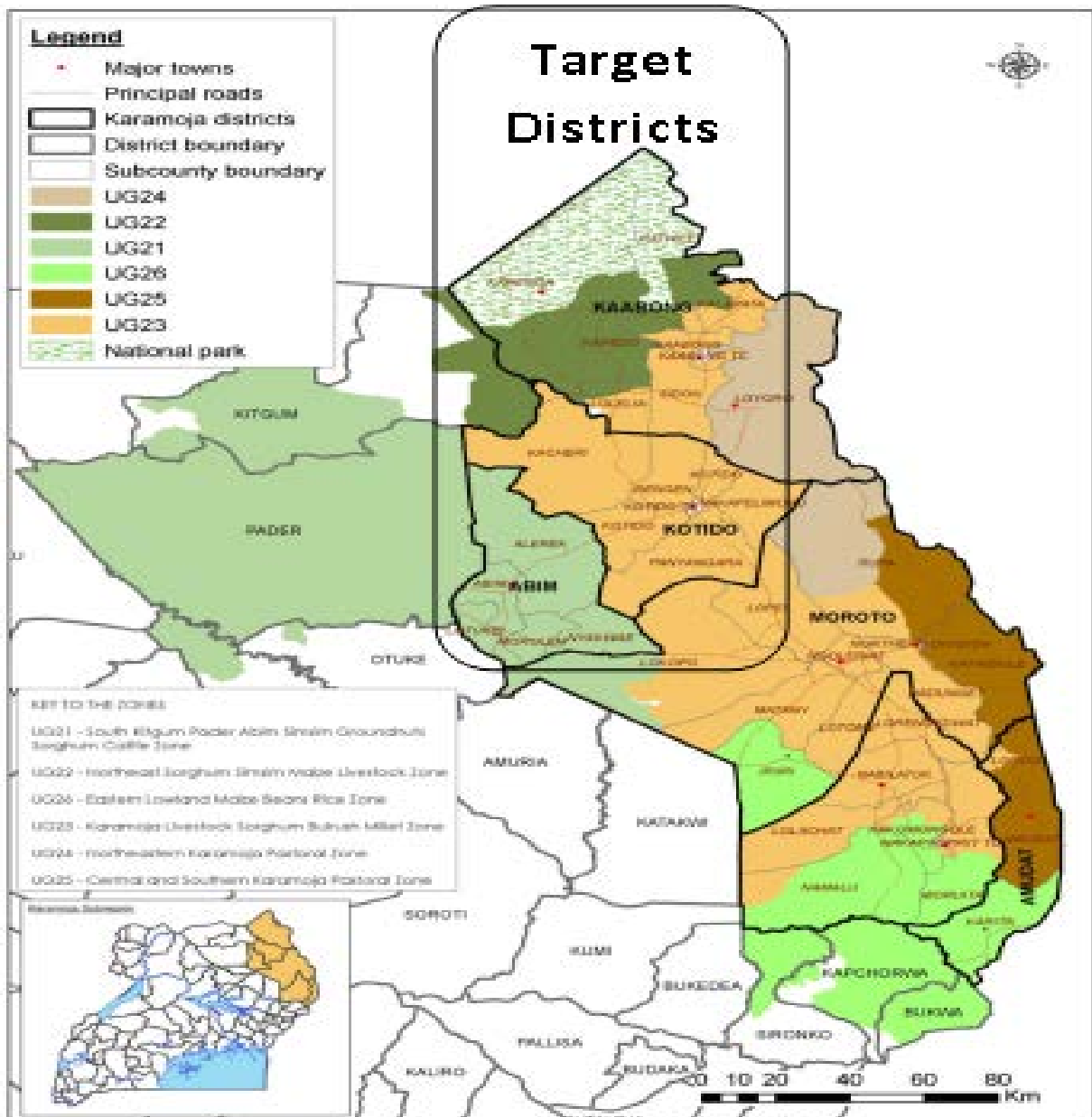
Structural considerations for conducting community FGDs will include:

- 1) Water Household Survey attributes.
- 2) Formulation of key topic guides
- 3) Enrolment and Permission forms
- 4) Selection of GHG Program Sub-groups
- 5) Procedure for recording Interviews(Notes and Audio Files)
- 6) Allocation of Note Taker IDs
- 7) Participant Contact Forms

- 8) List of Permission granting agencies.
- 9) Interview summary forms

Sampling Considerations

While selecting the participants for conducting the Energy- Water- Food nexus and benchmarking tool assessment, we would observe the following:



- 1) The sample will be spread across the three districts in Karamoja (Abim, Kotido and Kaabong) .The sample will also spread across sub-counties in the three districts that have the GHG Program running.
- 2) Empirical consideration of the FFP and FTF Standard Indicators to be assessed.
- 3) It will be ensured that all groups of participants of the Nexus Benchmarking Study will adequately be represented in all possible scenarios captured by the ESMAP MTT modules and Water Survey.

