Farmer adoption of planned climate adaptation: Institutional constraints and opportunities in the Upper East Region of Ghana

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Abstract: Climate variability and extremes are already impacting negatively on farm outputs in most developing countries. This has culminated in the introduction of numerous planned adaptation initiatives. Despite the existence of these efforts, the authors identify that adaptation deficit is still high in these countries. Although there is literature on factors that influence adoption of adaptation initiatives, not much coverage has been given to how institutions enable or constrain adoption. This study sort to explore the institutional constraints to and opportunities for farmers’ adoption of planned adaptation interventions under the Climate Change Adaptation in Northern Ghana Enhanced (CHANGE) and the Adaptation Learning Programme (ALP) projects. Using a mix of methods, the study elicited data from 184 crop farmers under these two initiatives in the Upper East Region of Ghana. The study found that the institutional opportunities for farmer adoption of planned interventions were adequate and proactive extension services; frequent farmer training and development programmes; ease of access to and timeliness of credit;

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PUBLIC INTEREST STATEMENT

Climate variability and extremes are already impacting negatively on farm outputs in most Ghana. This has culminated in the introduction of numerous planned adaptation initiatives. Despite the existence of these efforts, the authors identify that adaptation deficit is still high in Ghana. Although there is literature on factors that influence adoption of adaptation initiatives, not much coverage has been given to how institutions enable or constrain adoption. This study explored the institutional constraints to and opportunities for sustainable adoption of planned adaptation interventions. An in-depth understanding of the central role institutions play in the sustainable adoption of adaptation methods is essentially important to efforts targeted at reducing adaptation deficit in Ghana. The findings of this study may improve adaptation policy and management efficiency. The findings of this research have also been shared with relevant institutions and stakeholders through a workshop.
input subsidies; and timely weather information. The constraints to farmer adoption were land tenure insecurity; inadequate involvement in the planning of interventions; limited coverage of interventions due to cost; poor extension services; and inaccurate or non-existent weather information. On the basis of these farmer perspectives, the research recommends urgent need to enhance institutional capacities and improved farmer access to institutional support.

**Subjects:** Development Studies; Rural Development; Environment & the Developing World; Development Geography

**Keywords:** Climate variability; Planned adaptation; Adoption; Institutional capacity; Ghana

1. **Introduction**

The adoption architecture of climate adaptation strategies is affected by institutional opportunities that influence the rate and levels of adoption at any given point in time and at any scale. The institutions involved in the diffusion and/or promotion of adaptation usually constitute deriving forces that facilitate farmer adoption of strategies. Institutional factors deal with the extent or degree to which institutions impact on technology adoption by farmers. Institutions include all the services to agricultural development, such as finance, insurance and information dissemination (Melesse, 2018). Institutional promoters of adoption are usually viewed in the form of deliberate government or NGO projects aimed at providing farmer support in the form of technical training, access to markets, input supply and subsidies among others to enhance adoption (Melesse, 2018).

Prior to the introduction of any new agricultural technology, there is need for institutional arrangements that would enable adoption of technologies. For instance, the adoption of some technologies by farmers may require access to markets for inputs and outputs, appropriate government policies (like subsidies etc.) and information dissemination and supply of complementary inputs as well as specialised training, extension services and agriculture insurance. These are institutional factors that are beyond the individual or group of farmers’ controls (Ronnie-Hornik, 2004; Lionberger, 1960; Noga et al., 2017). Access to participate in training, demonstration, field day and other extensions services therefore creates the platform for acquisition of the relevant information that promotes technology adoption (Melesse, 2018).

Studies show that both formal and informal institutions are relevant to adaptation in the sense that they legitimize practice and rules of conduct. These are imperative in defining access to resources and the different adaptive capacities of individuals, households, and communities (Yaro, 2013). It has also been argued that institutions tend to situate the interaction between individuals, groups, and the state through the regulatory structuring of coping and adaptation options, opportunities, and limitations. If it holds true that institutions provide the framework within which households, groups and communities can make specific adaptation choices, then its critical to intensify empirical research, particularly at the local level to ascertain how these institutions operate, and whether their *modus operandi* enhance or provide means for adaptation beyond the short term (Atampugre et al., 2021).

Climate variability and extremes are already affecting negatively farm outputs in most developing countries like Ghana. This has culminated in the introduction of numerous planned adaptation initiatives, particularly in the northern regions of the country. Despite the existence of these efforts, the authors identify that adaptation deficit is still high in these regions. Although there is literature on factors that influence adoption of adaptation initiatives in this part of Ghana, not much coverage has been given to how formal and informal institutions enable or constrain adoption. This study sort to explore the institutional constraints to and opportunities for farmers’ adoption of planned adaptation interventions from the perspective of beneficiary farmers within
The catchment of two programmes (i.e., Climate Change Adaptation in Northern Ghana Enhanced-CHANGE and the Adaptation Learning Programme-ALP) in the Upper East region of Ghana.

