

# **BUILDING RESILIENCE IN LOW-INCOME COMMUNITIES: THE ROLE OF OFF-GRID APPLIANCES**

## **A Case Study of Siaya County, Kenya**

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EFFICIENCY FOR ACCESS COALITION



## ACKNOWLEDGEMENTS

This report was developed by CLASP in partnership with Rural Senses on behalf of the Low Energy Inclusive Appliances programme, a flagship initiative of the Efficiency for Access Coalition.

Efficiency for Access is a global coalition promoting energy efficiency as a potent catalyst in clean energy access efforts. Since its founding in 2015, Efficiency for Access has grown from a year-long call to action and collaborative effort by Global LEAP and Sustainable Energy for All to a coalition of 20 donor organisations. Coalition programmes aim to scale up markets and reduce prices for super-efficient, off- and weak-grid appropriate products, support technological innovation, and improve sector coordination. Current Efficiency for Access Coalition members lead programmes and initiatives spanning three continents, 62 countries and 34 key technologies.

[CLASP](#) is a non-profit organisation that works on climate mitigation and expanding clean energy access through efficient appliances. CLASP achieves this mission through a variety of instruments such as policy, research, awards and building tools such as the [VeraSol database](#), [MEPSY](#) and the [CPRC](#).

[Rural Senses](#) is a UK-based Social Enterprise that specialises in qualitative research and digital transformation. Their mission is to make community data accessible, affordable, and ethical, unlocking the potential of emerging markets. Rural Senses drives qualitative research and digital transformation as they empower communities and organisations worldwide, fostering positive impact across projects and geographic areas.



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### A changing climate and its impact on rural communities

**Energy-efficient off-grid appliances have a vital role to play in addressing climate change and promoting resilience and adaptation. The main focus of this report is to explore the concept of community resilience in the face of climate change, with a specific emphasis on the role of off-grid solar products and equipment in supporting such resilience for low-income communities in sub-Saharan Africa.** The adverse effects of weather-related disasters disproportionately impact these communities, leaving them vulnerable to the results of a changing climate. Sub-Saharan Africa is already experiencing more frequent and severe droughts, floods, and extreme weather events. These events are particularly devastating for rural communities, which often have limited access to resources and infrastructure to cope with the impacts. The agricultural sector, which is a vital contributor to the economy in many rural areas of sub-Saharan Africa and provides employment for many people, is particularly vulnerable to the impacts of climate change.

**In response to this challenge, CLASP has commissioned Rural Senses to gather insights from rural communities regarding their perceptions of the challenges posed by climate change and to use these insights to identify resilience-building pathways.** Within this context, the role of seven off-grid solar products and equipment – electric pressure cookers, fans, motorbikes, refrigerators, televisions, water pumps, grain mills and solar PV systems– was also explored.

To achieve this, Rural Senses interviewed 300 people in Siaya County using a perception-based surveying approach called the user-perceived value (UPV). This approach involved asking interviewees to select graphically depicted items and then probing them for the reasons behind their choices (why-probing). For further details, see the Annex. A detailed socio-economic survey, with questions on background, climate events, communication, household decision-making, and farming practices, was also conducted with the same group to contextualise this data.

**The community in Siaya places great importance on ‘food security’, ‘water security’ and ‘shelter’. Droughts are seen as the most significant climate risk, and irrigation pumps are crucial to increasing resilience.**

To measure the community's vulnerability and resilience to climate change, the data were then assessed against a social resilience framework initially developed by Patel et al. (2017) and modified for the requirements of this project.

**The surveys showed that the main barriers to resilience in Siaya County are the lack of economic security, proper infrastructure, and climate education.** The resulting insights are a first step in better understanding how to increase community resilience and the role of off-grid solar products and equipment within that. Specifically, we hope that the data collected as part of this project will feed into Kenya's ongoing county energy planning work. This is important, as by strategically planning for off-grid solar products and equipment that strengthen community resilience against existing climatic and social vulnerabilities and risks, planners and project developers can address the challenges faced by rural communities. The community resilience mapping methodology of this research can also be applied to other regions. Additionally, the results will shed light on the role of appliances in enhancing community resilience and energy security more broadly. Ultimately, the goal is to reduce energy insecurity, improve energy access decisions, and support the resilience of rural communities in both daily life and emergencies. This will help mitigate the effects of climate change and support the agricultural sector.

Figure 1: Siaya County



1. The method is further described at the end of this document.

2. Patel, Sonny S, M Brooke Rogers, Richard Amlôt, and G. James Rubin. "What Do We Mean by 'Community Resilience'? A Systematic Literature Review of How It Is Defined in the Literature." PLOS Currents 9 (February 2017). <https://currents.plos.org/disasters/article/what-do-we-mean-by-community-resilience-a-systematic-literature-review-of-how-it-is-defined-in-the-literature/>.

### 1. PERCEPTIONS TOWARDS CLIMATE EVENTS

#### Residents of Siaya County are highly concerned about climate change.

**83% of the 300 people interviewed consider climate change a significant issue.** The highest percentage (56%) of respondents reported being most worried about droughts, followed by extreme heat (14%), floods (11%), earthquakes (8%), wildfires (6%), and hurricanes (1%). Notably, extreme rain was not included as an option in the survey but was mentioned independently by some interviewees. It is uncertain if this lack of an option influenced the low percentage of respondents expressing concern over extreme rain.