The selected districts in Karamoja are:

- Abim District
 - Kotido District
 - Kaabong District
- Selection of beneficiaries of GHG Program sub-groups shall be undertaken to ensure that the strata group samples are selected randomly
 - For this purpose, we will require a list from GHG of active sub-counties in the three districts.

Qualitative Protocols for Data Collection and Analysis

Study Design

The Nexus benchmarking study is a mixed-method that depicts the application of the multi-tier framework for assessing impact of food security program through better integration of energy-water-food “Nexus” design into existing and future Food for Peace programs with the context of GHG activities in Karamoja. Our focus in this study is on documenting the adoption of the ESMAP MTT to be used to look into “nexus” of the interactions between the energy-water-food linkages and the adapted MTTs to measure how the “use” of energy impacts on water supply and food production.

ESMAP MTT Objectives for Assessing Energy Access Ex Post:

- Evaluate the contribution of projects to improving energy access
- Improve accountability of energy providers and policy-makers
- Better assess the linkages between energy access and poverty
- Track progress towards achieving the SE4All goal

Adapted Water Survey Objectives for Nexus Benchmarking:

- Test and refine for use of module in existing and new Food for Peace Programs
- Enable GHG identify the opportunities for applying energy activities to accelerate programs goals.
- Provide actionable insight for the design of the energy-food-water nexus intervention within the GHG Program

Data Management and Analysis

Data handling and Entry- Enumerator Training

ESMAP will provide methodological support on the MTT to be adopted which will be used to facilitate enumerator trainings. Daily debriefing sessions will occur with all field workers and weekly meetings with the study lead. Participant contact summaries will be used for reference during the meetings, and a further Debriefing Meeting Form will be completed. The purpose of the debriefing meetings are:

- For field staff to update each other on progress with data collection
- For field staff to discuss key findings from data collection so far, including differences and similarities
- For field staff and study heads to discuss how these preliminary findings might feed into the nexus design
- For field staff to discuss any problems/changes with the topic guides
- For field staff to get an idea of whether new ideas are still emerging or if saturation has been reached on key topics
- To provide a daily/weekly record of proceedings.

File Names

Each interview or focus group will be allocated a unique identifying number. This will be written on the interview/focus group form, in notes taken, and will be used to name audio files and transcript documents. The format for naming files will follow Table 3, e.g. IDIFSA05; FGDHKB09.

Table 1. Labelling files

<i>Type of data collection</i>	<i>Gender of respondent/group</i>	<i>Type of respondent/group</i>	<i>District (transmission)</i>	<i>Unique ID of interview/FGD</i>
IDI	M F	FS= Retailers , VHTs AWOTID, KAPDA, Sacco members CM=Peace committee members/C	A K KB	01-50
FGD	M F	H= House hold head WC= CU2 caregiver, PLW	A K KB	01-20

Although FGD participants will introduce themselves and be referred to in the discussion by their first name, they will also each be assigned a number by the note-taker to facilitate identification of different voices when transcribing and referencing quotations. The numbers will be assigned based on seating arrangements, and will reflect the file name assigned to the FGD, followed by their sequential number from the ordering of the group, for example FGDMHK02/05.

During field work

All notes and audio files will be kept on the person of the field worker at all times or in a locked vehicle or room. Participants and non-participants will not be allowed to view the notes at any time and content of discussions and interviews will not be revealed to anyone else.

Interviews

Names of interviewees will not be used at any stage of the data collection process. Pre-determined identification numbers will be used on data collection form (topic guide and notes); Audio recordings will not start until the interviewee has given consent and will not record their name.

Transcription and Translation

Quantitative

A data entry interface will be created for all quantitative data such as demographic details, in Excel. This will be double entered at the research offices. Data will then be imported into the statistical program based on the ESMAP MTT structures. The relevant transcript and audio files will be linked to each interview case.

Transcription

Audio recordings will be listened to carefully and then transcribed into Word in the language of the interview and then translated ready for exporting into the statistical qualitative data management software for coding and analysis. All typed records will be kept in password protected computer hard drives and in a password-protected back-up drive.

A standardized layout will be applied to all transcripts to facilitate the comparison of data at the analysis stage. This will include a summary of quantitative data to describe the participant's demographic characteristics, the location and other key information to situate the interview. Transcribers will be familiar with the theoretical perspectives of the nexus benchmarking study and will ensure this is reflected in the approach to transcription.

