



FINAL REPORT

DRY SEASON GARDENING AS CLIMATE ACTION BY RURAL WOMEN: A CASE STUDY OF KULIYAA COMMUNITY IN NORTHERN GHANA

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Community-Driven Climate Solutions: Dry-Season Gardening in Kuliyya, Northern Ghana | Ghana Case Study

Summary

Climate change impacts are increasingly affecting societies and the livelihoods of people in rural communities of the global south. Thus, adaptation to such impacts is inevitably necessary for livelihood sustenance. Dry-season gardening is one of the ways through which rural communities adapt to inconsistent rainfall patterns and droughts in rural areas. The main goal of this project was to identify how community-driven climate solutions and dry-season gardening can inform climate change education and communication among rural women in the community of Kuliyya in northern Ghana. Specifically, this research highlights a community led women's involvement in dry-season gardening as a solution to climate change impacts in the community. The case study adopted a community-based participatory research design to examine dry-season gardening as a meaningful climate change adaptation education strategy among these rural women. Guided by a Community Research Advisory Committee (CRAC), consisting of community female knowledge keepers and elders from the community (see Bourassa et al., 2020), this research project investigated women's participation in climate change adaptation through dry season gardening as a contribution to the ongoing Monitoring and Evaluating Climate Communication and Education (MECCE) Project. This research helps to understand why community-led climate initiatives are key to climate change adaptation education and communication. A Community Research Assistant (CRA) from the community of Kuliyya led the research process including recruiting of 20 female and 4 male co-researchers and a data collection process. This qualitative research project used multiple methods of a participatory approach for data collection: monthly CRAC meetings, Focus Group Discussions (FGDs), and one-on-one mop-up interviews with Elders and other stakeholders. Information from the CRAC meetings informed the design of the focus group discussion questions. Additionally, it emerged from the focus group discussions that there was a need to have mop up interviews with other key stakeholders. Dry-season gardening is a key climate adaptation strategy in many developing countries. Particularly, in northern Ghana, dry-season gardening is a livelihood source for most rural families. Regarding climate change education, these gardens serve as pedagogical sites for sharing climate-related information.

This narrative report has five main parts. The first part is the general description of the Climate Change Educational program (initiative). This research investigated, the dry-season gardening, including its aims, audience, as well as the theory of change taken by our initiative. The second part is the Case Study research methodology which explains the research design and methods of this project. The third part presents the findings of this case study and explains why this project exemplifies a quality Climate Change Educational program. The fourth part of this report highlights the most critical impacts of this case study, while the fifth part of this report discusses the lessons to learn about scaling and the applicability of the CCE initiative in other contexts.

Report

The CCE Initiative

Community-based initiatives have been highlighted as the pillars of climate change adaptation solutions. Community gardens, particularly dry-season gardening, have been found to play a key role in climate change education (Walter, 2013). These gardens serve as pedagogical sites where rural women can share climate-related information. Specifically in this study, the dry season gardens increased the CRAC members' (co-researchers)

knowledge about climate change adaptation, empowered them economically, provided household livelihoods, and led to food security for families. The main purpose of this case study was to identify how community driven climate solutions, and dry-season gardening, can inform climate change education and communication among rural women in the community of Kuliyya. Our target audience included climate change researchers, government agencies, and non-governmental organizations working within rural communities. The need for gendered climate change education informed this research. As a result, our study examined climate change education using a gender lens.

Our findings indicated that the educational initiative, gender-inclusive dry season gardening, enhances the livelihoods of women, empowers communities, strengthens community capacity, and improves self-determination. According to UNDP Ghana (2019), "Women in rural communities in most developing countries like Ghana are often vulnerable to climate change because they depend a lot on local natural resources for their livelihoods" (para. 2). Although both men and women suffer from the impacts of climate change, women face a heightened burden because they do not have access to resources. This fact further highlighted the need to integrate gender issues into climate change adaptation education and communication. On the recommendation of the CRAC, four men were included in the research, as they supported the women in their gardening activities.

Women's engagement in dry season gardening is a climate change adaptation strategy for rural livelihood enhancement; as well, the women themselves and the research process supported women's empowerment and cultural change towards climate change adaptation. This study investigated inclusive community-driven climate change adaptation education solutions through dry-season gardens among rural women in Kuliyya.