#### Drought

**Most respondents (63%) cited food security when asked why they were concerned about droughts.** One interviewee stated, *"Whenever drought occurs, there is insufficient food for us and our community. Drought affects us greatly. The rivers and streams dry up, cattle lack pasture, and we lack food because we can't plant crops. The crops that are already on the farms are destroyed."*

**Given that agriculture is the primary source of livelihood in Siaya County, this concern about food security is not surprising - the majority of those interviewed are crop farmers (50%) who rely on vegetables for sustenance and to support their livelihood.** In fact, according to the [Siaya County Website](#), agriculture contributes 60% of household income and provides 61% of employment opportunities. According to the United Nations (2020), droughts already constrain Kenya's agricultural productivity and food security. Moreover, this problem is projected to worsen in the future.

**In response to questions about counter measures that were most important in relation to drought, participants identified a water pump (18%), borehole (14%), and irrigation system (11%) as their top priorities.** The reasons given for choosing these items were primarily related to the need for water security (84%), food security (40%) and improved yields (27%) to better withstand drought and improve harvests.

**Undoubtedly, accessing sustainable water sources and utilising irrigation technologies can help mitigate the catastrophic consequences of crop failure,** which can threaten both food security and livelihoods.

The interviewees understand the importance of these measures in addressing drought, including the 35% who rely on rainfall for irrigation.

Some of the responses from the interviewees include:

*"Having a water pump will be of great use during the dry season when we irrigate our farms."*

*"The borehole cannot dry up because it has been drilled deep below the water table."*

Access to sustainable water sources, such as wells or drip irrigation, can increase resilience to climate conditions that impact crop growth and irrigation during drought. This is evident in the interviewees' responses when discussing the importance of irrigation, with many emphasising its significance during periods of drought. One interviewee noted that irrigation could provide a means of earning income during such times, saying, *"Even in the face of drought, we can have a kitchen garden from which we would find a means to earn."* Others mentioned how irrigation gives them hope during hot weather, with one saying, *"It can give me hope when I have a way of doing irrigation. Even if it is hot, I have hopes of getting food that can help."* Interestingly, during the UPV appliance survey, 20% of respondents selected "irrigation pump" as the least useful appliance, citing reasons such as lack of knowledge about using it, small plot size, or lack of nearby water sources.

#### Extreme Heat

Of the interviewees, 14% were most concerned about extreme heat. They demonstrated knowledge of electronic and natural cooling methods, such as fans and passive cooling systems like trees for shelter. One interviewee emphasised the importance of passive cooling under increasing temperatures and limited power provision: *"You know when the sun is shining, we need shelter, and the house is what gives us shelter."* The importance of shelter is further highlighted by the fact that "house" was the most commonly selected option (82%) as part of the UPV general. Interviewees stressed that a house is essential, as it offers protection against weather-related hazards and increases resilience to extreme climate changes. As two interviewees explained, *"Like now we have had rains for the past one week if people could be having no house and living under a tree, I believe many would have died because a house covered so many things;"* and *"You can die of cold and the sun can cause harm to you that is why you must have a house"*. Moreover, interviewees generally believed that feasible alternatives were available, such as opening a window for a breeze or seeking shade under a tree. As one interviewee stated, *"I think I don't need it all that much because where I am staying here, I think I have enough forest cover. Trees are there, I have shade, the air is good. So there is good air circulation."*

3. These categories originate from the UPV framework which is detailed as part of the methods section at the end of this document.

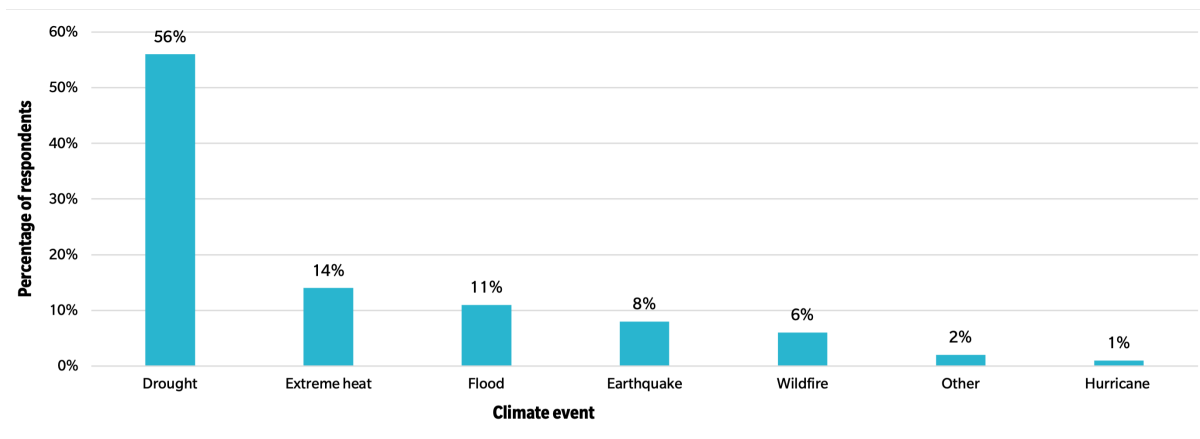
4. This figure was calculated from the 50% who selected "Other" when asked about their irrigation methods, with 70% of them stating that they rely on rainfall.