For this Nexus benchmarking study, the transcription method will reflect the interpretative approach underpinning the qualitative research, striving to convey as fully as possible the experiences and representations of the participants. This will include word-for-word transcription, recording all hesitations, pauses, utterances, cross-talking and incomplete sentences. An agreed set of notations will be applied to indicate these in a separate SOP.

Major interruptions by other people or telephones will be recorded to contextualize any breaks in speech or repetitions. However, minor interruptions will not be recorded in order to ensure the flow of the transcript supports interpretation and analysis. The transcription will be proof-read against the audio file by both the transcriber and a supervising member of the research team to check for accuracy, identify any missed or misheard words and to clarify any areas of confusion or unclear terminology. All queries and changes will be made using MS Word's track changes tool. An agreed cleaned version of the transcription will be created, ready for translation.

Translation

This study recognizes the role of translation in constructing knowledge, and the role of translators as active agents in the research process. As such, translators will be familiar with the theoretical perspective of the research as well as its objectives. Translation will take a meaning-based approach from the original language into English. The translator will attempt to convey the meaning of the source language within the natural grammar of the target language – English. In addition, clarifications will be made in brackets, in order to capture and interpret for the reader meaningful elements of the source material, and the way the elements combine to form the meaning of the text as a whole. These clarifications will repackage the original narratives and utterances into words, grammar and idioms peculiar to the target language (English). Quality criteria for the translations will be comprehensibility (especially relating to culture-specific concepts), appropriateness (in

content and approach) and accuracy (faithful to the source text and key facts). The original text will remain in the document, with the translation made beneath each short section of 4-5 lines. Sections of text will be double-checked for fidelity and appropriate communication of meaning by another member of the field team.

Cross-Checking

Each transcript, and then each translation, will be checked by the team leader by listening to sections of the recordings and cross-checking the transcription, or reading sections of translations and cross-checking these with the original language texts. If errors are identified the entire file will be sent back for re-transcription or re-translation and the cycle of cross-checking will recur.

If minor errors occur or in cases where transcription or meaning is unclear, the team leader will discuss with the person who carried out the interview/FGD to agree on a correct transcription or translation. If a clear transcription/translation cannot be agreed, or if the speech or phrase is ambiguous, two or more options for interpreting the speech will be offered in the final transcription/translation.

Data Analysis

Methods

Field notes will be coded on a daily basis, as they are entered into the Excel program. This will enable ongoing analysis and reflection on the purposes and findings of the research. This coding will group the tier definitions into nexus benchmarking themes. Alongside this coding, a reflective analytical diary will be kept, to draw out and justify emerging themes and lines of enquiry through the fieldwork process.

Transcripts will be coded line-by-line, and then later developing themes and theoretical constructs by grouping the base coding together. This method borrows from the iterative approach of grounded theory. A coding template from ESMAP will be used to code transcripts in an on-going process as data is collected. As more transcripts are coded, the template will be further refined to reflect any new emerging ideas or themes.

On-going analysis will be characterized by frequently going back to the original transcripts to ensure text is coded within context. Coding will be carried out using qualitative data analysis software chosen by ESMAP and GHG. Following the coding process, themes and theoretical constructs will be developed from both the field notes and the interview transcripts.

This analytical process will attempt to situate the Energy-Food-Water nexus of the GHG Program activities and the wider FFP/FTF networks in which they are embedded, giving attention to cultural, historical, political and economic contexts. The analysis will be carried out with reference to the background documents and GHG Strategic Objectives in Karamoja.

Organizing Data

Data files will be imported into the statistical program provided by GHG/ESMAP, where all transcriptions, contact summaries and audio files will be filed.

Quantitative Data

Quantitative data will be double entered into an Excel spreadsheet and then imported into the selected statistical program as a new case, to be linked with the relevant transcript and audio files. Descriptive statistical analysis will also be performed on the data in Excel.

Initial Coding and Template

Transcripts will be coded based on the ESMAP MTT methodology and protocols. These protocols will be used for identifying, adding new codes and refining existing codes.

Development of theoretical constructs and narratives

The fully coded project will be explored for theoretical constructs by ESMAP in conjunction with the GHG team. This will include the running of queries, looking at any differences in the concepts emerging according to sub-groups, and different characteristics of participants.

The Research lead with input from the research team, will develop a narrative bridging the original research concerns with the participants' subjective experiences. The aim of the theoretical narrative will be to retell the participants' stories in terms of the theoretical constructs. The findings will be related to wider theory and background GHG documents in the Energy-Food- Water nexus benchmarking.

This will involve relating the findings to the original conceptual framework, which may be adjusted or replaced by a new framework based on the evidence from the Nexus benchmarking study. Drawing from this narrative, the research questions for the study will be revisited and recommendations made.