The Case Study

The case study was done by Department of Geography Education, University of Education, Winneba, Ghana. Raphael Ane Atanga, Principal Investigator and a Lecture is the key person of the project. In answering the main research objective of investigating how community-driven climate solutions through dry-season gardening inform climate change education and communication among rural women in the community of Kuliyya, we adopted a community-based participatory research (CBPR) theoretical framework. The sub-objectives of this study included

- (a) to investigate participatory communication education and inclusive community-driven climate change adaptation solution through dry season gardening in Kuliyya, and
- (b) to understand female involvement in dry season gardening in Kuliyya through communication education and how this affected inclusive community-driven climate change adaptation solutions.

Case study methods and participants

Based on the CBPR adopted, a Community Research Advisory Committee (CRAC) from the Kuliyya community guided the entire research project. The CRAC consisted of female Elders, Knowledge keepers (composed of locally knowledgeable females in the community), and women from the community. The CRAC had many experiences surrounding climate change, dry-season gardening, traditional land tenure systems, and other resources available to women to engage in dry-season gardening. In addition, a Community Research Assistant (CRA) from the community of Kuliyya led the research process, including recruiting 20 female and 4 male co-researchers, data collection process, workshops, and focus group discussions. Although the study focused on rural women, the 4 male co-researchers played significant roles in supporting the women with their community garden. The CRA ensured that the research was executed ethically, and all community cultural protocols were followed. This

study used multiple methods of a participatory approach for data collection: monthly CRAC meetings, Focus Group Discussions (FGDs), and one-on-one mop-up interviews with Elders and other stakeholders. Information from the CRAC meetings informed the design of the focus group discussion questions. Additionally, it emerged from the focus group discussions that there was a need to have mop-up interviews with other key stakeholders.

Monthly CRAC meetings were held with five female Elders (CRAC members) of the women's organization (the Kabembia Tigisem) to guide and direct the research. Additionally, FGDs were held with 20 women of Kabembia Tigisem who engaged in dry-season gardening. The FGD guide questions were structured under themes/headings that reflected the main and specific research objectives of this study as can be seen in the FGD guide attached. It emerged during the workshops that there was a need to interview other key stakeholders. As a result, the second data collection phase was a one-on-one mop-up interview with 3 men of Kuliyya and a male patron who supports the women in their dry season gardening activities. This helped fill up gaps in the initial data. This brings the total number of research participants to 24. This approach not only added broad perspectives but also brought newer ideas to the discussion. A purposive sampling method was adopted to recruit the 24 co-researchers for this study. The inclusion criteria were women and men above 18 years old living within the community of Kuliyya who engage in dry-season gardening.

Advancing Quality CCE through this Case Study (findings)

Our case study findings about women in climate change adaptation through dry season gardening exemplify a quality CCE initiative. The study found that an inclusive community driven climate solution through dry-season gardening could inform climate change education and communication among rural women in the community. The following most important findings relating to Climate Change Education emerged from our case study.

First, the gender dimension of dry-season gardening was further highlighted by the research project. Socio-cultural, economic, and political factors remain major barriers, preventing women from accessing formal sector employment within Kuliyya. As a result, women depend directly on the land and natural resources for survival within the community of Kuliyya. Therefore, they are at higher risk of climate change within the community of Kuliyya than their male counterparts. Centering gender in climate change education is therefore key to addressing these unique challenges. As UNDP-Ghana (2019) concluded gender issues are integral to climate change mitigation and adaptation to minimize climate change impacts on women and children. Although these barriers exist within the community, the finding's showed women are making significant efforts to adapt to climate change. The co-researchers described dry season gardening as the major source of employment for most women within the community. The gardens support families financially, promote self-reliance and enhance access to healthy foods. Against this background the women have even formed an organization, the Kabembia Tigisem, to enhance women's participation in dry-season gardening.