2. Theoretical and literature review

2.1. Force field theory

The research was developed on Kurt Lewin’s (1951) Force Field Theory. The Force Field Theory is an important strategic tool used to understand what is required to implement change or introduce new technology or culture in human society, corporate business world and/or the individual personal environment. Force-field theory is an analysis that is based on influential development in the social sciences. It provides a framework for looking at the factors (forces) that influence a situation, originally social situations. The theory looks at forces that are either driving movement toward a planned goal (deriving or helping forces) or blocking movement toward a goal (restraining or hindering forces). In direct relation to social situations, Kurt Lewin views culture as being in a state of equilibrium.

According to Lewin “A culture is not a painted picture; it is a living process, composed of countless social interactions. Like a river whose form and velocity are determined by the balance of those forces that tend to make the water flow faster, and the friction that tends to make the water flow more slowly the cultural pattern of a people at a given time is maintained by a balance of counteracting forces.” (Lewin, 1948). Lewin (1948, p. 47) further indicated that “To bring about any change, the balance between the forces which maintain the social self-regulation at a given level has to be upset”.

Thus, implementing change (driving force) by way of introducing planned adaptation strategies to farmers to achieve increased productivity is met by resistance (restraining forces or constraints) from farmers whom are used to traditional ways of agriculture as well as other restraining factors like cost, risk etc. Thus, implementers of the planned strategies would have to apply “push strategies” while farmers seeking to maintain old farming systems would apply “pull strategies” resulting in creation of a force field. Farmer resistance must be eliminated or reduced through effective two-way communication and training to disseminate the inherent advantages of the planned strategies as well as address farmer concerns. Figure 1 depicts the force field model.

Hence, before the planned adaptation strategies (change) are introduced the force field is in a state of equilibrium between forces favourable to change and those resisting change (Connelly, 2017). Lewin also introduced the presence of a pseudo-stationary social equilibrium. This implies that, for change to occur, the prevailing farming systems or equilibrium must be upset. This can be achieved either by adding conditions (in this case additional technical and equipment support) favourable to the change or by reducing resisting forces. Lewin (1951) proposes that whenever driving forces are stronger than the restraining forces, the prevailing undesirable practices or equilibrium will change. This proves more efficient when applied to understanding how people move through change and why they resist change (Connelly, 2017). There will always be driving forces that make change attractive to people and restraining forces that work to deter people from adopting change. Thus, successful change is achieved by either strengthening the driving forces or weakening the restraining forces.

3. Institutional opportunities to adoption

The literature is clear or shows that institutions (both formal and informal) matter for agricultural development (Ronnie-Kijima et al., 2011; De Laiglesia, 2006; Noga et al., 2017). Essentially, informal and formal agricultural institutions reduce the cost of participating in agricultural business, encourage trust, and reduce price volatility (Noga et al., 2017). In sub-Saharan African countries, well-
functioning extension services have been at the forefront of the push for diffusion of new agricultural technologies (e.g., fertiliser application, improved seeds, irrigation farming, mechanisation and water conservation techniques etc.) among farmers (Kijima et al., 2011). However, it is equally true that poor or ineffective performance of agricultural institutions in the continent also impacts negatively on the performance of farmer’s and the agricultural sector in general (Noga et al., 2017).

In advance of the introduction of any new agricultural technology, there is need for institutional arrangements that enable adoption of the new technologies. The removal of institutional bottlenecks or constraints can facilitate quick adoption of new agricultural technologies by target subsistence or smallholder farmers (Muzari et al., 2012). According to Noga et al. (2017), institutional consultation with the recipients of new agricultural technologies to understand how best the fundamental areas of support needed is a much better way of achieving high levels of adoption. Meinzen-Dick et al. (2004), argues that the process of involving farmers in the planning stages helps to incorporate locally related, contextual factors such as culture and power relations that govern how people interact and learn within a given society.

The design, diffusion and application of new agricultural technologies should result from actions and interactions of diverse key stakeholders including farmers, government, and non-governmental institutions, who can together boost the adoption of new technologies (Brooks & Loevinsohn, 2011). This approach entails greater involvement of farmers or the recipients of the agricultural technology in major decision-making processes to ensure that the technologies being introduced meet their needs and aspirations (Food and Agricultural Organisation—FAO, 2019; Tendler, 1993). Hence, the introduction of new technologies by institutions should be systematically coordinated and should facilitate stakeholder interactions in manner that is effective, trustworthy, and inclusive (Meinzen-Dick et al., 2004). Additionally, there are non-institutional factors (including farmer personal characteristics, demographic, socio-economic backgrounds and innovation-specific characteristics) are somehow connected to some institutional factors which are arguably fundamental to explaining the probability of farmer adoption of new technologies.

