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Exploring the autonomous adaptation strategies to climate change and climate variability in selected villages in the rural northern savannah zone of Ghana

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Evidence abounds attesting to changes in the global climate. In Ghana, climate change and climate variability have brought several exposure-sensitivities on different people and at different times. Due to the multiplicity of climate change and climate variability effects, adaptation strategies invariably could be influenced by several factors. This paper assesses the adoption of adaptation strategies in the rural northern savannah zone of Ghana as a result of climate change and variability. Using two villages each from Savelugu Nanton, West Mamprusi and Kassena Nankana East Districts, which are slightly different as case studies, the paper unearthed panoply of varied adaptation strategies in each of them including intensification of irrigation; integration of livestock production; changes in tillage practices; fertiliser application on farms; shift from agriculture to non-farm jobs; seasonal migration and purchase of drought insurance for maize. The results indicate that the relativity in adoption and utilisation of the different adaptive strategies are interlinked with geographical, social, economic, institutional and political factors and processes in the villages. The findings drum home the essentiality of location-specific planned adaptation strategies for climate change through a bottom-up approach, in order to ensure their effectiveness and sustainability.

Keywords: climate change; autonomous adaptation; planned adaptation; rural northern savannah zone; Ghana

Introduction

Never has the issue of adaptation to climate change and mitigation been talked about and researched on than the contemporary era. While early works, especially international policy on climate change, focused extensively on mitigation measures to reduce the emission of greenhouse gases (GHGs) (Stringer *et al*. 2009), the realisation of the inevitability of changes that will take place in the climate due to the development endeavours of humankind actuated the interest in climate change adaptation paradigm. No matter how robust mitigation measures are, a certain degree of climate change is inevitable as a result of historical

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emissions and the inertia of the climate system (IPCC 2001, Matthews and Caldeira 2008). Adaptation is therefore critical in dealing with the unavoidable impacts of climate change (Stern 2006, UNFCCC 2007 cited in Stringer *et al*. 2009). Innately, humans have the propensity to adapt to changing situations in their surroundings (Stringer *et al*. 2009), although their ability to adapt to these changing conditions depends largely on their relative adaptive capacities (Smit and Wandel 2006, Adger *et al*. 2007, Westerhoff and Smith 2009, Engle 2011). Though a marginal contributor to the global climate change, Africa is the worst affected by the effects of climate change, and is rated as highly vulnerable in the future due to its low adaptive capacity (IPCC 2007, Onyeneke and Madukwe 2010).

Recent studies show that mean annual temperature in Ghana has increased by 1.0°C since 1960, an average of 0.21°C per decade (McSweeney *et al*. 2008). The months of April, May and June, and geographically the northern savannah zone, experienced the most rapid temperature increase, around 0.27°C per decade. Future projections for the country show that temperatures will change by 0.6°C, 2.0°C and 3.9°C in 2020, 2050 and 2080, respectively (Environmental Protection Agency (EPA) 2011). And, notwithstanding the uncertainty in the amount and distribution of precipitation, inter-annual variability in the country is expected to increase, as there will be an increase in the intensity of high-rainfall events, but an overall decrease in the number of rain days (McSweeney *et al*. 2008, EPA 2011).

Being characterised largely by agrarianism and primary extraction, the effects of climate change weigh very heavily on the poor in Ghana and many African countries, especially in the rural areas (Laube *et al*. 2012, Rodima-Taylor *et al*. 2012). Unequivocally, poor people in the rural areas have high dependency on natural resources for their livelihoods, hence the emergence of any adverse effects on natural resources through climatic changes undermine their means of sustenance. For instance, the underlying forces and processes of the prevailing exposure-sensitivities, including food insecurity, water scarcity, illness and infirmity and financial insecurity in the Afram Plains (Kwahu West District) in Ghana, arose principally out of climatic variability and extreme precipitation events that occur frequently throughout the district and across West Africa (Westerhoff and Smith 2009, Codjoe and Owusu 2011). In response to these climatic effects, kaleidoscope of autonomous adaptive strategies have been undertaken by members of the community in a bid to enhance their livelihoods (Westerhoff and Smith 2009). How successful these adaptation strategies will be is predicated on their potential to decrease vulnerability on the one hand and increase resilience on the other (van Aalst *et al*. 2008 cited in Stringer *et al*. 2009). Evidence at the national and regional scales in Ghana reveal that the three regions in the northern savannah zone of Ghana – Northern, Upper West and Upper East – are the most vulnerable to drought and have the lowest adaptive capacity (Antwi-Agyei *et al*. 2012). These regions are characterised by savannah vegetation, uni-modal rainfall regime (six months in a year) and high temperatures. Generally, Ghana has experienced about a 1°C rise in temperatures over the past three decades, with rainfall decreasing by 20% and run off by 30% (McSweeney *et al*. 2008). Projections based on future scenarios show that total annual rainfall will decrease by 9–27% by the year 2100, with the range representing spatial variations (Minia 2004).