5. In the appliance specific UPV we asked participants to select the appliances that are most and least important of the eight presented (electric pressure cooker, fan, motorbike, refrigerator, television, water pump, grain mill and solar PV). This was followed by "why"-probing, further explained in the methods section.

6. It is worth noting that during part of the UPV data collection process where people were asked to select items and give reasons as to why the item is important (why-probing), "shelter" was the third most important reason that underpinned item selection (the first most important reason was food security, and the second was water security).

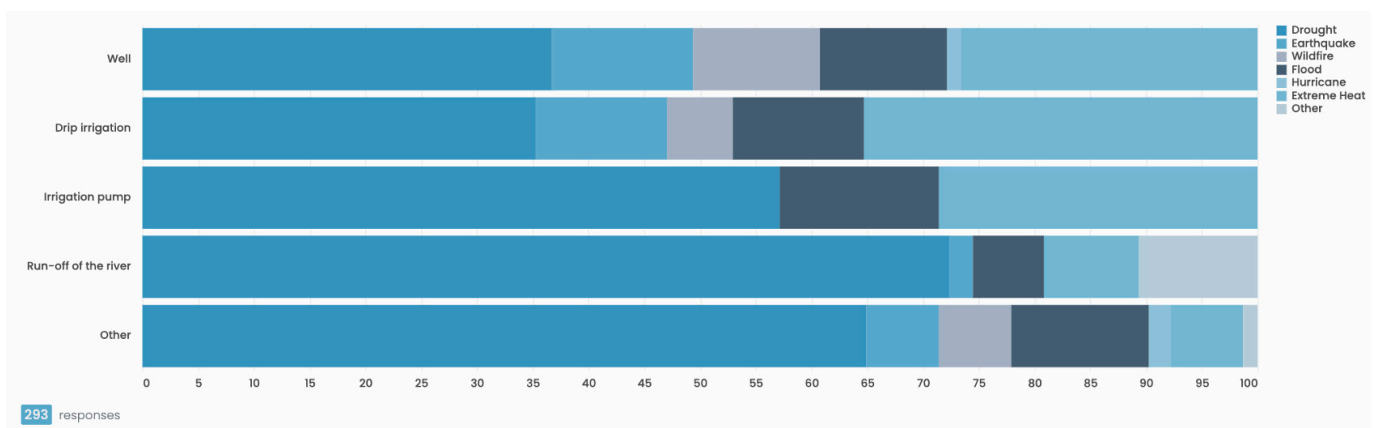
7. The UPV general refers to the UPV game where participants were shown 46 everyday items and were asked to select five that are most important to you and rank these in order of importance. This was followed by "why"-probing, further explained in the methods section what is most important given a certain climate event and why.

**Figure 2: Climate events interviewees are most worried about (n=300)**



**Figure 3: Comparison of worry of climate events against irrigation methods.**

(Note that the category "other" primarily refers to rainwater)



A recent study by Kebir et al. (2022) highlighted the importance of passive cooling in rural low-income areas, and noted that it's important to consider alternative cooling methods in the absence of rural electrification and increased heat stress.

Although the interviewees acknowledged the usefulness of fans for cooling down, it was interesting to note that fans were not selected as part of the UPV general and were perceived as the least useful appliance by 42% of the participants during the UPV appliance game. This could be attributed to the lack of adequate electricity supply to operate them, making them seem like a "luxury". Some of the interviewees pointed out that *"Fan is not important for me because a fan uses electricity and most people don't have electricity;"* and *"It is a fan because I don't have electricity that I can use to run the fan and even if I could be having electricity, it could be using a lot of my tokens and yet I can open the windows and door to bring the circulation of air."*

Based on the responses of the interviewees, the lack of interest in fans seems to be attributed to two main factors:

1. Successful use of natural extreme heat mitigation strategies (trees, shelter, windows, etc.)
2. Electricity-related limitations that prevent the purchase and use of fans

Data from this study do not reveal the extent to which electricity-related limitations play a role in the community's reluctance to use fans. However, it is worth exploring this topic in subsequent studies due to the potential of fans as a tool in mitigating the impact of extreme heat and enhancing resilience to climate hazards. Therefore, further assessments related to electricity supply should consider the size and capacity of solar systems that consumers use in order to determine the technical feasibility of powering fans. This could help to better understand the root cause of the community's apprehension towards using fans and devise effective strategies to address it.

## Floods

In relation to floods, the UPV game data showed that interviewees expressed 'shelter' and 'mobility' as primary means of coping, specifically using boats. For example, one interviewee shared, *"When it floods a boat will enable me to move to the other side where it is not flooded."* Another explained, *"I can say that a boat can be useful for me during a flood because sometimes you find that it rains a lot and everything is washed away and the boat is what I can use to save my life and that of my family."*

However, when asked specifically about addressing flood-risk situations as part of the socio-economic survey, the interviewees expressed a different response, stating that they would "run" or "shift" to a safer place; they did not refer to specific modes of transport. This indicates a disconnect between the findings from the UPV game and respondents' perceptions of coping with floods. This discrepancy may be because only 20% of those interviewed had ever experienced flooding in their home, indicating that most interviewees did not have previous first-hand experience with such an event and, therefore, provided hypothetical responses.