Ensuring Ethics and Quality in Practice

Ethics

The field team will be briefed in the ESMAP MTT methodology and protocols in order to place priorities of protecting research participants, anticipating harms, avoiding undue intrusion, rights to confidentiality and anonymity, individual rights and involvement in research ahead of other requirements, whether for their own gain or that of the research.

Quality assurance

Standard operating procedures (SOPs) will be written for all stages of the study, including recruitment, data collection and data analysis, and these together with ESMAPs MTT protocols will be used as the basis for quality assurance assessment protocols. The SOPs will be developed in conjunction with the field research team, and all members of the team will be trained on how to interpret and implement the SOPs throughout the Nexus Benchmarking Study.

The regular debriefing meetings and review of data collection forms by the field team and the research lead should help to ensure that data collection processes are being conducted in an appropriate and consistent manner.

Team roles:

- 1) Research Lead – managing and overseeing recruitment and data collection in the field; input into data analysis and writing up stages.

- 2) Tool developer Consultant – designing and supervising the research study; responsible for monitoring progress of data collection; leading on data analysis and writing up.
- 3) Research Assistant 1 – identifying and recruiting participants; assisting with data collection; input into writing up.
- 4) Research Assistant 2 – identifying and recruiting participants; assisting with organisation of interviews/FGDs; assisting with transcribing and translation.
- 5) Transcriber/translator – primary responsibility for conducting transcription and translation of all relevant field documents.

Data collection

The research lead will act as the moderator for FDGs and interviewer in IDIs, and will have overall responsibility for the organization of data collection, for monitoring the enumerator recruitment and data collection processes in line with the quality assurance protocol, and for holding team debriefings and feeding back to other members of the research team.

The research assistants will assist in the recruitment process, in arranging suitable times and locations for the FDGs/IDIs and for ensuring participants are able to attend the events. For the FDGs, one research assistant will act as note-taker and the other will act as coordinator, ensuring the organization and arrangement of facilities at the FDG.

Research assistants may take it in turns to act as note-taker and coordinator, as desired. Following the FDGs/IDIs, the research lead will be responsible for ensuring that the contact summary forms are completed immediately after data collection, and sent as soon as possible to the GHG team.

Data entry:

- 1) The transcriber will be responsible for transcribing each of the digital recordings immediately after each recording, checking it against the audio file, and presenting it to the research lead and research assistants for further checking and additional edits.
- 2) The transcriber will also be responsible for translating the transcripts into English and for arranging review of the translations by other members of the research team.
- 3) Where necessary, the research assistants will also be required to conduct transcription and translation of data.
- 4) The field research lead will have responsibility for checking and ensuring that transcription and translation are conducted appropriately, in line with the SOPs, and for sending them to the GHG study team as soon as each one is completed and checked.
- 5) The transcriber and research assistants will be required to enter the data from each of the FDG/IDI enrolment forms, the FDG note-taker's forms and the contact summary forms into Word or Excel documents (translating where appropriate).

- 6) The research assistants should be responsible for taking minutes at the regular team debriefing sessions.
- 7) The transcriber and research assistants will also collate and store appropriately the consent forms and other data collection materials as per the ESMAP protocol.

Data analysis

The study research consultants will take overall responsibility for the data analysis, but will consult with the ESMAP team at regular stages throughout the analysis phase to feed into the coding process and MTT nexus scenarios.

Data Collection Timeline

Dates	Study phase	Activities	Who
March 23-27	Draft Scoping & Preparation (Milestone 1)	<ul style="list-style-type: none"> • Meet field team • Draft Study Plan/SOPs and topic guides • Assess locations for data collection • Consult with GHG regarding recruitment and participants • Draft Survey Instrument 	<ul style="list-style-type: none"> • Consultant • Consultant, MC, GHG • ESMAP, GHG • MC, GHG • MC, GHG • Consultants
March 30-April 3	Validation Draft Nexus Benchmarking Module (Milestone 2)	<ul style="list-style-type: none"> • Survey instrument intermediate iterations, and final validated instrument • Revise and finalize SOPs. • Survey methodology and sampling frame • Test/Validation of Nexus Module • Nexus Module peer reviewed and Code Book in Collaboration with ESMAP 	<ul style="list-style-type: none"> • GHG, Consultants • ESMAP, GHG • GHG, Consultants • ESMAP, Consultants
April 6- 17	Raw Data & Codes Data Collection (Milestone 3)	<ul style="list-style-type: none"> • Begin recruitment and data collection • Training of enumerators • Survey target communities • Remote technical support to guide Uganda based research team on methodology • In country technical support to refine survey instrument with research team • Transcribe and translate data as it is collected • Regular team debriefings and feedback to wider research team • Share data with GHG and ESMAP • On-going coding and analysis of data 	<ul style="list-style-type: none"> • MC, Consultant • Consultants • ESMAP, MC • MC, GHG • Consultant • Consultant • Consultants
April 20-24	Final Draft, Nexus Benchmarking Module Data Analysis (Milestone 4)	<ul style="list-style-type: none"> • Continue coding • Data analysis in direct coordination with ESMAP • Finalized nexus benchmarking Module • Develop theoretical constructs and narratives 	<ul style="list-style-type: none"> • Consultant • Consultants, ESMAP Support • Consultant • Consultants
April 27-29	Milestone 5	<ul style="list-style-type: none"> • Finalized nexus benchmarking report • Preliminary Results Analysis • Final Presentation (Kampala) 	<ul style="list-style-type: none"> • Consultants • ESMAP, GHG
TBD		<ul style="list-style-type: none"> • Final Presentation (DC) 	<ul style="list-style-type: none"> • Consultant • MC