Literature addressing climate change adaptation strategies at specific locations in Ghana exists, including works by Westerhoff and Smith (2009), Codjoe and Owusu (2011), and Asante *et al*. (2012). However, studies that attempt to map out the various adaptation strategies of individuals in slightly different geographical space in a comparative fashion, especially in the rural northern savannah zone of Ghana, are non-existent, although considerable differences in exposure-sensitivities prevail (Antwi-Agyei *et al*. 2012). Thus, the main objective of this paper is to gain insight into the nuanced autonomous adaptation strategies in the six villages in the rural northern savannah zone, the processes and factors

enhancing or constraining the adoption of the disparate strategies in such slightly different geographical spaces, and their implications for *planned adaptation.* This is important because " . . . policy development needs to acknowledge cultural and context-specific practices more prominently and recognise that adaptations are a response to multiple changes and stressors . . . and affect different groups of society in different ways" (Stringer *et al*. 2009, p. 761). Thus, the paper will examine the nexus between the existing *autonomous* adaptation strategies and the anticipatory *planned* adaptation strategies.

The rest of the paper is structured as follows. Section two contextualises the concept of adaptation through an examination of its gamut attributes as well as a review of literature on its application. The section also touches on the diffusion of innovations theory by Rogers (1995), as it complements the different attributes of the concept of adaptation in explaining the adoption patterns. Section three gives an overview of the background of the study sites and the methodological approaches that were used in the study. Section four highlights the dimensions of planned adaptation strategies in Ghana, while the fifth section discusses the different *autonomous* adaptation strategies adopted by the six villages and the processes underpinning them. The paper is concluded in the sixth section.

Contextualising adaptation to climate change

The concept of adaptation in the realm of climate and environmental change has been extensively researched, evidenced by the existence of rich literature. In general terms, adaptation refers to a process of deliberate change, often in response to multiple pressures and changes that affect peoples' lives (Stringer *et al*. 2009). Positioning adaption in the milieu of climate change treatises, several authors (IPCC 2001, Smit and Pilifosova 2001, Burton *et al*. 2002, Nelson *et al*. 2007, Eriksen *et al*. 2011) have not only defined adaptation to climate change, but have discussed it holistically.

The IPCC (2001), for instance, defined adaptation to climate change as an adjustment in ecological, social or economic systems in response to actual or expected stimuli and their effects or impacts. This entails changes in processes, practices and structures to moderate potential damages or to benefit from opportunities associated with climate change. Burton *et al*. (2002) regard adaptation as the ability of social and environmental systems to adjust to change in order to withstand the consequences of change. From the perspective of Nelson *et al*. (2007) adaptation relates to the decision-making process and the set of actions undertaken to maintain the capacity to deal with current or future predicted change. Similarly, adaptation has been defined as the process or adjustments through which people reduce the adverse effects of climate on their health and well-being, and take advantage of the opportunities that their climatic environment provides (Eriksen *et al*. 2011). Emerging from the plethora of definitions of adaptation to climate change are several confluences, which inform the inherent characteristics of the concept and their linkages to the diffusion of innovations theory (Rogers 1995) which is very important in elucidating the adoption issues in this paper.

The theory of diffusion of innovations looks at the way innovations are taken up in a society. Rogers (1995), notes that four main elements are critical in influencing the diffusion of an innovation: the innovation itself, communication channels, time and the nature of the social system. According to Rogers (1995), "innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (p. 11). The rate at which an innovation is adopted or fails hinges on the attributes of the innovation and the potential adopters' opinions. In general, innovation diffusion theory proposes five attributes of innovations that shape adoption or rejection: relative advantage, compatibility, complexity,

trialability and observability. In respect of the communication channels, Rogers (1995) observes that "mass media channels are often the most rapid and efficient means to inform an audience of potential adopters about the existence of an innovation" (p. 18). However, personal communication (face-to-face) is also important and gives more reassurance to people.