Image Credit: Ennos

## 2. BUILDING COMMUNITY RESILIENCE TO CLIMATE CHANGE

**To determine a community's resilience to climate change, we must first understand the qualities comprising community resilience.** For this project, we will use the components (community networks and relationships; communication; health; governance and leadership; resources; preparedness; mental outlook; economic investment) identified by Patel et al. (2017) to assess resilience in Siaya County.

**1. Local knowledge:** This refers to the understanding and awareness of a community's vulnerabilities and strengths, which is crucial in managing the impact of a disaster. Comprehensive knowledge of the community's resources and hazards allows them to respond better to crises and to plan and prepare for future risks.

The interviewees exhibited an understanding of the primary climate-related risks in their community, including droughts, extreme heat, floods, and wildfires. They also proposed strategies to respond to these risks and identified other potential hazards, such as disease outbreaks, mudslides, storms, theft, and inadequate water, electricity, and education infrastructure. In addition to describing their responsibilities in case of an emergency, respondents described community relationships as a critical resource in crises by expressing that a neighbour would be their first point of contact in the event of fire or flood.

**2. Community networks and relationships:** Strong social networks and relationships within a community can aid in coordinating and responding to a crisis effectively. The community's ability to work together and support each other during a disaster can significantly increase its resilience and chances of a successful recovery, especially in rural poverty-stricken areas like Siaya County.

The survey findings reveal that the community in Siaya County has strong networks and relationships, with 41% of respondents feeling "connected" and 28% feeling "very connected" within their community. Their reliance on neighbourly assistance during climate hazards also reflects this sense of connectedness. Additionally, most interviewees rely on "word of mouth" and "social events" (38% and 19% respectively) to communicate with other communities, receive political updates (29% and 13%), and acquire health information (33% and 18%). The importance of social gatherings in promoting community cohesion is evident, and "word of mouth" communication can be particularly useful in disaster situations when formal communication channels are disrupted. Furthermore, the majority (82%) of those interviewed participate in community organisations and social activity groups (e.g., church, stokvel, NGO, NPO, community-based organisations, etc.), which demonstrates a strong sense of community cohesion.

In crises, these established networks can assist community members in coordinating emergency responses, accessing critical information, and building disaster resilience.

**3. Communication:** Effective communication is critical in managing disasters and promoting resilience. Good communication ensures that information is shared and understood by all community members and enables open dialogue and exchange of ideas. This can facilitate better decision-making, increase coordination, and reduce the impact of a disaster.

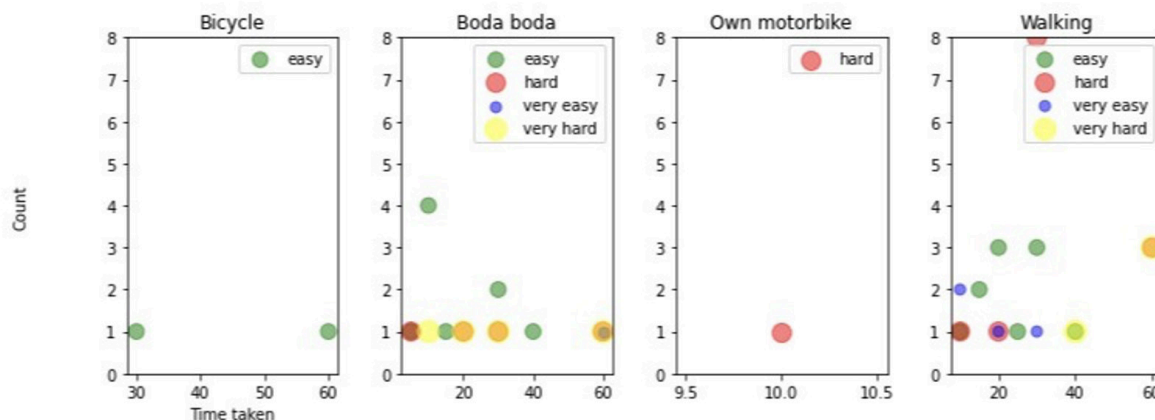
Radio is the primary source of information in the area, with 56% of those interviewed listening daily and only 19% never listening. Television is also a source of information, with 26% watching daily and 46% never watching. Despite the widespread availability of mobile phones, with 84% of those interviewed having one, most do not use it to access the internet. Only 19% of respondents access the internet, with 11% doing so occasionally, 6% every day, and 1% once a week. Additionally, as discussed in the previous paragraph, community relationships, as demonstrated by the reliance on "word of mouth" and social events for communication and information sharing, also play a crucial role in effective communication and disaster management in Siaya County. Understanding communication channels is essential for disseminating information about climate risks, including early warnings and best practices, which can help build community resilience.

**4. Health:** The health of a community and access to healthcare services are crucial factors in determining its resilience. A community that prioritises health and has access to quality healthcare is better equipped to manage the impacts of disasters and recover faster.