In Ghana, the National Climate Change Adaptation Strategy or Policy has been instrumental in setting up the framework for adaptation to climate change in Agriculture and other sectors of the economy (Bawakyillenuo et al., 2016). The policy framework also champions strategies and conditions to ensure adoption of adaptation strategies from the national to individual farmer level. Further, the policies and programmes of the central government through the Ministry of Food and Agriculture (MoFA) constitute formal institutional measures that seek to create the opportunities for farmer adoption of planned strategies. This includes the fertiliser subsidy programme, tractor and equipment support programme and the improved seed subsidy programme. Similarly, a relaxed land tenure system at both the formal and community levels offers opportunities for farmers adopt planned strategies that require increased land size. This also offer women and the marginalised in society opportunities to acquire land agricultural purposes, hence adopt planned strategies for adaptation to climate variability.

4. Constraints to adoption

Institutional and non-institutional arrangements in planned climate variability adaptation have resulted in poor adoption due to imbedded formal and informal constraints. While there is evidence of deliberate efforts from governance (formal) and community level (informal) systems that help farmers adopt planned interventions of climatic and other challenges across Africa, institutional frameworks still fall short of the requisite capacity (under-resourced and fragmented) to effectively coordinate implemented initiatives (IPCC, 2012). In some parts of sub-Saharan Africa, the absence of and/or poor functioning agricultural and community institutions have impacted the performance of the agricultural sector negatively (Bategeka et al., 2013).

The institutions and institutional arrangements of an informal nature foster collective action, these have remained important over the past decades and remain a critical entry point into
dealing with exclusionary tendencies against vulnerable members of communities. Additionally, lack of access to credit is emphasised in the literature as one of the major institutional constraints to adoption facing farmers in African countries (World Bank, 2010). In Uganda, the dismantling of producer cooperatives curtailed farmer’s access to preferential forms of credit, as earlier mentioned (Bategeka et al., 2013). Access to credit has been the bane of rural smallholder farmers in Ghana. This has serious implications on farmers’ ability to adopt planned strategies that require a level of financial investment to implement.

Furthermore, colonialism created contradictory land tenure systems at both national and community levels that have skewed land ownership in favour of men and the powerful in society (Bategeka et al., 2013). It created a landlord class that conflicted with the landless (or land hungry) peasants (Bategeka et al., 2013). The inappropriate land tenure system is one of the most important but “neglected” obstacles to farmer adoption of certain planned adaptation strategies in agriculture. Additionally, poor circumstances created by poorly functioning economic markets in rural areas, lower the profits that a farmer receives from technology adoption. Examples of these market imperfections include missing markets for risk, credit, or land (i.e., a lack of formal insurance providers, financial institutions, or ability to buy, sell, own or reliably hold onto one’s land). At the same time, in the absence of any market inefficiencies, unprofitable technologies will, rightly, go unadopted. In sum, it can be concluded that dysfunctional institutional arrangements and norms are the major (but by no means the only) constraints to farmer adoption of agricultural technologies or planned interventions in climate variability adaptation in agriculture.

5. Materials and methods

5.1. Study context
The study was undertaken in two local government jurisdictions of the Upper East Region of Ghana. The region is in the north-eastern corner of the country between longitude 00 and 10 West and latitudes 10.030° N and 110 N and bordered by Burkina Faso to the north and Togo to the east as well as the Northern region to the south. The climate is characterized by one rainy season from May/June to September/October. The mean annual rainfall during this period is between 800 mm and 1,100 mm. The rainfall is erratic spatially and in duration. There is a long spell of dry season from November to mid-February, characterized by cold, dry and dusty harmattan winds. Temperatures during this period can be as low as 14 degrees centigrade at night but can go to more than 35 degrees centigrade during the daytime. The Upper East region of Ghana is one of the five northern regions in Ghana that have been hard hit by the impact of climate change and variability. With agriculture as the dominant economic activity in the region, rural peasant farmers have over the years suffered the brunt of climate change and variability.