Time is another important element in the diffusion of innovations theory as it determines the adoption rate. Based on time, Rogers (1995) classified adopters into five categories: innovators, early adopters, early majority, late majority and laggards. Accordingly, individuals who are predisposed to being innovative will adopt an innovation earlier than those who are less predisposed (Rogers 1995). The fourth main element in the diffusion of innovations theory is the social system, which is a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal (Rogers 1995, p. 23). Members of a social system may be made up of individuals, informal groups, organisations and/or subsystems. The social system constitutes a boundary within which innovation diffuses because, the structure of the social system, the social system's norms, the roles of opinion leaders and change agents all have an influence on the adoption of the innovation.

Process and condition attributes of adaptation

The concept of adaptation has both process and condition attributes. As Smit and Pilifosova (2001) note "Adaptation refers both to the process of adapting and to the condition of being adapted" (p. 882). This implies that the adoption of adaptation strategies goes through several thought processes by potential adopters. These include first and foremost, the knowledge of the need to change, followed by the analysis of the kinds of alternatives to adopt and why. To a large extent the process stage of adaptation encompasses the examination of the five attributes of the innovation in the diffusion of innovations theory.

Scalar dimension of adaptation

Inherent in the concept of adaptation to climate change is the scalar dimension – spatially, time-wise and developmental level. Spatially, adaptation strategies differ considerably at the global, regional, national and the local levels. With respect to temporal scales, adaptations vary with current impacts and future changes (TERI 2010) and among the different classes of people in society. The poorest populations whose livelihoods depend principally on natural resources (Stringer *et al*. 2009, Rodima-Taylor *et al*. 2012) are worst affected by climate change than the rich. The scalar dimension is explained by the time element in the diffusion of innovations of theory. Based on different resource endowments, the rate of adoption of various adaptation strategies to climate change will differ between the rich and the poor. Consequently, in the adoption of the different adaptive strategies to climate change at the local level there will emerge the five adopter categories put forward by Rogers (1995): innovators, early adopters, early majority, late majority and laggards.

Different stakeholders' engagement in adaptation

Another attribute of the concept of adaptation to climate change is that it is undertaken by two principal agents in the human system. According to Smit and Pilifosova (2001), "Human system adaptation can be motivated by private or public interest (i.e. who adapts?). Private decision-makers include individuals, households, businesses, and corporations; public interests are served by governments at all levels" (p. 883). The stakeholder engagement in adaptation can be framed within the concept of the social system in the

diffusion of innovations theory. Apart from the adopters, there are also other actors including peers and change agents in every community who, through their relations, can affect the diffusion process of an adaptive strategy.

Forms of adaptation to climate change

Several authors, including Burton (1996), Smithers and Smit (1997), Smit *et al*. (1999) and Bryant *et al*. (2000), have discussed the various classes of adaptations, relying on ubiquitous attributes. Smit *et al*. (1999), for instance, differentiated adaptations to climate change on the yardsticks of purposefulness, timing, temporal scope, function/effects, form and performance. Burton (1996) has differentiated adaptation strategies to climate change on the grounds of individuals' choices, namely, "bear losses", "share losses", "modify threats", "prevent effects", "change use" and "change location". However, there are also two fundamental forms of adaptations to climate change in the human system: *autonomous* and *planned* adaptations (see the fourth section for explanation on latter). Autonomous adaptations take place independently, as a reaction to changes that are occurring in the climatic system without a public agency intervention (Smit and Pilifosova 2001). The key interest of this paper is to gain an understanding on the processes and drivers propelling the adoption of the different *autonomous* adaptation strategies in the six villages in the rural northern savannah zone of Ghana and how they could shape future *planned* adaptation strategies.

Evidence from literature shows that one of the sectors in Africa profoundly affected negatively by climate change is agriculture, and adaptation measures (autonomous and planned) are indispensable for the reduction of these negative impacts (Adger *et al*. 2003, Kurukulasuriya and Mendelsohn 2006). Studies by Deressa *et al*. (2008), Gbetibouo (2009), Westerhoff and Smith (2009), and Onyeneke and Madukwe (2010) have all revealed the adoption of multiple autonomous adaptive strategies within the same geographical space by different households and individuals in various locations in Africa. It can be argued that factors that predicated the choices of various autonomous adaptation strategies are the varied adaptive capacities of individuals and households. Evident from these studies reveal the determinants of these adaptive capacities to include economic resources (access to credit facilities, wealth status, and savings), infrastructure, education, information and skills, social capital, agroecological settings, access to land and availability of labour. It goes without saying that households and individuals that have relative advantages on the determinants of these adaptive capacities will have high adaptation rates. Information dissemination as a determinant of adaptive capacity, for instance, plays a significant role in the acceptance or rejection of an adaptive strategy. As an example, farmers in Swaziland rejected the National Adaptation Programme's emphasis on cassava instead of maize because they were not properly consulted (Stringer *et al*. 2009).