Health is a top priority for Siaya County's community members, as reflected by the high number who selected 'health centre' (22%) as the most frequently used service: 'being healthy' is within the top five values mentioned by 17% of interviewees. Frequent reference is made to infrastructure and appliances that prevent community members from falling 'sick' or catching 'diseases'. As this interviewee highlights: "*Water helps with cleanliness, as in without water you cannot survive and also the water helps you, you can wash dishes, cook and you can also drink. Reason for cleaning using water, I clean with water to avoid diseases.*" Additionally, community members show confidence in healthcare personnel, with 91% indicating they would seek care from healthcare professionals such as doctors, nurses, or health providers. Despite this, most individuals (61%) receive care outside their community, but 80% can access healthcare within an hour by using motorbike taxis (i.e., boda boda) or on foot.



**Figure 4: Assessment of modes of transport on how communities access healthcare services and their perception of ease of access.**



**5. Governance and Leadership:** Effective governance and leadership are important factors in promoting community resilience. Good governance and leadership help ensure that resources are used effectively and that appropriate decisions are made during and after a disaster.

The available data are insufficient to evaluate the effectiveness of Siaya County's government and leadership. This would need to be addressed in subsequent evaluations. Regardless, in questions related to communication and information access, interviewees relied least on government officials for communicating with other communities (2%) and receiving political updates (7%). One respondent responded, "*Village elder not relaying important information*" and "*A lot of propaganda*" to being asked to share "other risks or hazards affect you and/or your community". This suggests a lack of trust in the government's ability to effectively communicate important information and updates to the community when needed, which would ordinarily be expected from government officials.

**6. Resources:** The availability of essential resources such as food, water, shelter, and medical supplies is critical for the resilience of a community. Access to these resources can help communities effectively manage the impacts of a disaster and recover more quickly.

In Siaya County, the availability of adequate and sustainable resources for shelter is a concern, as indicated by the limited use of iron sheets in construction. Only 33% of respondents reported using iron sheets, considered the most durable roofing material, while 55% expressed dissatisfaction with the quality of their homes. Despite this, other building materials such as cement (11%), mud bricks (18%), and wood (23%) are still in use. However, the limited use of bricks and cement suggests that most homes in the area are likely to be mud huts, particularly vulnerable to damage from extreme weather events. The availability of adequate and sustainable resources for irrigation is also a challenge in the area, with only a combined 7% of respondents reporting the use of drip irrigation or irrigation pumps. Although the percentage of individuals with access to clean water for consumption is not specified, many expressed a significant need for boreholes and clean water.

This highlights the importance of improving resource management in the community to enhance resilience.

**7. Preparedness:** The importance of preparedness cannot be overstated when promoting resilience. Preparation at all levels, including individuals, families, and governments, is crucial to reducing the impact of disasters and ensuring a successful recovery.

The survey results indicate that most of the community lacks the means to prevent flooding (54%) and fire (66%). While a follow-up question to determine the type of prevention methods used or desired would have been useful, the data nonetheless highlights the need for increased preparedness in the community. Regarding food security, most respondents rely on traditional means of irrigation such as rainfall, wells, and run-of-the-river, with only 5% using drip irrigation and 2% using irrigation pumps. Access to these more advanced technologies was found to reduce concerns about drought, leading to the inference that sustainable access to water and irrigation technologies could play a crucial role in increasing resilience to drought, a key step in improving food security.

8. Kebir, N., Miranda, N. D., Sedki, L., Hirmer, S., & McCulloch, M. (2022). Opportunities stemming from retrofitting low-resource East African dwellings by introducing passive cooling and daylighting measures. *Energy for Sustainable Development*, 69, 179-191. <https://doi.org/10.1016/j.iesd.2022.06.007>

**8. Mental Outlook:** Mental outlook refers to the attitudes, feelings, and perspectives present during uncertainty and after a disaster. A positive mental outlook can help a community face and manage the challenges posed by a disaster and increase the chances of a successful recovery. This includes promoting community morale, reducing fear and anxiety, and encouraging a sense of hope and resilience.

While this is important, we did not capture data on this during this study. However, it is interesting to note that this type of post-disaster community empowerment and uplifting work is often led by strong community leaders who, as the limited data suggests, may be lacking in Siaya County. This assumption is further supported by our experience engaging with government officials who were unwilling to support data collection unless it was financially lucrative for them. For this reason, exploring the connection between the "mental outlook" and "governance and leadership" components of community resilience is worth considering in subsequent studies.

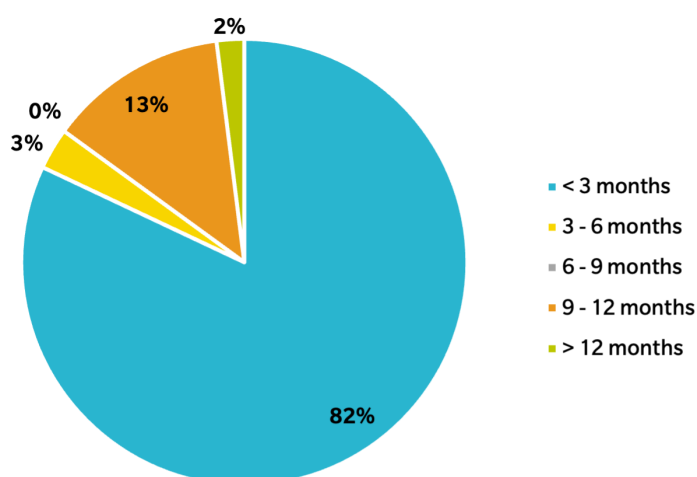
**9. Economic investment:** The economic impact of a disaster can have long-lasting effects, making it crucial to address the consequences in promoting resilience and recovery. Investing in infrastructure, job creation, and economic development can help communities better prepare for future events.