Second, community gardens serve as an alternative source of livelihood. Key to climate change adaptation education is enhancing resilience to drought through dry season gardening as an alternative source of livelihood. The findings supported earlier studies that showed community gardens in dry-season gardening enhance women's resiliency (UNDP Ghana, 2019). However, this research demonstrated the gardens serve as pedagogical sites for learning about climate change and alternative sources of livelihood for the women in the community, hence, helping in mitigation and adaptation to climate change within the community. This helps to empower women within the community in the fight against climate change (Wright-Asante et al., 2017). Another important finding is that the women started this livelihood activity of dry season gardening by themselves. This means they were more than just helplessly waiting for external livelihood support from government or international

organizations to rescue them as it is often portrayed in the African context (Adekoya, 2013; Randolph & DeMulder, 2008). This point must be highlighted as it is key for promoting self-determination in the fight against climate change (Acharibasam, 2022). Additionally, promoting self-determination is important for climate change education.

Third, community gardens provide an avenue for engaging in climate change adaptation education. The results show that the dry-season gardens serve as pedagogical sites for rural women in the community of Kuliya. Particularly, the gardens serve as a source of climate change information for rural women in adapting to climate change, thereby, helping inform adaptation strategies within the community. The women's organization plays a key role in climate change education within the community of Kuliya. The community gardens are open to all women including new arrivals within the community, thereby, providing an opportunity to share climate change information among women. It is an effective way to introduce new community women to the climate change challenges within the community of Kuliya. Women new to the Kuliya community learn about climate change from the women who already live in the community through personal engagement on meeting grounds and in the gardening processes. The experienced women teach the women new to the community as they all participate in the gardening activities and share information about climate change in the community. Following this, the process of teaching new women about climate change is informal, practical, and experiential through the gardening process. The new women learn about climate change as they participate in gardening activities. Besides the peer-to-peer learning, it emerged that due to increasing droughts, the female Elders and Knowledge Keepers provide teachings on the type of crops to grow, raising nursing beds, nursing seeds, transplanting, treating pests traditionally, and watering crops efficiently. Having personally experienced and lived through climate change impacts, these female Elders are a good resource the women rely on for climate change education. Again, these are respected members of the community whose words carry weight. These findings are key to climate change education in the Ghanaian context.

Fifth, group learning is key to climate change education. Engaging rural women as a group enhances climate change education. Climate change education and information have the potential to impact people's mental health. This can be seen in the form of climate anxiety, solastalgia, and ecological grief. We found psychosocial aspects of climate change in this research as some of the community members had experienced adverse effects from climate change and lost their livelihoods due to floods and droughts. The co-researchers described floods destroying their gardens and expressed despair in the fight against climate change. As a result, social connections and support systems are key to learning and adapting to climate change. The women reported that gardening and doing things as a group fosters unity and plays a key role in how they adapt to climate change. Through this group, women learn how to garden, have access to vegetables even if they do not cultivate a garden or lose their gardens to adverse climatic events, and get support in times of ill health or climate-related disasters like when a building collapses. Houses in the community are built with mud, and heavy rains and floods can sometimes lead to houses collapsing. These kinds of social supports are key to adapting to climate change within rural communities. Additionally, working as a group facilitated access to land as it presented a common front in convincing the area chief to release land for their activities. Given that the community is a patriarchal community where men inherit the land, this group is helping break down some of these social barriers related to land tenure systems. Hence, offering climate change education in groups within rural communities like Kuliya helps address economic, environmental, and social norms and traditions that reduce women's capacity and prevent accessing resources in adapting to climate change and again, working as a group allowed for mentorship from the Elders in the community.

Sixth, environmental signals educated the women about climate change within the community. It emerged from the study that changes in the rainfall patterns including the length, duration, start and end of the rainfall and dry seasons, increase in temperature as well as the amount of rainfall constitute local environmental signals which communicated and educated the women about the changes in the climate of the community. Additionally, the invasion of termites in gardens and poor fruition of wild economic trees like shea nut, dawdawa, and baobab trees also changes due to the impacts of droughts in the community.

Seventh, women's participation in dry-season gardening is helping to change (neutralise) gender roles. Previously, gender roles were well defined within the community of Kuliya, men did physically challenging task like the digging of wells for dry-season gardening while women transported (carried the vegetables on their heads) to the market for sale. However, these roles are changing as women now dig their own wells.

According to the Female Elders, women do not get the needed support from men anymore; as a result, they dig their own wells. This finding, changing gender roles resulting from climate change, is key to CCE education.