The mixture of autonomous adaptation strategies unearthed in most of these studies include the utilisation of different crop varieties, tree planting, soil conservation, early and late planting, irrigation, portfolio diversification and changing tillage operations. Also, of great importance to an in-depth understanding of the myriads of adaptive strategies for climate change is an innovative and quasi-autonomous adaptive strategy that has been utilised by farmers in India – "Index-based weather risk insurance". This insurance scheme operates through the setting of an automatic adjustment feature – triggered by climate information – and this provides a simple mechanism for managing insurer risk and determining farmer eligibility for benefit payments (McGraw *et al*. 2007). Based on its relative less cumbersome nature, the index-based weather risk insurance is preferred to the traditional crop insurance, which relies on farm loss sampling after a given disaster in order to determine

compensation payment. Fundamentally, however, it can be argued that households' and individuals' adoption of the index-based weather risk insurance, especially the poor, will depend on the state of the following determinants of adaptive capacity: availability of reliable information and dissemination, economic resources and institutional arrangements. Due to the vulnerability of poor households, often times the decision to adopt various innovations depends on the availability of adequate information, their demonstrable benefits and reliable institutional arrangements.

Study areas and methods

Study areas

The study for this paper took place in six villages (Nyangua, Pungu-Bavugnia, Wungu, Gbeduri, Nyoglo and Kanshegu) located in three districts (Savelugu Nanton, West Mamprusi and Kassena Nankana East) in the northern savannah zone of Ghana (Figure 1). The background characteristics of these districts and villages are presented below.

West Mamprusi district (Wungu and Gbeduri villages)

The West Mamprusi District is located within longitudes 0° 35′ W and 1° 45′ W and Latitude 9° 55′ N and 10° 35′ N. The district is located in the Northern Region and is bordered by 11 districts in Upper East and West Regions. The total land area covered by the district is about 5013 km^2 with population of about 168,011 in 2010. Generally, it is a rural district with only Walewale, the capital being the most urbanised. The district is characterised by the savannah glycols soils with a very low water table, hence inhibiting access to underground water. Agriculture is the main occupation of over 80% of its active working

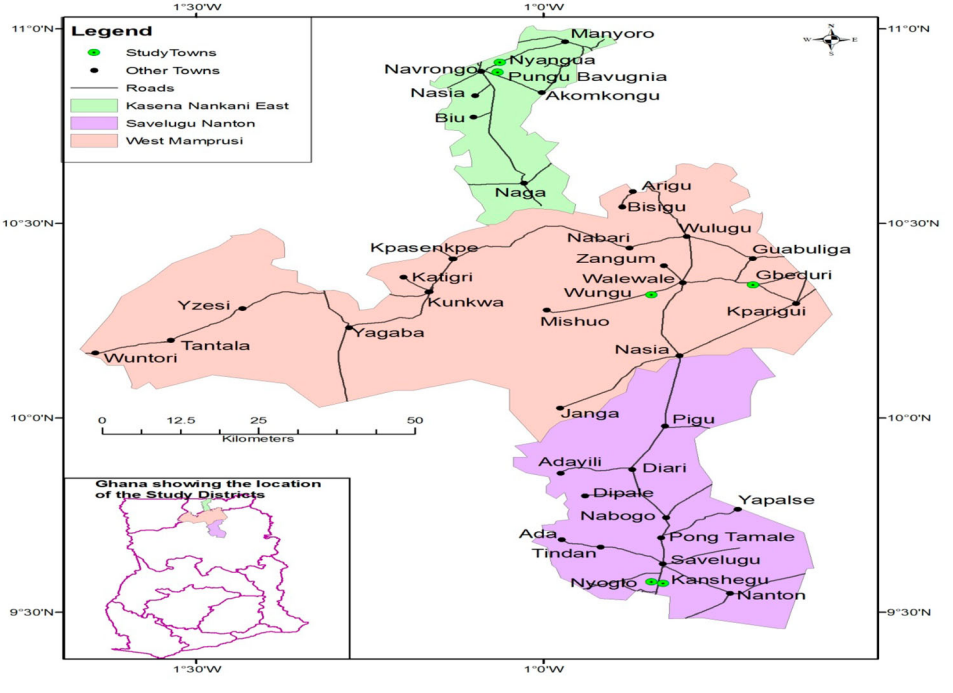

Figure 1. Map showing location of study communities in Northern Ghana.