Appendix 1

ESMAP MTTs

To measure access to energy we will use three multi-tier tools from ESMAP:

- 1) Access to household electricity services
- 2) Access to electricity for production applications
- 3) Access to household cooking solutions

Access to Household Electricity Services

		Tier-0	Tier-1	Tier-2	Tier-3	Tier-4	Tier-5
Tiers	Tier Criteria	-	Task Lighting AND Phone Charging	General Lighting AND Television AND Fan (if needed)	Tier-2 AND Any Medium Power Appliances	Tier-3 AND Any High Power Appliances	Tier-2 AND Any Very High Power Appliances
	Type of Appliances	-	Very low power appliances (<30W)	Low power appliances (31-150W)	Medium power appliances (151-600W)	High power appliances (600-1500W)	Very high power appliances (>1500W)
Applications	Indicative List of Appliances	Tier-0	Tier-1	Tier-2	Tier-3	Tier-4	Tier-5
	Lighting	-	Task lighting	Multi-point general lighting			
	Entertainment & Communication	-	Phone charging, Radio	Television, Computer, Printer			
	Space Cooling & Heating	-		Fan	Air cooler		Air conditioner*, Space heater*
	Refrigeration	-			Refrigerator*, Freezer*		
	Mechanical Loads	-			Food processor, Washing m/c, Water pump		
	Product Heating	-				Iron, Hair dryer	Water heater
	Cooking	-			Rice cooker	Toaster, Microwave	Electric cooking

Tier-0	Households do not regularly use any electrical appliance or electric lighting (except non-rechargeable (dry-cell) battery powered torches and radio.
Tier-1	Households regularly use electric task lighting and phone charging or radio.
Tier-2	Households regularly use general lighting, phone charging or radio, as well as a television and a fan (if needed).
Tier-3	Households regularly use general lighting, phone charging or radio, a television and a fan (if needed), as well as at least one additional medium-power appliance.
Tier-4	Households regularly use general lighting, phone charging or radio, a television and a fan (if needed), as well as at least one additional high-power device, along with some medium power appliances.
Tier-5	Households regularly use general lighting, phone charging or radio, a television and a fan (if needed), as well as at least one additional very high-power device, along with some medium and high-power appliances.

Access to Electricity for Productive Applications

			Tier-0	Tier-1	Tier-2	Tier-3	Tier-4	Tier-5	
Attributes	1. Capacity	Electricity	Power		Min 5 W	Min 70 W	Min 200 W	Min 800 W (Min 2 kW for institutions)	Min 2 kW (Min 10 kW for institutions)
			Daily Supply Capacity		Min 20 Wh	Min 274 Wh	Min 1.0 KWh	Min 3.4 KWh	Min 8.2 KWh
			Typical Source		Solar Lanterns	Solar Home Systems	Generator or Mini-Grid	Generator or Grid	Grid
		Non-Electric				Available non-electric energy at least partially meets requirements	Available non-electric energy largely meets requirements	Available non-electric energy fully meets all requirements	
		Both				No Relevant Application is Absent Solely due to Energy Supply Constraints			
	2. Duration of Daily Supply	Electricity		Min 2 hrs	Min 4 hrs	Min half of working hours	Most of the working hours (Min 75% of working hours)	Almost all of the working hours (Min 95% of working hours)	
		Non-Electric				Available non-electric energy partially meets requirements	Available non-electric energy largely meets all requirements	Available non-electric energy fully meets all requirements	
		Both				Longer working hours are not prevented Solely by lack of adequate energy (capacity or duration)			
	3. Reliability					No Reliability Issues that have Severe Impact		No Reliability Issues or Little Impact	
	4. Quality					No Quality Issues that have Severe Impact		No Quality Issues or Little Impact	
5. Affordability					Variable cost of energy is less than two times the grid tariff		Variable cost of energy is less than grid tariff		
6. Legality					Energy Bill is paid to the utility / pre-paid card seller / authorized representative / legal market operator				
7. Convenience					Time and Effort in securing and preparing energy does not cause severe impact		No Convenience Issues or Little Impact		
8. Health and Safety	Health (Fuels)				Use of Non-BLEN solutions (if any) for heating in the open or with smoke extraction	Use of BLEN or equivalent solutions for heating (if any)			
	Safety				Energy supply solutions have not caused any accidents over the last one year that required professional medical assistance.	Energy supply solutions have not caused any accidents over the last one year			