The results indicate that 80% of those interviewed reported that recovering from a catastrophic event takes less than three months. 9% indicated it could take nine to twelve months, and 8% indicated it could take over a year.

The amount spent on recovery varies greatly, with 32% of those interviewed spending less than KES5,000 (USD 35.92) and 19% spending between KES100,000 (USD 718.39) and KES1,000,000 (USD 7183.91). We did not observe any trend between expenditure and household income. For 64% of interviewees, projected spending during and after a catastrophic event is equal to or greater than monthly household income. Furthermore, 80% of those interviewed live below the poverty line of 1.90 USD/day, and 56% of those who spend more than their income are the most poverty-stricken. This indicates that the community is not economically well-equipped to handle the impacts of catastrophic events.

The majority of the population in Siaya County comprises subsistence farmers who are significantly impacted by the consequences of climate change. This highlights the critical importance of providing farmers with the resources/tools to increase their resilience to extreme weather conditions and mitigate adverse economic effects, such as boreholes for sustainable water supply, water pumps, and drip irrigation. Although improvements to farmers' access to these resources would likely contribute to income stability, additional steps must be taken to increase job security to build resilience and reduce poverty. This would equip community members with the financial means to purchase the items mentioned above in the first place. To address this, increasing job diversity in the area is crucial. For instance, investment in infrastructure and job creation in other industries can help build resilience and prepare communities better for future disasters. With a more diverse and secure job market, the economic consequences of disasters can be reduced, and recovery can be quicker and more sustainable.

**Figure 5: Main Occupation of Respondents Across the Three Countries**



8. Kebir, N., Miranda, N. D., Sedki, L., Hirmer, S., & McCulloch, M. (2022). Opportunities stemming from retrofitting low-resource East African dwellings by introducing passive cooling and daylighting measures. *Energy for Sustainable Development*, 69, 179-191.

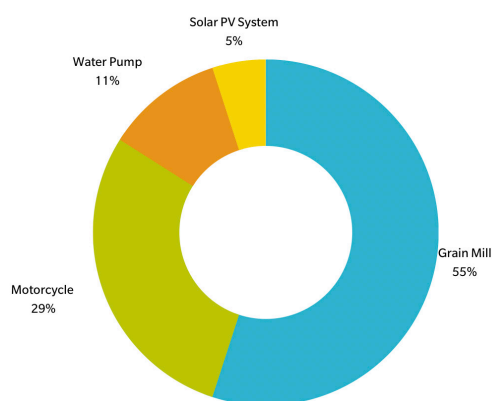
### 3. THE ROLE OF APPLIANCES IN BUILDING RESILIENCE

This section focuses on the views of Siaya County residents regarding the role of various appliances in building economic and social resilience in the face of climate change, recognising the crucial nature of off-grid solar products and equipment.

#### Economic factors

From the appliance-specific UPV, it is evident that the interviewees value appliances that have income-generating potential. Specifically, they selected grain mills (55%), motorcycles (29%), water pumps (11%), and solar PV system (5%). Respondents highlight that appliances can provide services to the community, such as milling grain, transporting goods or people, charging mobile phones and generating income. The importance of income as it relates to resilience was highlighted in the previous section under 'economic investment'. The appliances can also be used for personal business ventures, including selling goods and services, such as ground flour or snacks. By generating income, the interviewees hope to improve their economic status, support their families, and escape poverty. As this interviewee highlights, *"A motorcycle is the most valuable to me because if you have one, you can get someone to ride it and earn money every day if possible, and also, if you are sick, you can use it to go to the hospital."*

Figure 6: Interviewee preferences for appliances



A study by Alam et al. (2021)<sup>10</sup> found that owning assets is just as important as generating income from appliances for economic status. In this survey, we asked participants which assets they owned and found that they considered many of their appliances as assets. This is not surprising, given that almost all interviewees owned a mobile phone, which is the second most commonly used method of communication. The second most commonly owned appliance was a radio, which is important for receiving information and was the second most used item for political updates and the third most used for healthcare information. Solar PV systems were seen as assets by 14% of respondents, while radios, TVs, and stoves were perceived as assets by 16%,

10%, and 7%, respectively. As one interviewee noted about a TV: *"Noteworthy when you have a good life and some little possessions to take care of you, you can have the motivation to sit down and enjoy watching a TV."*

#### Social factors

To assess social status, we look at the following six UPVs in relation to appliances: aspiration, community development, personal performance, personal growth, respect from others, and self-worth. However, none of the appliances were explicitly linked to social status.