Table 1. Characteristics of selected villages in Walewale District.

	Characteristics				
Villages	Population	Livelihoods	Infrastructure	Dominant religion	Main tribe
Wungu	5300	Rain-fed agriculture and trading	Has one of the oldest basic schools, potable water facility, connected to the national electricity grid, but lacks health facility	Islam	Mamprusi
Gbeduri	3000		Has basic school infrastructure, connected to the national electricity grid, but lacks potable water and health facilities		

Source: Field Data, 2012.

population, with crops such as cotton, tobacco, groundnut, maize, rice, millet, beans and potatoes being cultivated. Two villages selected within this district for the study are Wungu and Gbeduri (Table 1).

Kassena Nankana East district (Nyangua and Pungu-Bavugnia villages)

The Kassena Nankana East District is located in the Upper East region of Ghana and borders Burkina Faso to the north. Estimated population of the District is 109,000, with Navrongo being the capital town. The landscape of the district is broadly undulating with few isolated hills, which are about 300 m in height, located in the western part. It is characterised by the savannah ochrosols soils, which are porous and contain black clay soils. It is also characterised by less luxuriant savannah grassland with fewer trees and shorter grass landscape. Dense vegetation is, however, found along river basins and forest reserves. The district records an average rainfall of 950 mm per annum and has very high water table, suitable for the sinking of shallow wells for dry season gardening. Agriculture is the main economic activity of the majority of people in the district. Two villages selected from this district for the study are Pungu-Bavugnia and Nyangua (Table 2).

Savelugu Nanton district (Nyoglo and Kanshegu communities)

The district is located in the Northern Region, to the north of the Tamale municipal district. It occupies an area of 1790.70 km^2. The total population of the district stood at 139,283 in 2010. It is a very rural district with Savelugu being the capital. The landscape is mostly flat and gently sloping towards the North and characterised by the interior Savannah woodlands vegetation. Agriculture is the main economic activity in the district. Major staple crops include beans, millet, rice, maize, soybeans and yams. Two villages selected from this district for the study are Kanshegu and Nyoglo (Table 3).

Research design and methods

This paper is developed from the project "Assessing Adaptive capacity to climate change and climate variability in the rural northern savannah of Ghana" undertaken by the authors in 2012. An eclectic mix of participatory qualitative assessments and quantitative research

Table 2. Characteristics of selected villages in Kassena Nankana East district.

	Characteristics				
Villages	Population	Livelihoods	Infrastructure	Dominant religion	Main tribe
Pungu-Bavugnia	900	Rain-fed agriculture, irrigation and livestock rearing	Partly connected to the national electricity grid, lacks potable water facility, basic school and health facility	Christianity	Kassena
Nyangua	600		Lacks basic school infrastructure, potable water, electricity and health facilities	Traditional African Religion	

Source: Field Data, 2012.

Table 3. Characteristics of selected villages in Savelugu Nanton district.

	Characteristics				
Villages	Population	Livelihoods	Infrastructure	Dominant religion	Main tribe
Kanshegu	1500	Rain-fed agriculture and trading	Has one primary school, pipe-borne water and connected to electricity, but lacks health facility	Islam	Dagomba
Nyoglo	1400	Rain-fed agriculture and irrigation	Lacks basic school infrastructure, potable water, electricity and health facilities		

Source: Field Data, 2012.

methods was employed in this study. These included focus group discussions; individual in-depth interviews and individual questionnaire surveys. Participatory approaches in African rural communities can facilitate understanding and use of uncertain climate information (Roncoli *et al*. 2009).

Focus group discussions

Two focus group discussions were held in each village. These were the men focus group, comprising the traditional chief and ordinary men of all ages, numbering between 12 and 18 people. The second focus group discussion was made up of women of all ages, also numbering between 12 and 18 people. Themes of the focus groups' discussions included the historical perspectives of farming, perceptions of the climate, governance of local institutions, natural resource endowments, access to resources, adaptation strategies to climate change over time and adaptive capacities. In order to tease out the composite perspectives of the factors influencing the relative adoption of the different adaptive strategies, the male and female focus groups in each village were brought together for this exercise. Using a scale of 0–2 (0 = Not Applicable; 1 = Low or Weak; and 2 = High or Strong)

Table 4. Distribution of respondents in study villages.