Tier-0: No requirements.

Tier-1: If the productive engagement requires electricity based applications, then at least 5 W of capacity is available for at least 2 hours each day.

Tier-2:	If the productive engagement requires electricity based applications, then at least 70 W of capacity is available for at least 4 hours each day. If the productive engagement requires heating and non-BLEN solutions are used, then the use is either in the open or with smoke extraction. Energy solutions have not caused and are not likely to cause significant accidents that required professional medical attention.
Tier-3:	If the productive engagement requires electricity based applications, then at least 200 W of capacity is available for at least half of the working hours each day. If the productive engagement requires heating and non-BLEN solutions are used, then they are deployed either in the open or with smoke extraction. Any non-electric solutions used at least meet the needs partially. Energy solutions have not caused any accidents over the last one year that required professional medical assistance. The productive engagement does not forego any relevant application solely because of energy supply constraints. There are no convenience, reliability or quality issues that cause a severe impact on the productive engagement. The variable cost of energy is less than twice the cost of equivalent grid electricity, and the energy is acquired through legal means.
Tier-4:	If the productive engagement requires electricity based applications, then at least 800 W of capacity is available (at least 2 KW for institutions) for at least 75% of the working hours each day. If the productive engagement requires heating then BLEN or BLEN-equivalent solutions are used. Any non-electric solutions used largely meet the needs. Energy solutions have not caused any accidents over the last one year. The productive engagement does not forego any relevant application solely because of energy supply constraints. There are no convenience, reliability or quality issues that cause a severe impact on the productive engagement. The variable cost of energy is less than one-and-a-half times the cost of equivalent grid electricity and the energy is acquired through legal means.
Tier-5:	If the productive engagement requires electricity based applications, then at least 2 KW of capacity is available (at least 10 KW for institutions) for at least 95% of the working hours each day. If the productive engagement requires heating then BLEN or BLEN-equivalent solutions are used. Any non-electric solutions used fully meet the needs. Energy solutions have not caused any accidents over the last one year. The productive engagement does not forego any relevant application solely because of energy supply constraints. There are no convenience, reliability or quality issues that cause any on the productive engagement. The variable cost of energy is less than or equal to the cost of equivalent grid electricity and the energy is acquired through legal means.

Access to Cooking Solutions

		Level-0	Level-1	Level-2	Level-3	Level-4	Level-5	
Attributes	1. Health	Indoor Air Pollution (PM and CO)		Primary solution (if used indoors) meets the (Provisional) ISO Tier mentioned below. If used outdoors, a minimum of Level-3 applies.				
				ISO Tier-1	ISO Tier-2	ISO Tier-3	ISO Tier-4	ISO Tier-4
			AND, any inferior solutions are used for less than 30% of the time. Otherwise shift one Tier below.				AND, any inferior solutions are used only on rare occasions	
	Overall Pollution (PM and CO)		Primary solution meets the (Provisional) ISO Tier mentioned below.					
			ISO Tier-1	ISO Tier-2	ISO Tier-3	ISO Tier-4	ISO Tier-4	
			AND, any inferior solutions are used for less than 30% of the time. Otherwise shift one Tier below.				AND, any inferior solutions are used only on rare occasions	
	2. Convenience							
	• Fuel Acquisition and Preparation Time (Hrs / wk)			< 7	< 3	< 0.5		
	• Stove Preparation Time (Min/meal)		< 15	< 15	< 5			
	3. Safety of Primary	IWA Safety Tiers		Primary solution meets (Provisional) ISO Tier-1	Primary solution meets (Provisional) ISO Tier-2	Primary solution meets (Provisional) ISO Tier-3	Primary solution meets (Provisional) ISO Tier-4	
OR, Past Accidents (Burns and Un-intended fires)						No accidents over the last one year that required professional medical attention.		
4. Affordability						Levelized Cost of Cooking Solution (incl. cook-stove and fuel) <15% of HH Income		
5. Cook-stove Efficiency (Not to be applied if cooking solution is also used for space heating)			Primary solution meets (Provisional) ISO Tier-1	Primary solution meets (Provisional) ISO Tier-2	Primary solution meets (Provisional) ISO Tier-3	Primary solution meets (Provisional) ISO Tier-4		
6. Quality of Primary Fuel Variations in heat rate due to fuel quality that affects ease of cooking						No Major Affect		
7. Availability of Primary Fuel						Primary fuel is readily available for at least 80% of the year	Primary fuel is readily available throughout the year	

Level-0 | No requirements.