The research is focused primarily on the beneficiaries within the catchment of Climate Change Adaptation in the Northern Ghana Enhanced (CHANGE) Project (2013 to 2015) in the Bolgatanga municipality and the Adaptation Learning Programme (ALP) Adaptation Strategies Project (2010 to 2017) in the Gurum and Tempane districts. These two projects were selected for the research on the basis that both projects ended in 2015 (CHANGE project) and 2017 (ALP project) in the region. This allows for easy evaluation of the output levels of beneficiary peasant crop farmers under the two projects. While the CHANGE project was implemented in Sumbrungu, Yikene, Zaare, Yoroga, Gowrie, Vea, and Nyariga of the Bolgatanga metropolis, the ALP adaptation strategies project was implemented in Farfar, Akara, Kugri and Tairanga of Gurum and Tempane districts of the Upper East region. Figure 2 shows the map of the region, indicating Bolgatanga Metro and Gurum and Tempane districts.

6. Method

6.1. Study Design
The research was a non-interventional study and adopted the descriptive study design as the principal approach. The philosophical orientation of the research is pragmatism and so it adopted
the mixed-method approach (Tashakkori & Teddlie, 1998). The pragmatic philosophical approach promotes the application of both positivism and interpretivist social science philosophical approaches. Hence, the study applied both quantitative and qualitative methods and the data sources were based on both secondary and primary sources.

7. Sampling technique and sample size
A total of six (6) farming communities were sampled from Bolgatanga and Garu-Tempani. The simple random sampling techniques was employed to select Sumbrungu, Yikine and Yorogo of the Bolgatanga municipality as well as Akara, Kugri and Tariganga of Garu and Tempani districts as the study communities.

The unit of analysis of the study were the smallholder crop farmers in Bolgatanga and Garu and Tempani districts. The sampling frames were generated using data from the various district agriculture development units (DADU) across six randomly selected communities in the two districts. Based on the combined number of smallholder crop farmers in all six farmer groups, the Krejcie and Morgan (1970) table for sample determination was applied to arrive at a sample size of one hundred and eighty-four (184) smallholder crop farmers. Additionally, based on the proportion of total farmer population in the farmer groups in the two locations, the study came up with a sample distribution of 103 smallholder crop farmers for the Bolgatanga and 81 smallholder crop farmers for Garu and Tempani districts. Similarly, the sample distribution at the community level was conducted on the basis of the proportion of smallholder crop farmer in each farmer group at the community level to the municipality or district sample allocation. Table 1 depicts the sample distribution of crop farmers per the study communities.

8. Data collection and analysis
The primary data was collected using the researcher administered questionnaires and focus group discussions (FGDs). While the researcher administered questionnaires were used to collect quantitative data, a total of six focus group discussions with the farmers were used to collect the qualitative data.
Table 1. Distribution of farmer respondents per project communities

| Municipal/District       | Community | Project Farmer Allocation | Number Sampled |
|-------------------------|-----------|---------------------------|----------------|
| Bolgatanga Municipal    | Sumbrungo | 116                       | 18             |
|                         | Yorogo    | 255                       | 40             |
|                         | Yikene    | 288                       | 45             |
|                         | **Total** | **659**                   | **103**        |
| Garu & Tempane District | Akara     | 200                       | 28             |
|                         | Kugri     | 150                       | 21             |
|                         | Taringanga| 240                       | 34             |
|                         | **Total** | **590**                   | **81**         |
|                         | **Grand Total** |                | **184**        |

Source: Field survey (2020).

The Statistical Product for Service Solutions (SPSS v 22.0) was employed to run the analysis of quantitative data or responses from the field. Descriptive statistics such as percentages, frequencies, and mean were used to analyse the identified and most common constraints and institutional opportunities to crop farmer adoption of planned interventions in the study communities.

Qualitative data generated through focus group discussions (FGDs) with farmers were recorded and transcribed. Thematic analysis was used in the description of qualitative data. Themes within data from the FGDs were continuously identified as data collection was ongoing to respond to inevitable changes brought about by the uncontrolled, natural setting, interactions, and evolving events in which the FGDs were undertaken. Although key themes were generated in a theoretical approach, resulting in themes of institutional context, analyses were conducted mainly within the interpretative paradigm to describe and understand the underlying constraints and institutional opportunities that shape and give meaning to farmers’ adoption behaviour towards planned interventions.

Data were presented in a tabular form depicting the frequencies and percentages for effective interpretation of the results of the study.