Village	Number of respondents
Wungu	85
Nyoglo	90
Kanshegu	90
Nyangua	90
Gbeduri	85
Pungu-Bavugnia	90
Total	530

Source: Field Data, 2012.

participants were asked to discuss the extent to which each of the factors influences the adoption of the different adaptive strategies and rank them. A factor was ranked "0 = Not Applicable" if the participants unanimously perceived it as not having any influence on the state of adoption of an adaptive strategy. Ranking of factors as "1 = Low or Weak' by participants implied that those factors do not enhance large-scale adoption of the corresponding adaptive strategies. However, the assignment of "2 = High or Strong" to factors by participants meant that these factors promote large-scale adoption of their corresponding adaptive strategies.

Individual in-depth interviews

In-depth interviews were conducted with ordinary men and women in each village, and experts at the district capitals. In each village, five men and five women were purposively selected for these interviews. Based on the villages' own wealth ranking, respondents in each gender category were made up of two very poor, two moderately poor and one rich person. Respondents with these backgrounds were selected to gain insight into their life stories and perceptions about climate change and variability and the adaptation strategies they resort to and why. The experts' interviews were conducted with the planning officers at the districts, to ascertain their roles in enhancing or constraining the adaptive capacities of villages. Other experts interviewed were the non-governmental organisations (NGOs).

Individual questionnaire survey

A total of 530 respondents took part in the survey (Table 4). Ninety respondents were targeted in each village, but some respondents did not take part in some villages. Of the total respondents, approximately 55% (291) were male while 45% (239) were female. The major themes covered by the survey were: perceptions of climate change and variability; adaptation strategies; adaptive capacities; and the institutional support systems. With respect to perceptions on climate change, an overwhelming majority (80%) of the respondents perceived an increased in temperature in the past 30 years, with 55.9% perceiving a decrease in rainfall, while 37.5% perceived that it is characterised by extreme fluctuation patterns. These experiences formed the basis in the thought processes behind the evolving livelihood strategies as per the following quotations.

> Oh! Can we survive only on rain-fed farming? The yield is not enough to feed our families. (Men focus group, Pungu-Bavugnia, 2012)
>
> Farming is no longer good, so it makes sense to diversify our livelihoods. (Men focus group, Kanshegu, 2012)

Planned adaptation strategies to climate change in Ghana

Planned adaptation refers to " . . . a deliberate policy decision on the part of a public agency, based on an awareness that conditions are about to change or have changed and that action is required to minimise losses or benefit from opportunities" (Pittock and Jones 2000 cited in Smit and Pilifosova 2001, p. 884). This adaptation type can either be anticipatory (undertaken before impacts are apparent) or reactive (Smit and Pilifosova 2001). In Ghana, the National Climate Change Policy (NCCP) (Ministry of Environment, Science, Technology and Innovation 2012) provides the framework for planned adaptation strategies to climate change. Overall, the NCCP has five priority policy areas: agriculture and food security; disaster preparedness and response; natural resource management; equitable social development; energy, industrial; and infrastructural development. These policy areas have been subdivided into a total of 10 programme areas that address both adaptation and mitigation issues: develop climate resilient agriculture and food security systems; build climate resilient infrastructure; increase resilience of vulnerable communities to climate-related risks; increase carbon sinks; improve management and resilience of terrestrial, aquatic and marine ecosystems; address impacts of climate change on human health; minimise impacts of climate change on access to water and sanitation; address gender issues in climate change; address climate change and migration; and minimise GHGs.

Planned adaptation strategies under the climate resilient agriculture and food security systems and the minimisation of impacts of climate change on access to water and sanitation programmes are of great importance to this paper. These include the introduction of non-traditional crop varieties such as cow pea and white maize with short gestation periods; and the rehabilitation and expansion of existing irrigation facilities. Although the introduction of the fertiliser subsidy programme[1] in 2008 by the government was not in direct response to climate change, indirectly this initiative fits within the planned adaptation strategy to climate change in the country.

Discussion of autonomous adaptation strategies to climate change and variability in the six villages and their underpinning processes

According to Rodima-Taylor *et al.* (2012) " . . . effective responses to climate change require innovation – technological as well as institutional and relational. Innovations are human adaptations to changing needs and socio-economic conditions, and are therefore embedded in social processes" (p. 107). Analyses of the data for this paper revealed that, indeed, due to the challenges posed by climate change and variability in the study areas, respondents have realised the need to change and have therefore resorted to multifaceted autonomous adaptive strategies in order to support their sources of livelihood, predominated by agriculture. The disparate levels of adoption of these adaptive strategies are shaped by various socio-economic and political processes including the inherent biophysical/natural resources, government/traditional institutional arrangements, knowledge/information flow, infrastructure, financial resources, social network (not mutually exclusive but complimentary) of these villages as discussed below.