The findings suggest that dry season gardening seems to play a role in re-shaping gender roles in the Kuliya community. Gardening in the community used to be largely a male practice. Given the patriarchal nature of the community, the men mainly owned gardens while their wives and children supported with light activities such as preparing food, selling garden produce, bringing fencing materials, and watching over vegetables against destruction by stray animals. While the traditional role of women in the community was known to be limited to domestic chores in the past, dry season gardening in adaptation to climate change seems to be changing this tradition in terms of women's role. Through the women group, the women currently own gardens and engage in the gardening activities in addition to the domestic chores. While this increases the burden on women roles, it provides them with more economic freedom to earn income to support the family in addition to what their husbands could bring.

Additionally, climate change has led to the seasonal migration of men from the community to other parts of Ghana especially, southern Ghana in search of jobs. This has resulted in a situation where most households are left with only the women and children to feed. To support themselves and their children, the women have started engaging in dry-season gardening themselves. With the men gone, it has become difficult to find men to support in digging wells for dry-season gardening. To fill this gap, women have taken up the responsibility of digging their own wells and being the main breadwinners for their families in the absence of their male partners.

Eighth, the study revealed gaps in current climate adaptation strategies introduced by the (Ghana) governments and other organizations in the form of early maturing crops and how this has led to shortages in fencing materials (millet stalks) for dry-season gardens. Due to rainfall variability, the Ghana government is rolling out programs encouraging farmers to switch from traditional crops like millet to early maturing crops such as maize. Cereals like millet require a lot of water and long maturity periods to grow but they play significant cultural roles within the community. The millet stalks are fencing materials for dry season gardening and can also be used as roofing materials for huts and fuel for cooking in households. As the CRAC described, fencing is an issue because climate change impacts including shortage of rainfall amounts and duration have affected the growth of millet, and thus, they all grow maize now. As a result, they do not get fencing materials for the gardens. Unfortunately, community members have resorted to felling the few trees within the community to fence their gardens, leading to deforestation and the loss of traditional medicinal trees within the community. Climate impacts on traditional crops and how this impacts rural communities' health and wellness are key to CCE. Addressing how we can adapt

to climate change and maintain important cultural practices is important to CCE. Again, highlighting the failure of government climate change policies is key to effective climate change education. The community members highlighted the need for community-led solutions and broader consultation before governments introduce climate change solutions. In the case of this policy, the community members were not consulted before the climate solution was introduced. The provision of alternative fencing and roofing materials as well as energy sources for cooking would have supported community members to adjust much better to this government policy. The policy influence from the community level seems ineffective because the several years of efforts from the community to get electricity from the national electricity grid did not succeed.

Ninth, the women of Kuliyya have adopted an innovative communication channel for easy communication and transfer of knowledge related to climate change. Realizing many of the members do not own cell phones, oral forms of communication became the commonest and most effective means of dissemination of useful climate change information among the women group:

We communicate among ourselves mostly by word of mouth. Should we have a meeting, our leader will pass the information to us through word of mouth. One person sends it to the other and then it is passed to the other person all by word of mouth. We sometimes also use mobile phones to communicate among ourselves but that is not too common since many of our members do not have a handset. (FGD, Kuliyya, December 16, 2022)

This form of participatory communication is key to climate change education among the women of Kuliyya. This correlates with the participatory communication model where dialogue, information sharing, perceptions, and opinions among various stakeholders facilitate empowerment, especially for the most vulnerable (Tuftte & Mefalopoulos, 2009). Again, using person-to-person communication as demonstrated in this study builds trust in climate information and allows the women to ask further questions from knowledgeable members.

Tenth, it emerged that women faced unique barriers in participating in dry-season gardening. The co-researchers reported inadequate water supply, lack of fencing material, and limited funds among others as some of the barriers preventing them from participating in dry-season gardening. Particularly, the co-researchers noted that the water table has become very low because of droughts. As a result, it has become difficult digging the wells they rely on to water their gardens. The women also complained about how difficult it is to draw water from some of these wells to water their gardens because of the deep nature of the water table. These exhausting activities negatively impact on the health and wellness of the women. Irrespective of these challenges, the women in Kuliyya still engage in gardening to feed their families, as the following describes:

We currently depend on the gardens to feed our families and also earn some income to take care of our children in school. Without dry-season farming, hunger, and starvation will have been serious in our communities. (FGD, Kuliyya, December 16, 2022)

The last outcome from the study emerged in how the community-based participatory research approach helped address gender inclusivity in dry season gardening in climate change adaptation. The main concern about research within remote communities in Africa has always been the adoption of helicopter research, creating a situation where researchers' voices outweigh those of community members. As a result, the community-based participatory research created the space for the community, to lead and guide the research through their CRAC. It addressed the power relations in the research, presenting the researchers as learners and the community members as experts. This created a safe space for the women to share their experiences with climate change and dry-season gardening.