9. Results and discussion

9.1. Institutional opportunities to adoption

Institutional opportunities are the deliberate projects and national policies and services put in place to drive farmer adoption of planned climate variability adaptation strategies among farmers in the target communities. The primary institutions of interest identified by the study were Trade Aid Integrated (TAI) of the CHANGE project in Bolgatanga municipality and Presbyterian Agriculture Station (PAS) of the ALP project in Garu and Tempane districts as well as the Ghana ministry of food and agriculture (MoFA). Field officials of these institutions were the key actors in the implementation of institutional opportunities introduced by these organisations. The study identified extension services, farmer training and development, access to credit and input subsidies as well as provision of weather information and tractor services as the institutional opportunities put in place by both projects to drive farmer adoption of planned interventions.
It was revealed that all 184 respondents in the project communities indicated that they were offered intensive training and development on the benefits, preparation, and application of the planned interventions on demonstration farms under the CHANGE and ALP projects. The hands-on training provided by project implementers enabled crop farmers gain practical knowledge and skills in the application of the planned interventions. This was an important component of the adoption process since its enhanced farmer knowledge, persuasion, decision-making, adoption, and subsequent implementation of the planned interventions as prescribed in Rogers (1995) Diffusion of Innovation (DOI) theory. The training offers farmers first-hand opportunity to better understand the planned interventions and their relative advantage over the old techniques they applied. For instance, crop farmers in Yorogo and Akara collectively agreed on the importance of farmer training and development in the adoption decision-making process. The farmers in Yorogo collectively agreed that:

The training provided by CHANGE on how to prepare and apply compost manure on the demonstration farms gave them a better understanding as to how to prepare the compost to meet crop nutrient requirement and its application as well as the advantages of compost over the system of burning straw on the farm before ploughing and sowing (Focus group discussion, Yorogo 2020).

However, crop farmers in Akara collectively indicated that:

The training they received on the demonstration farm allowed enabled them to better understand the application of fertilizers, ploughing techniques and the right seeds to use during the farming season. This enabled them to realise the advantages of the strategies introduced by PAI over the old techniques they applied earlier. They were also taught the benefits of joining the savings and loans association as well as weather forecast information in their farming activities (Focus group discussion, Akara, 2020).

Further, it was revealed that about 99% of the 184 crop farmers disclosed that they had access to extension services from field officers of the CHANGE and ALP projects as well as extension officers from the Ministry of Food and Agriculture (MoFA). The extension services enable farmers to access information and solutions to challenges they encounter in their routine farming activities. The extension officers provide both individual and group on-farm training and guidance to ensure that farmer knowledge on the application of the planned interventions is regularly updated. It also provides a technical and routine platform for farmers to share ideas and seek answers to pertinent questions bordering them. The provision of extension services is an integral part of ensuring farmer confirmation and continuous adoption of planned strategies as spelt out in Rogers’s (1995) adoption decision-making cycle. The study discovered that the provision of extension services by TAI and PAS within project communities in Bolgatanga and Gur and Tempane, respectively, ceased at the end of the lifecycle of the CHANGE and ALP projects. This had serious implications on farmer continuous adoption of the planned interventions introduced by the two projects. Crop farmers in Sumbrungu collectively agreed that;

The visits by agricultural extension officers on their farms and during their farmer group meetings helped them to find answers to the problems they encountered during the implementation of the new farming techniques (Focus group discussion, Sumbrungu, 2020).

This further highlights the relevance of technical training and extension services as institutional opportunities in the adoption decision-making process of crop farmers. This conclusion agrees with the findings of Melesse (2018), Noga et al. (2017), Mwangi and Kariuki (2015), Hornik (2004), and Lionberger (1960) among others.

Additionally, the study discovered that the provision of input subsidies and services by implementers of the adaptation projects and central government were key institutional measures put in place to facilitate and sustain adoption. While approximately 63% of the 184 crop farmers
indicated that they benefited from subsidised tractor services, about 90% of the farmers reported that they benefited from government fertilizer subsidies through MoFA. Furthermore, the farmers disclosed that the projects introduced savings and loans associations that allowed them gain access to credit facilities. For instance, all crop farmers in Garu and Tempane disclosed that the village savings and loans association (VSLA) introduced under the ALP project provided all members access to credit facilities to invest in their farming and other productive business activities. Similarly, farmers in Bolgatanga municipality indicated that the credit facility scheme introduced by TAI enabled them to set up savings and loans associations that provided initial capital for commercial basket weaving and general investment in the procurement and implementation of planned strategies introduced under the CHANGE project.