Intensification of irrigation

Irrigation is considered as one of the most effective responses to crops production in the midst of erratic weather conditions. Indeed, a significant autonomous adaptation strategy to climate change and variability in the study areas is the intensification of hand dugout

wells irrigation system, during both the rainy and dry seasons. Attesting to its significance are the following quotes from the field interviews:

> Oh! Can we survive only on rain-fed farming? The rain-fed farming alone is not enough to feed the family. With the "garden" (hand dugout wells irrigation system), you no longer buy vegetables and can sell some to buy other foodstuff. (A 55-year-old farmer at Pungu-Bavugnia, 2012)
>
> An important activity for us women is the irrigation based vegetable production. It is very helpful to our income generation efforts. (Women focus group discussion, Nyoglo, 2012)

Table 5 shows that of the total number of respondents in the survey, only a very small number (37) of people are adopting this strategy, many of whom are found in Nyoglo where a small dug-out with canals enable cultivation of vegetables mainly by women (Women focus group discussion, Nyoglo, 2012). In Gbeduri and Wungu, irrigation is undertaken by means of diesel pumps supplying water from the White Volta River tributaries, involving more investments in equipment and valley land. In Bavugnia and Nyangua, the high level of the water table enables shallow wells, which are sunk and renovated each dry season for dry season gardening mainly for tomatoes and vegetables. Nyangua also has a stream where the use of diesel pumps is active all year round. The disparate adoption patterns of this adaptive strategy to climate change among the six villages can be explained by the attributes (accessibility and affordability) of the strategy (Rogers 1995) and other social and institutional processes. As Brown (1981) observes " . . . a given innovation is not adopted in isolation of one's social, economic, locational and institutional context . . . " (p. 239).

Regarding the accessibility and affordability attributes, it emerged clearly that local people's ability to adopt the irrigation strategy is dependent on the availability of irrigation facilities or water and financial assets. Therefore, in Nyoglo and Kanshegu where people have access to the Nyoglo dam, all non-adopters attributed their lack of participation in the irrigation strategy to lack of funds to rent land within the dam area and procure inputs. It therefore implies that adopters of this adaptation strategy are either innovators or early adopters (Rogers 1995) with access to substantial financial resources. On the other hand, an overwhelming majority of non-adopters of the irrigation adaptive strategy in Nyangua, Gbeduri and Wungu alluded to the lack of irrigation dams as the reason for

Table 5. Comparison of the adoption of the intensification of irrigation as an adaptive strategy in the six villages.

	Intensification via Irrigation				Why this strategy was not adopted			
Village	Was adopted (%)	Was not adopted (%)	Total (%)	Total (*N*)	Lack of Capital (%)	Lack of irrigation dam (%)	Total (%)	Total (*N*)
Wungu	1.2	98.8	100	83	23.2	76.8	100	82
Nyoglo	23.6	76.4	100	72	100	0	100	36
Kanshegu	7.5	92.5	100	80	100	0	100	68
Nyangua	8.1	91.9	100	86	7.6	92.4	100	79
Gbeduri	3.6	96.4	100	84	23.5	76.5	100	81
Pungu-Bavugnia	7.7	92.3	100	39	76.7	23.3	100	43
Total	37	407	–	444	181	208	–	389

Source: Field Data, 2012.

Table 6. Comparison of the adoption of the intensification of livestock rearing as an adaptive strategy in the six villages.

	Integration of livestock rearing				Why this strategy was not adopted			
Village	Was adopted (%)	Was not adopted (%)	Total (%)	Total (*N*)	Lack of capital (%)	I do not rear livestock (%)	Total (%)	Total (*N*)
Wungu	98.8	1.2	100	83	100	0	100	1
Nyoglo	60.3	39.7	100	68	20	80	100	20
Kanshegu	80	20	100	80	60	40	100	16
Nyangua	96.6	3.4	100	87	0	100	100	3
Gbeduri	96.4	3.6	100	84	25	75	100	4
Pungu-Bavugnia	77.8	22.2	100	36	23.5	76.5	100	17
Total	380	58	–	438	10	35	–	45

Source: Field Data, 2012.

the non-adoption (Table 5). In addition, weak and corrupt leadership is one of the social phenomena underpinning the low adoption of the irrigation adaptive strategy especially in Wungu where they use expensive diesel pumps. The extent to which weak and corrupt practices of traditional leaders in Wungu constrained the adoption of this adaptive strategy was made manifest in the women focus group discussion.