Level-1 | The primary cooking solution meets the (Provisional) ISO Tier-1 requirements for Indoor Air Pollution, and Overall Pollution, and any inferior solutions are used for less than 30% of the time. The primary cooking solution also meets the (Provisional) ISO Tier-1 requirements for Safety (if tested) and Efficiency respectively.

Level-2 | The primary cooking solution meets the (Provisional) ISO Tier-2

requirements for Indoor Air Pollution, and Overall Pollution, and any inferior solutions are used for less than 30% of the time. The primary cooking solution also meets the (Provisional) ISO Tier-2 requirements for Safety (if tested) and Efficiency respectively. The household spends no more than 7 hours per week on fuel acquisition and preparation, and less than 15 minutes of stove preparation time per meal.

Level-3

The primary cooking solution meets the (Provisional) ISO Tier-3 requirements for Indoor Air Pollution, and Overall Pollution, and any inferior solutions are used for less than 30% of the time. The primary cooking solution also meets the (Provisional) ISO Tier-3 requirements for Safety (if tested) and Efficiency respectively. The household spends no more than 3 hours per week on fuel acquisition and preparation, and less than 15 minutes of stove preparation time per meal.

Level-4

The primary cooking solution meets the (Provisional) ISO Tier-4 requirements for Indoor Air Pollution, and Overall Pollution, and any inferior solutions are used for less than 30% of the time. The primary cooking solution also meets the (Provisional) ISO Tier-4 requirements for Safety (if tested) and Efficiency respectively. Variations in quality of fuel do not affect cooking in any major way. The household spends no more than 3 hours per week on fuel acquisition and preparation, and less than 15 minutes of stove preparation time per meal. The primary fuel should be readily available for at least 80% of the time during the year. There should have been no accidents over the last one year that required professional medical attention. The levelized cost of cooking solutions should be less than 15% of the household income.

Level-5

The primary cooking solution meets the (Provisional) ISO Tier-4 requirements for Indoor Air Pollution, and Overall Pollution, and any inferior solutions are used only on rare occasions. The primary cooking solution also meets the (Provisional) ISO Tier-4 requirements for Safety (if tested) and Efficiency respectively. Variations in quality of fuel do not affect cooking in any major way. The household spends no more than 0.5 hours per week on fuel acquisition and preparation, and less than 5 minutes of stove preparation time per meal. The primary fuel should be readily available throughout the year. There should have been no accidents over the last one year that required professional medical attention. The levelized cost of cooking solutions should be less than 15% of the household income.

APPENDIX 2

Water Household Survey

To measure access to Water we will use a short Household Survey to create linkages of the Nexus elements.

Access to Water Module

This survey will provide the linkages needed to assess the nexus between energy and food by focusing on water, looking at the following attributes:

Attributes	Description
Water Sourced	River, including or combined with small plugged soil or other type of dikes Borehole - this can combined with manual, mechanical or electrical systems to bring water to surface Rain
Reliability	Availability of water supply measured in terms of days and hours of the day available
Quality of Service	Availability of water supply measured in terms of minimum water quality conditions
Affordability	Costs associated by water boiling via cookstoves (traditional or improved), cookstoves fuels and alternatives, like solar water cookstoves or water purifiers
Legality	Control of water source, is anybody denied access? Who manages the water source
Convenience	Capacity – sufficient boil drinking water, cooking meals ,types of energy sources Time and effort - Impact cause by time and effort in accessing the required amount of water (i.e. Distances to water source and transport means)
Health	Quality of water - water ready for human consumption (In Uganda water always is boiled before consumption) Sanitation - sufficient water for Households to wash and clean

Water HH Survey

Interview Questions (Open-Ended):

I am interested in your water access and usage habits in regards to water sources, reliability, convenience, legality, and about your perceptions of water quality for healthy living.