Examining household income and energy appliance ownership showed a correlation between the two. This discovery further supports the presence of a first-cost barrier for appliances, as highlighted in the 2022 Appliances for All report by Efficiency for Access. Higher household income was associated with higher ownership of off-grid appliances. For example, motorbike ownership increased from 1–7% for households with an income between KES 500 -15,000 (USD 3.59 - 107.76) to 33% for households with an income of KES 20,000 and above. Among the nine respondents who own a fridge, more than half (56%) were in the 10,000 KES income bracket. A similar trend was observed for television ownership, although to a lesser extent.

Additionally, given the crucial role of communication in times of crisis and the widespread ownership of mobile phones among interviewees, exploring the discussion on mobile phones can provide valuable insights into their potential for aiding community members in adapting to climate hazards.

Using the UPV game, analysis of conversations from the 40% of respondents who selected mobile phones revealed "connection" (97%) and "being informed" (26%) as the primary values associated with this device. For those who emphasised "connection," mobile phones were seen as a means of communication, allowing them to send and receive information, ask for help in times of crisis, including financial support, and stay up-to-date. As one respondent explained, *"With the help of a mobile, you are able to send money that will cater for the cost of the needs required."* Another respondent noted that a mobile phone would help them send information quickly to someone if they required medical care. Mobile phones were also viewed as a way to communicate with others for basic needs like food and water. For example, one respondent said, *"You can even flash your relative and he/she ask you what's wrong, and you respond 'am not fine, help me I slept hungry' and through that phone you can receive some money because they can't be aware to know how you are faring on without you telling them."*

Those who expressed "being informed" as a key value associated with mobile phones stressed their critical role in providing access to information and receiving updates in times of emergency or crisis. For example, one respondent stated, *"A mobile phone is important because, for instance, when the earthquake gets worse, I can use the phone to communicate with other people telling them of what is happening here and also to make inquiries if they may be experiencing the same thing."*

10. Alam, G. M. M., Erdiaw-Kwasie, M. O., Nagy, G. J., & Leal Filho, W. (Eds.). (2021). Climate Vulnerability and Resilience in the Global South: Human Adaptations for Sustainable Futures. Springer International Publishing. <https://doi.org/10.1007/978-3-030-77259-8>.

Participants also highlighted that a mobile phone helps them stay updated on news and events worldwide.

As one respondent mentioned, *"I can see what is happening all over the world,"* and another said, *"You can find that you can hear about information from afar even if it's something bad that has happened"*. Furthermore, respondents emphasised that a phone allows them to gather and access information quickly. One interviewee said, *"The reason why the phone is important to me is that it makes me get information quickly."* Another added, *"So you connect using the mobile phone and get the information faster."*

This demonstrates that mobile phones are a vital tool for individuals to navigate emergencies and bolster their disaster response capabilities. The capacity to communicate with others and instantly access information is of paramount importance during times of crisis or emergency. Mobile phones empower people to exchange crucial information and monetary support, solicit assistance, and stay up-to-date with happenings in their communities and across the globe. In sum, these findings underscore the critical role of mobile phones in enabling people to adapt to and manage climate hazards and related emergencies.

## Conclusion

### 1. Droughts are perceived as the greatest climate risk by the Siaya County community.

Despite living in remote areas with varying levels of urbanisation, 83% of individuals interviewed in Siaya County expressed concerns about climate change. 56% of the 300 interviewees identified droughts as the greatest climate risk. Most of them, who are crop farmers (50%), rely on vegetables for sustenance and water for irrigation. Agriculture is their main source of income and food security, but climate change has made it increasingly challenging to depend on these resources. Access to reliable water services is crucial for improving personal resilience, food security, and yields. Among those interviewed, extreme heat was the second concern (14%). However, passive-cooling methods such as shelter, trees, and open windows were deemed sufficient, while active-cooling methods like fans were seen as a luxury that required electricity. In fact, fans were rated as the least valuable appliance by the majority of interviewees (40% as part of UPV appliance).

### 2. A lack of economic status, proper infrastructure, and climate education are significant barriers to resilience in Siaya County.

Based on Patel et al.'s (2017) resilience categories, the community in Siaya County demonstrates a strong understanding of its vulnerabilities and strengths, enhancing resilience against climate change impacts. The community benefits from robust social networks, relationships, and participation in community organisations, facilitating effective communication and disaster management. Health is a priority, and there is confidence in healthcare personnel. However, limited data suggests low confidence in the county's

government and leadership. Additionally, the community's vulnerability to climate change is amplified by a weak economic foundation and inadequate infrastructure (e.g., basic housing stock with limited stress resistance).

To enhance resilience in communities like Siaya, there is a need for targeted efforts to overcome resilience barriers. Studies by the World Bank (2020), Alam et al. (2021), Bamutaze et al. (2019), and Gioto et al. (2018) emphasise the importance of economic factors such as income generation, asset ownership, and job opportunities in building resilience. This assessment of appliance usage in resilience-building reveals their potential to improve infrastructure services, including healthcare access, agricultural productivity, and climate education through training on climate-resilient farming techniques. This can involve employing machinery in agriculture, utilising irrigation for drought resistance, adopting mobile phone-based financial technologies for microfinance and micro-insurance access to markets, and more.