Additionally, the methodology helped build capacity as this was the first time the community had been engaged in this research format where a CRAC and CRA were formed and recruited. The community's knowledge was prioritized in the research process. The CRA guided the researchers on cultural protocols within the community while the researchers on the other hand also mentored the CRA on how to do research as well as apply for and hold grants. This created the space within the research process for reciprocal and iterative learning. The methodology also helped build respectful relationships with the community where research power was with the community. The community decided the workshop dates, reviewed, and approved PowerPoint slides, and all focus group and interview questions. Integrally, they were included in the data analysis process, hence, ensuring the community was involved in all research processes right from its inception, and proposal design stage to its completion. The findings were presented to the community members first before being shared with other agencies. All resources for the research remained in the community, CRAC members were given honoraria for their time and the CRA was also employed locally and paid a salary. All research equipment for the research is left with the community of Kuliya. This reflected an entirely different approach to doing research in a good way. The relationship with co-researchers further built trust which enabled the researchers to obtain shared knowledge about dry-season gardening. CRAC meetings provided an opportunity for the community to lead the research ensuring their knowledge is upheld. Through the CRAC meetings and the knowledge obtained, the research came out with relevant questions for further discussion during focus group discussions. This was an additional platform to include other women in the discussion.

Besides, further recommendations through snowballing extended the learning platform to include a few men who played a critical role for the women in their gardening activities in the community. This provided an avenue to know that men and women primarily have specific roles to play in gardening where the hard energy-demanding jobs and providing security for the garden are male jobs while the women do the other jobs in the garden. Thus, this collaborative participatory approach to the study provided an avenue to understand how inclusive participation of women in dry season gardening to adapt to climate change. The community members described the research process as a good way to do things and something different from previous research. The CBPR framework adopted has helped to build trust with the community further.

Psychosocial dimension

The research findings showed some of the co-researchers were struggling with the psychosocial aspects of climate change impacts. Most of the women had lived experience with the adverse effects of climate change. This emerged as either losing their livelihoods to floods or housing facilities due to floods. Bringing the women together through this research process helped build the capacity and social connections needed to support them adapt to climate change. The CRAC meetings and the FGDs brought the women together and helped to share climate change information is crucial to climate mitigation and adaptation. Again, other gaps were identified through this research where the researchers and the community members can collaboratively apply for further funding to support the women to adapt to climate change. For example, the researchers are supporting the women to put together an application to a local NGO for fencing materials for their gardens.

Action-learning dimension

The research incorporated action learning with the community, where the Elders led gardening activities with the co-researchers. These activities included a nursery, transplanting activities, composting and organic manure, effective watering, and mulching to conserve moisture. These were hands-on practical activities led by the Elders and other knowledge keepers in the research. This also created the space to engage in discussions around using

fertilizers and genetically modified seeds that have been approved in neighbouring countries of Burkina Faso. The women wanted to know if they could have access to some of the seeds grown in Burkina Faso, which are genetically modified. This created the space for the researchers and Elders to engage co-researchers on the need to stick with traditional seeds within the community. The research incorporated action learning with the community, where the Elders led gardening activities with the co-researchers. These activities included a nursery, transplanting activities, composting and organic manure, effective watering, and mulching to conserve moisture. These were hands-on practical activities led by the Elders and other knowledge keepers in the research. This also created the space to engage in discussions around using fertilizers and genetically modified seeds that have been approved in neighbouring countries of Burkina Faso. The women wanted to know if they could have access to some of the seeds grown in Burkina Faso, which are genetically modified. This created the space for the researchers and Elders to engage co-researchers on the need to stick with traditional seeds within the community.