However, it was discovered that supervision of the operations and activities of the VSLAs by officials of the CHANGE and ALP projects was also tied to the lifecycle of the projects and so ceased at the end of the projects. The management of the bank accounts of the various VSLAs was left to the leaders of the associations at the end of the projects. This arrangement brought about several challenges including mismanagement of funds, high loan defaulting rate and favouritism in loan disbursement among others. This resulted in high attrition rate among members of the association after the end of the adaptation projects. Crop farmers in Tariganga collectively agreed on the challenges VSLAs encountered after the withdrawal of field officials of the ALP project. According to them,

The unity that existed among members of the association reduced seriously after the officials of PAS stopped monitoring their activities. The association didn't meet as regularly as they use to, while some members had taken loans and had refused to pay back, others had even stopped attending meetings. The group is no more active, compared to the period before the end of the project (Focus group discussion, Tariganga 2020)

Finally, the farmers disclosed that they were not granted access to ready market in the case of both projects. Though access to ready market is one of the key institutional opportunities in the literature, the study discovered that both projects did not provide crop farmers with direct opportunities to access ready markets. The findings from crop farmers were corroborated by the program managers of both the TAI (CHANGE project) and PAS (ALP project). The program managers of TAI and PAS and the project implementation strategies revealed the provision of extension services, farmer training and development, input subsidies (improved seeds, fertilizers, pesticides etc.), tractor services, savings and loans associations and provision of weather information. According to the project management team, these interventions were designed to facilitate farmer adoption of the planned strategies introduced by the projects.

Thus, the study discovered that both projects provided institutional opportunities aimed at facilitating crop farmer adoption of the planned strategies. However, it was revealed that with exception of extension services and fertilizer subsidies from MoFA, the provision of institutional opportunities by CHANGE and ALP projects were tied to the project lifecycles which ended with the projects. This arrangement by the project implementers had a negative impact on continuous adoption of the planned adaptation strategies beyond the project lifecycles.

10. Institutional constraints to adoption
In the light of increasing farmer vulnerability to worsening climate variability in the region and the subsequent introduction of planned interventions to mitigate the situation, there is need to examine the constraints that hinder farmer adoption of these interventions. This will amongst other benefits allow policymakers develop appropriate interventions that will strengthen farmer adoptive capacity.

The study identified and grouped the constraints of crop farmer adoption into three (3) broad categories of socio-cultural, economic and institutional constraints. These broad constraints are composed of sub-constraints which individually or in combination impede farmer ability to adopt planned adaptation interventions introduced by the CHANGE and ALP projects in Bolgatanga and
Garu and Tempane district, respectively. Hence, removing these constraints would guarantee or empower crop farmers to adopt planned strategies at various levels. The attainment of crop farmer adoption and implementation of the planned strategies guarantees an increase in crop yields and outputs as well as food security and poverty reduction in the project communities and by extension the entire region and country. Table 2 presents the three (3) broad constraints to peasant crop farmer adoption with their corresponding sub-constraints.

The study discovered that all the 184 farmers in Bolgatanga and Garu and Tempane under the CHANGE and ALP projects indicated that they faced at least one or a combination of constraints in their quest to adopt the planned interventions.

| Table 2. Constraints of peasant crop farmer adoption |
|--------------------------------------------------|
| **Broad Constraints to Crop Farmer Adoption** | **Sub-constraints** |
| **Socio-cultural Constraints** | Gender discrimination |
| | Land scarcity |
| | Illiteracy |
| | Lack of Information |
| | Cultural taboos |
| | Very complex to use |
| | No need for strategy |
| | Poor communication |
| | Poor social net-work |
| **Economic Constraints** | Lack of credit |
| | High risk level |
| | Expensive |
| | Less relative advantage |
| | Poor Access to Ready Market |
| **Institutional Constraints** | Poor or insufficient Extension services (free & subsidised input, technical advice etc.) |
| | Poor or Insufficient Training |
| | Poor or Insufficient Weather Information |
| | Non-involvement of farmer in Project Design |

Source: Field survey (2020).

| Table 3. Six top constraints to farmer adoption. N = 103 |
|-----------------------------------------------------|
| **Constraint** | **Frequency** | **Percent (%)** | **Rank** |
| Land scarcity | 93 | 90.3 | 3 |
| Lack of credit | 101 | 98.1 | 1 |
| Expensive Interventions | 98 | 95.1 | 2 |
| Less relative advantage | 91 | 88.3 | 4 |
| Insufficient Extension service | 98 | 95.1 | 2 |
| Non-participation in Project Design | 89 | 86.4 | 5 |

Source: Field survey (2020).
Based on the descriptive statistics analysis, the prominent socio-cultural, economic and institutional constraints to adoption among the 103 crop farmers in Sumbrugu, Yikene and Yorogo of Bolgatanga under the CHANGE project are presented in Table 3. The table also presents the ranking of constraints to adoption based on farmer response. Ranking is from 1 (highest negative impact) to 6 (lowest negative impact).  

Out of the six (6) top constraints to adoption in Table 4, farmers in the three communities ranked lack of credit as the constraint with the highest level of impact, hindering their ability to adopt the planned interventions. However, the farmers collectively ranked the non-participation of farmers in the design of planned interventions as the constraint with the least impact on adoption among the six constraints. All top six (6) constraints had varying degrees of negative impact on farmer adoption decisions as well as influenced farmers not in isolation but in combinations of two or more at any given point in time.  