### 3. Irrigation technology is critical to building resilience.

Individuals with access to sustainable water sources – such as wells, drip irrigation, and irrigation pumps, were less worried about droughts – which highlights the significance of irrigation technology in enhancing resilience to extreme weather conditions and climate change. An evident trend showed increased appliance ownership with higher household income, suggesting there may be potential for increased irrigation technology adoption among those with better financial standing. Many farmers depend on rainfall for irrigation, and access to reliable water sources can increase resilience to climate conditions that impact irrigation and crop growth. One interviewee noted, *"During drought periods, we are forced to look for other options of getting food, and irrigation is one of the solutions that we require to make food"*. By providing farmers with access to sustainable irrigation, they can better adapt to the impact of droughts and other extreme weather events. This can lead to greater resilience in local communities and help ensure the long-term sustainability of agriculture in the region.

### 4. Word-of-mouth is the most common means of communication and accessing information. Still, mobile phones are vital for instant access to information in a climate emergency.

Word-of-mouth is the leading way of communicating in Siaya (even among those who own mobile phones) and accessing information on political and health topics. The radio is the second most common source of political news (53%), while social events (33%) and radio (32%) play a less significant role in accessing health information. Nevertheless, mobile phones were valued for facilitating communication, providing access to information and enabling people to exchange crucial information and monetary support. The assessment on the use of mobile phones demonstrated that mobile phones are a vital tool for individuals to navigate emergencies and bolster their disaster response capabilities. The capacity to communicate with others and instantly access information is of paramount importance during times of crisis or emergency.

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## METHODOLOGY

### Case study selection

This report focuses on Siaya County located in western Kenya. Kenya is known for its growing economy, and the agricultural sector plays a critical role in its success. Agriculture directly contributes 33% to the Gross Domestic Product (GDP) and indirectly contributes 27% through sectors like manufacturing and distribution (FAO, 2022). More than 40% of the population is employed in agriculture, particularly in rural areas where 70% of the population is engaged in agricultural activities (REEEP, 2018). Siaya County was chosen for this project due to its high poverty levels, with 48% of the population living below the poverty line and experiencing food insecurity.

### Sampling strategy

During this study, 301 individuals were interviewed in Siaya County, Kenya over two weeks. The participants were chosen from four different locations: coastal/port towns, urban village towns, rural villages, and special interest villages. Twelve villages, three from each location, were selected at random from the 179 villages in Siaya County based on the 2009 census. [A map](#) illustrating the distribution of households across the twelve villages can be found in the link provided.

The participant selection was guided by the National Commission for Science, Technology, and Innovation (NACOSTI), and was facilitated by the Siaya County Commissioner and local area chiefs. Participants were selected from diverse socio-economic backgrounds and age ranges, with an aim to achieve a balanced representation of gender, disability, income, age, education, and employment. However, due to availability and willingness, some demographics were not fully represented, and participants were selected based on their willingness to participate. Therefore, the final sample was as follows:

- **Gender:** 61% of the interviewees were female and 39% were male.
- **Education:** The majority of interviewees had completed primary school (61%), while 26% had completed secondary school. 7% had no education and 3% had tertiary education. Only 2% had higher education.
- **Disability:** 9% of those interviewed had a disability. Self-reported disabilities fell into one of three categories: visual impairment, physical impairment, hearing impairment, or a combination of these.
- **Employment:** The majority of those interviewed were crop farmers (33%), while 16% were unemployed. 12% were self-employed. The remaining 37% fell within a combination of these or additional categories, such as animal farmer, retired, teacher, shop owner, student, or fisherman.

A risk and ethics assessment following the NACOSTI ethics board approval under license No: NACOSTI/P/22/21652 in research involving human participants was approved to ensure the study's integrity. As per the guidance provided by Hirmer et al. (2021), interviewees were compensated for their time. Anonymous quotes are inserted throughout the report to support the ascertainties made. To protect the interviewees' identities, all names were removed in line with the ethics procedures laid out by NACOSTI.

### Data collection and analysis

In this study, we employed the User-Perceived Value (UPV) approach, a pictorial game-based data collection method where participants select items. After selection, through a process of why-probing, the reasoning behind the selection is investigated (Hirmer, 2018; Hirmer et al., 2021). The 40 items consisted of everyday items found in the case study communities. Eight of the items can be considered as energy appliances (fan, fridge, TV, pump (irrigation and water), motorbike, pressure cooker, solar PV and grain mill). The UPV approach was used at the community level to uncover the following:

- The five items that communities perceive as important (General format).
- The one appliance that interviewees perceive as most useful and least useful (Appliance-specific format).
- The three items that are most relevant to the interviewee given the climate event that they are most concerned about. (Climate format).

The UPV approach was accompanied by socio-economic surveys and geo-location data collection to contextualise the community. The survey was conducted using Kobo and can be [viewed here](#).

The data was processed using Natural language Processing (NLP) to quantifiably measure community values and understand the importance of energy appliances to different demographic groups (van Boven et al., 2021). The findings also helped fill data gaps on the impacts of appliances, as listed in the "Off- and Weak-Grid Appliances Impact Assessment Framework" (Rural Senses et al., 2020).

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Image Credit: Futurepump

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