Climate justice

This research project addresses the marginalization of women's voices in CCE as a social justice issue within the global south. Within male-dominated societies, the voices of rural women, their perspectives, and climate change adaptation activities are marginalized in climate change education, especially in international discussions about climate change. Meanwhile, women face a heightened burden from climate change due to socio-cultural and economic reasons forcing them to depend directly on the Land for survival. According to UNDP Ghana (2019), "Women in rural communities in most developing countries like Ghana are often vulnerable to climate change because they depend a lot on local natural resources for their livelihoods" (para.2). Although both men and women suffer from the impacts of climate change, women face a heightened burden because they do not have access to adequate resources. Therefore, women's climate change educational needs differ from men's. Therefore, climate change education must consider some of these gendered responses. Evidence shows dry season gardening education has become rural women's major climate change adaptation strategy in northern Ghana (UNDP, 2019).

Indigenous knowledges/participatory methods influence

Our case study engaging rural women in dry season gardening was centred on Indigenous knowledge. Adopting a CBPR framework, our research prioritized the community's Indigenous knowledge throughout the research. Female community Elders and Knowledge keepers involved in the research through CRAC meetings and FGDs about dry season gardening were centred on Indigenous knowledges and cultural protocols. Based on this, the female Elders and Knowledge Keepers led all knowledge sharing on gardening activities, drawing on their traditional knowledges about climate solutions to dry-season gardening. Specific activities included traditional approaches to composting, nursing seedlings, transplanting plants, watering, and traditional approaches to mulching and conserving moisture for plants, and traditional approaches to controlling pests. Besides, the study shows that the CBPR framework created a platform to investigate and understand the form of participatory communication education and inclusive community-driven climate change adaptation solution through dry season gardening in Kuliyyaa. The approach also further allowed the researchers to understand female involvement in dry season gardening in Kuliyyaa through communication education and inclusive community-driven climate change adaptation solution.

Cultural and regional contexts influence

The cultural and regional contexts of this research influence this study's design, development and implementation in several ways. The study community, Kuliyyaa, is a rural farming community with patriarchal ways of life and traditions that position men as decision-makers,

heirs to family resources and decision makers in the society, similar to the regional context in Africa. Women are seen as secondary to men in patriarchal context which means women cannot be heirs to land and they need men (husbands) as leads to acquiring land. Access to the community land for the garden is free, following the traditional land acquisition procedures. The patriarchal and traditional nature of the study community required the researchers to go through the patriarchal traditional community entry process and this further legitimized and strengthened the CCE initiative in the community. However, the FGD and the CRAC meetings involved only women to avoid any potential dominance of men in such discussions due to this tradition. The language of the community also influenced the study design which involved the community elders and the CRA from the local community since these individuals have knowledge about the community. The rural context determined the schedules of the study, data collection, and CRAC meetings to ensure successful research processes. The choice of dry season gardening as a climate change adaptation solution further fits into the rural regional context where farming is the main source of activity for the people. Rural people's adaptation to climate change where rainfall has been the mainstay of agriculture turns to see dry season gardening as an alternative source of food production. The implementation of involved men and women executing the project to its completion because the women work in collaboration with their husbands represented by the 3 men in the community. Thus, the community sees gardening activities as supportive of family livelihoods that require the collective collaboration of men and women.

Sharing learnings across geographies

Geographically, the research findings benefit countries in the global south as they engage in CCE. The biggest learning outcome is how governments, organizations, and private individuals can support women in rural communities to adapt to climate and at the same maintain important indigenous cultural practices which support environment and sustainability.

Impacts of the Case Study

Impacts at the Internal Level

To achieve quality CCE, community-led approaches must be adopted where community voices are prioritized. Our case study has transformed how climate change research is conducted within the community of Kuliya. By adopting a CBPR framework, we created the space for the community to lead the climate change education process. Importantly, the case study helped equalize power imbalances within research, build trust between researchers and communities, and foster a sense of ownership over the research (Castleden, Garvin, & Huu-ay-aht FirstNation, 2008). The CBPR ensured ample collaboration between the research team, researchers, and Elders, Knowledge Keepers, and community members. The framework allowed for relationship building, co-learning, and mutual capacity building in CCE. The focus of this research project, its innovative conceptualization, design, and approach have influenced individual researchers and organisations alike in CCE from local, national and international levels. Within the local community, including individuals, women in general, and organisations in the community of Kuliya and beyond saw relevance in our research focus, concepts, methods, and approach to the quality CCE research we undertook in the community.