Additionally, the study came up with the top six (6) constraints to adoption among crop farmers in Garu and Tempane. The study also ranked the constraints to adoption based on farmer response. Table 4 presents the details. Please note that ranking is from 1 (highest negative impact) to 6 (lowest negative impact).  

Again, crop farmers ranked the lack of credit (96.3%) as the constraint with the highest level of impact. The farmers in Garu and Tempane under the ALP project ranked the lack of information as the constraint with the least impact among the six (6) top constraints to adoption.  

Most importantly, the economic constraints to adoption were identified as prominent among all the 184 crop farmers studied under both projects. The majority of farmers stated that lack of credit facilities and cost of the interventions were the major hindrance to their ability adopt the interventions. For instance, while the farmers in the Bolgatanga municipality indicated that lack of access to credit facility (98.1% of 103 farmers) and the high cost of the interventions (95.1% of 103 farmers) were the main constraints to adoption, about 96.3% of the 81 farmers in Garu and Tempane indicated that lack of credit and high cost of the interventions were the major constraints to adoption, respectively. Based on results from the group discussion with farmers in Yorogo in Bolgatanga, the farmers collectively agreed that;

The main problem we have in our quest to adopt and use the interventions introduced by the CHANGE project is the high cost of fertilizer, improved seeds, tractor services and pesticides. This is further compounded by our inability to secure loans or credit from the banks. We could have comfortably afforded the cost of the interventions if we had access to credit facilities or if the interventions are highly subsidised (Focus group discussion, Yorogo, 2020)

| Constraint | Frequency | Percent (%) | Rank |
|------------|-----------|-------------|------|
| Lack of information | 68 | 84.0 | 5 |
| Lack of credit | 78 | 96.3 | 1 |
| Expensive Interventions | 78 | 96.3 | 1 |
| Insufficient Extension service | 76 | 93.8 | 3 |
| Poor weather information | 77 | 95.1 | 2 |
| Non-participation in Project Design | 69 | 85.2 | 4 |

Source: Field survey (2020)
Farmers in Tariganga of Gur and Tempane generally indicated that:

We are not able to afford the price of improved seed varieties, pesticides and fertilizers because of the high cost. The banks will not also give as credit because we don’t have collateral for the loan (Focus group discussion, Tariganga, 2020)

Access to credit facilities has been the bane of farmers in sub-Saharan African countries like Ghana. The problem is even serious among rural farmers who do not have access to financial institutions in their communities or villages. However, where a financial institution(s) exists, smallholder farmers usually lack the required collateral security to apply for credit facilities. The adoption and implementation of planned adaptation interventions requires capital investment to achieve desired results. This poses a serious challenge to the already impoverished farmers who are battling with low output and incomes as well as inaccessible credit from financial institutions.

It was established that financial institutions were not prepared to offer farmers credit facilities because of their low output and income levels as well as the high levels of uncertainty associated with rain fed agriculture. In the face of these challenges, crop farmers are unable to mobilise enough capital to invest in planned interventions. This has been identified as a major constraint to adoption of agricultural technology or planned strategies among crop farmers. Thus, climate variability adaptation projects that seek to introduce planned interventions to farmers should include strategies or policies that facilitate access to credit facilities to achieve maximum farmer adoption and continuous adoption.

Furthermore, the cost of purchasing and implementing a planned climate variability adaptation interventions has a direct impact on the farmer adoption decision-making process. The study discovered that expensive planned adaptation interventions were significant constraints to adoption and implementation of same among the crop farmers. Again, considering the low output and income levels of farmers coupled with lack of access to credit facilities, it would be difficult if not impossible for these farmers to farmers to patronise planned strategies that are expensive to purchase and implement. As a result, the adoption rate of such planned strategies would be very low due to farmer inability to afford the cost involved. It was discovered that even in situations where project implementers subsidize the cost of purchasing and implementing expensive planned strategies, the beneficiary farmers are not able to sustain or continue adoption of the strategies beyond the project lifecycle.