1. *Water Source related questions.*

I would like you to begin by telling me generally about how and where you access water for daily use in your household? (*List water sources from respondent's answers*):

- 1) Does your water source change depending on rain?
- 2) What has been your primary water source over the last one year?
- 3) Do you get water for your animals from the same source as that for the Household?
- 4) Which water source do you prefer for your household and why?
- 5) How much water do you use for the household on an average day?
- 6) Does that pattern of water usage change and why?
- 7) Do you use any of your water for farming?
- 8) Who is responsible for collecting water in your household?

2. *Water-reliability questions:*

- 1) Do you have access to water at your primary source any time of the day, if not why?
- 2) How many hours a day is water available at your primary water source?
- 3) Have you ever changed your primary water source in the last one year and why?
- 4) Describe how water is collected from your primary source?
- 5) Under what conditions will you collect water from two or more water sources in a day?
- 6) Where else would you normally go to collect water for household use?
- 7) How long have you been collecting water from your primary water source?

3. *Water Quality:*

- 1) Tell me what you know to be quality water or any experiences you've had with it.
- 2) Do you know what the quality of water at your preferred water source is? How?
- 3) What would you consider/ how would you describe good water quality?
- 4) How would you feel about having a different water quality for the household vs. water for your animals and crops?
- 5) How do you think water quality is regulated or maintained at your preferred primary water source?
- 6) What would you do if you found out your household water was contaminated?
- 7) How do you think you would find that out?
- 8) What would you do if you found out that piped and pumped water was also contaminated?

9) How do you think you would find that out?

4. *Water Affordability:*

- 1) Do you pay for the water you collect at your primary water source? How much for 20ltr jerry can?
- 2) Do you boil your water before drinking? How?
- 3) Describe your primary and alternative cooking stoves used for boiling water and cooking for your household?
- 4) Do you feel you have enough fuel and time to boil your drinking water? Why?
- 5) How much time do you spend collecting fuel for your primary cook stove?
- 6) Does the time for collecting fuel affect time for collecting water or boiling it for drinking?
- 7) Tell me what you know or heard about energy efficient cooking stoves?
- 8) Do you know someone who uses an energy efficient cooking stove? Who?
- 9) What would you consider to be an improvement to your primary cooking stove?
- 10) How would that improvement affect your water consumption?

5. *Water Legality:*

- 1) Tell me what you know about those who control water sources in your community?
- 2) Do you know who controls your primary water source and why?
- 3) What would you consider as good control of your primary water source?
- 4) How would you feel about playing an active role in controlling your primary water source?
- 5) Do you feel that controlling/managing your primary water source affects your household consumption?
- 6) What would you do if you found out that those controlling your primary water source are doing it illegally?
- 7) How do you think you would find that out?
- 8) Would you change your preferred water source because of illegal control?
- 9) What considerations would you have before you made the decision to change your primary water source because of illegal control?
- 10) Have you ever been denied access to your primary water source in the last 12 months? Why?
- 11) Who denied you access to your preferred water source?

6. *Convenience Questions:*

Current Demographic considerations:

i) Age ii) Gender iii) District (Abim, Kotido and Kaabong)

- 1) Do you have enough water for your household and animal needs? Why?
- 2) How far is your primary water source from your homestead? (*Estimated as time to source*)
- 3) How many hours a day do you use on collecting water for household use?
- 4) How do you transport your water from the source to the household?
- 5) How do you think the convenience of your water source impacts on your water consumption habits?

7. *Health and Food questions:*

- 1) How important is clean drinking water to you? Why?
- 2) What do you consider as safe drinking water?
- 3) Do you prepare drinking water separately for children under 2 years and pregnant women?
- 4) How much water do you use for personal hygiene (bathing and washing) in your household?
- 5) Do you wash your hands before eating and after using the toilet? Why
- 6) How far is your toilet/latrine from your primary water source?
- 7) Have you fallen sick with Typhoid or cholera in the last (one) year?
- 8) Tell me how interested you are in health issues in your household? Why
- 9) How do you think your interest in health issues impact your water consumption habits?

8. *Food related:*

- 1) How many types of foods do you cook with the water from your primary water source?
(*List of foods*)
- 2) Do you produce or buy your own food? How?
- 3) Have you ever received free food in the last (one) year? How?
- 4) Would you consider yourself to be a farmer? Why?
- 5) Do you buy food for your household? How often?
- 6) How do you use water to improve your crop yields if farming?
- 7) How many hours a day does it take you to procure your daily food compared with collecting household water?
- 8) Describe how you normally prepare your food for cooking on a daily basis?
- 9) Would you consider yourself as having enough food for feeding in your household?
- 10) How do you think your water needs impact your food options? Why?
- 11) What sort of cultural things do you think affect your food and water consumption habits if any? Ex. social standing, urban/rural setting, peer group, consumer culture, gender, what your parents drink, etc.?