The coresearchers appreciated our research focus on gender, dry season gardening as an adaptation to climate change impacts and the collaborative qualitative approach to the study where the researchers, CRAC, CRA and other stakeholders shared knowledge in monthly meetings over a period of one year in addition to FGDs and key informant interviews in the data collection process. The focus on climate change and gender made women's actions in adaptation to climate change visible in the community. This also improved the confidence of the women in their group approach to tackling the problems of climate change in rural

settings instead of addressing CCE individually. The approach to this project gives positive and innovative influence on research approaches at personal and organisational levels because these collaboratives and CRAC approaches to research, where the members of the CRAC are made co-researchers rather than being mere research participants give the co-researchers collaborative power and ownership of the project and the research process. The impact at the individual and organisational levels can therefore be seen as positive and could influence the scientific approaches and concepts of local and international researchers and policy makes. Unlike the usual helicopter research, this research was hatched from healthy and ongoing collaboration between the research team and the Kuliya community. Implementation of practical recommendations from the study in the local community have local support. Besides, the impacts on local and international perceptions about women's roles in rural communities in adaptation to CCE can begin to broaden and shift towards gender inclusivity and group learning.

As noted earlier, women are disproportionately impacted by climate change. Gender, therefore, plays a key role in climate change education. The climate change educational needs of women differ from those of men. The main objective of our work is to reduce negative climate change impacts on rural women. Particularly, this CCE project created the space to address rural women's climate change educational needs by having their voices heard. Broadly, the findings from this CCE case study have wider application. In addition to addressing women's immediate climate educational needs, the findings also have national and international significance. For example, the findings have revealed gaps in climate change policy at the national level in the introduction of early maturing crops. In addition, we have also raised questions to inform climate change education globally. How can climate change education help adapt to climate change while maintaining Indigenous crops and other significant cultural practices?

Impacts at Different Levels

Another important impact of this project is on the climate change education of women in the Kuliya community and other rural people at the local, regional, national and intergovernmental level policies and initiatives. Our CCE research findings go beyond local knowledge sharing and CCE at community levels to involving researchers, governments and organisations interested in climate issues. Our study applied qualitative case study approach to investigate women's inclusion in dry season gardening in adapting to climate change. The impacts of this study on CCE are related to climate adaptation practices and group learning among rural women in Kuliya and similar rural areas in a broader context. The research design involved women in CCE which helped to project the role women play in instances of climate change education research, adaptation, and sustainable rural livelihood.

Applicability and Scaling of the CCE Initiative

There exists the potential to scale up this project to further address the climate educational needs of women within other rural communities in northern Ghana. Given the good work done with the Kuliya community, women from our other community partners (neighboring communities) have expressed the need to engage the researchers in similar projects. For example, the results from this research can be expanded to explore more sustainable fencing materials for dry season gardening to prevent deforestation.

In terms of applicability, because this case study adopted a qualitative research approach, we caution against generalizing our findings. Through our community-based research work, we have learned that communities are different, and we do not adopt a pan-Indigenous approach to working with our community partners. However, there exists the possibility of implementing similar CCE initiatives in communities that share similar sociocultural features with the community of Kuliya.

The main results from this study suggest that scaling this research to a broader scope and rural context in the application of its findings and future research could be very impactful in CCE.

However, application of the results and recommendations from this project should be applied to broader geographical scope with similar socioecological conditions as Kuliya with care. The results from our project create an opportunity to conduct future research, using multiple case studies with a bigger sample size plus qualitative and quantitative research methods so that the results can be more useful for both empirical and theoretical generalisations. This study is qualitative based on a single case study research that focused on Kuliya as a case in Ghana and the results are most relevant for this context. The findings of this study are directly applicable to the situation of the Kuliya community but could potentially also be applied to similar contexts in rural Ghana and other countries. Results from a single case study can be applied in other contexts for conceptual generalisation rather than empirical generalisation since the sample size is too specific for the results to be relevant for the general context (Yin, 2014).

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