Additionally, the study discovered that land scarcity was a constraint to farmer adoption of planned interventions in Yikine, Sumbrungo and Yorogo of the Bolgatanga municipality. About 90% of the 103 crop farmers indicated that land scarcity was a hindrance to adoption of planned interventions. This was attributed to poor land tenure system and sale of farmlands to residential developers due to meet expansion of settlements from the Bolgatanga township to communities in the periphery. For instance, crop farmers in a group discussion in Yikine collectively indicated that;

Land has become scarce in this community because of the increasing sale of land by our family heads to foreigners who want to build houses. Some of us have even lost our farms to these developers. It has become difficult to get good land for farming that would match up to the investment in acquiring the new farming techniques (Focus group discussion, Yikine, 2020)

It was discovered that clan and family heads sold large tracks of land to individuals, estate developers and other business entities with the aim of making high profit margins compared to returns from farming. In the face of land scarcity in the farming communities, crop farmers with small farm size as well as those facing eviction from their farmlands would be less motivated to adopt planned strategies that require initial capital investment. It is important to state that some
of the planned strategies required initial capital investment to implement; hence, there is need to cultivate on a relatively high scale to make enough revenue to off-set the initial investment.

As a result, farmers would not be motivated to adopt such planned in the face of land scarcity since they would not be able to expand their farm size. Conversely, though land scarcity was not part of the six prominent constraints (63% of 81 farmers) to farmer adoption in Guru and Tempane, farmers complained of the land degradation, which was the result of the gradual desertification of farmlands in the communities. This affected their ability to acquire new farmlands or expand their existing farmlands to implement new farming technologies. Additionally, the baring nature of new land for farming will also require the application of high quantities of soil and crop health as well as planting and land management strategies to make the land arable. This comes with high costs which is beyond the reach of poor farmers in these communities.

Thus, the identified constraints affected farmer adoption of the planned climate adaptation interventions introduced under the two projects in varying ways and degrees. These constraints affected farmers in isolation but in combinations of two or more at any given point in time. The removal of bottlenecks or constraints through the introduction of sustainable institutional opportunities will facilitate adoption of new agricultural technologies by smallholder farmers (Bachmann et al., 2016; Fagariba et al., 2018; Muzari et al., 2012). Hence, based on the principles of the Lewin’s (1951) Force Field theory, the introduction of institutional opportunities of adoption (deriving forces) would help remove the constraints restraining forces) that affect farmer adoption of planned interventions.

11. Conclusions and recommendations
The design, diffusion and application of new agricultural technologies should result from actions and interactions of key stakeholders including farmers, government, and non-governmental institutions, who can together boost the adoption of new technologies. Hence, the focus was on the institutional opportunities that facilitate crop farmer adoption of planned adaptation strategies introduced under the CHANGE and ALP adaptation projects and the constraints of adoption faced by crop farmers in the project and study communities.

The institutional opportunities put in place by the CHANGE and ALP adaptation projects to drive farmer adoption of the planned strategies were extension services, farmer training and development, access to credit (through village savings and loans associations-VSLA) and input subsidies as well as provision of weather information and tractor services. The study also concluded that institutional constraints like lack of credit facilities, high cost of interventions, land scarcity, less relative advantage of technology, poor extension services, poor and unreliable weather forecast information services and non-participation of crop farmers in the design of planned adaptation interventions and projects were the prominent constraints to adoption of the planned interventions among the crop farmers of the study. These constraints had varying degrees of negative impact on farmer adoption decisions as well as influenced farmers not in isolation but in combinations of two or more at any given point in time.

The study recommends that adaptation projects by MoFA, CARE, CFCT and donor organisations should be preceded by a case-by-case analysis of the key institutional opportunities that would facilitate or enhance farmer adoption of the planned interventions to be introduced. Additionally, the study recommends to MoFA, CARE Ghana, CSTC and other non-governmental and donor organisations in climate variability adaptation to regularly train extension officers on the planned adaptation interventions they diffuse among farmers. The aim is to ensure that extension officers are knowledgeable in all interventions introduced at any point in time. Regular visitation of farmers by extension officers will ensure that farmers continue to receive on farm training and monitoring to guarantee adoption and continuous adoption. It also ensures that farmers will receive real time solutions to challenges they encounter which hitherto could have resulted in discontinued adoption of the interventions.
Finally, policy at the national and local government levels on climate variability adaptation should be targeted at provision of key opportunities that would remove identified constraints to farmer adoption of planned interventions. Ultimately, the removal of all identified constraints through institutional opportunities would contribute significantly to promote crop farmer adoption and continuous adoption resulting in farmer adaptation to the planned interventions.

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Declarations
The following are the principal declarations on the by author.

Disclosure statement
The study was conducted as part of the authors PhD mandatory research work at the Department of Integrated Development Studies of the School of Development Studies in the University of Cape Coast, Ghana. The study was conducted entirely for academic purposes and was not funded by any organisation or institution.

Ethical statement
This is to confirm that the study is sole work of the author and is not a reproduction of another author or previous work of a different author. The work has not also been submitted for publication in a different journal.

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