> In our village, the traditional leadership has been compromised. Fulani herdsmen are like the biological children of the chief. Their cattle continually destroy our crops during the rainy season and the chief takes no action against them when we lay complaints. People do not therefore want to suffer to irrigate only for their crops to be destroyed by the Fulani cattle. Even the village men are afraid of the chief. (Women Focus Group Discussion, Wungu).

Integration of livestock rearing into crops production

Integration and intensification of livestock rearing into crop production is a widely adopted adaptive strategy to climate change in the six villages. As Table 6 shows, 87% of the 438 respondents are engaging in this adaptive strategy, and the spatial distribution of respondents is almost equal among the six villages. The following quotations underscore the imperative of this autonomous adaptive strategy in the rural northern savannah zone of Ghana. These quotations are also in consonance with research findings by Adams *et al.* (1998) and Laube (2007).

> . . . if you depend solely on rain-fed agriculture and your crops happen to fail, what can you do again? It is people with animals who will sell to buy food . . . animals are a form of insurance against bad times. (Focus group discussion, Chief and elders of Wungu, 2012)
>
> I benefit from animals a lot . . . during funerals when animals are needed for rituals. Also, when there is hunger and hardships especially, around April/May [lean season], we sell animals to buy food. (A 26 year-old farmer in Wungu, 2012)

The overwhelming adoption of this adaptive strategy stems from its compatibility with existing livelihood practices. Complementarity exists between crops farming and livestock rearing in the study areas; hence the compatibility of livestock rearing with existing livelihood practices. Income earned from crops was used to purchase livestock to serve as sources of social safety net for difficult times, and the production of manure. In years of

low harvests and often during lean seasons, the livestock are in turn sold for food and inputs for farming. This is purely an anticipatory but at the same time an autonomous adaptation strategy. Processes determining the adoption of this strategy are financial capital and the ability to rear livestock. However, considering rearing as an age-old practice many adopters belong to the early or late majority groups of adopters as per Rogers' (1995) classification, as people engage in rearing according to their financial resources. For instance, cattle owners hire Fulani herdsmen while poor households keep smaller number of goats and sheep. One interviewer noted as follows:

> The very poor invest mainly in poultry, which can be a real lifesaver. (Poor widow in Nyangua).

Changes in tillage practices

Adaptations of traditional tillage practices are among the adaptive strategies to climate change in the rural northern savannah zone. These include changes in planting times (early or late), utilisation of non-traditional crop varieties (white cowpea, early maturing white maize), intensive practice of mixed cropping and the use of bullocks and tractors to till the land instead of human labour. Deressa *et al*. (2008), Gbetibouo (2009), Westerhoff and Smith (2009), and Onyeneke and Madukwe (2010) found similar adaptive practices in their works. Importantly, the introduction of early maturing white maize as noted in the fourth section above is one of the planned adaptation strategies to climate change introduced by the Government through the Ministry of Agriculture. A large number of respondents (96%) out of the total number of respondents (433) on the prevailing adaptive practices affirmed their adoption of changes in tillage practices (Table 7). Geographically, there is not much difference in the adoption patterns of the changes in tillage practices in the six villages. Reasons underpinning the adoption of this adaptive strategy to climate change included the following.

> We have also shifted from the four month variety of maize to the three month variety. This makes it possible for the crops to mature before the rains stop. (A 36-year-old farmer in Gbeduri, 2012)
>
> We plant varieties of crops with long and short gestation periods . . . The reason behind mixing them is security against rain uncertainties. If there is prolonged drought after planting, the late-maturing varieties may withstand it better than the early-maturing varieties. (A 50- year-old farmer at Kanshegu, 2012)

Table 7. Comparison of the adoption of changes in tillage practices as an adaptive strategy in the six villages.

	Adapt tillage practices				Why this strategy was not adopted			
Village	Was adopted (%)	Was not adopted (%)	Total (%)	Total (*N*)	Lack of funds (%)	It is time consuming (%)	Total (%)	Total (*N*)
Wungu	97.6	2.4	100	83	100	0	100	2
Nyoglo	93.8	6.2	100	65	66.7	33.3	100	3
Kanshegu	89.9	10.1	100	79	25	75	100	4
Nyangua	98.8	1.2	100	86	100	0	100	1
Gbeduri	96.4	3.6	100	84	100	0	100	3
Pungu-Bavugnia	100	0	100	36	50	50	100	2
Total	415	18	–	433	10	5	–	15

Source: Field Data, 2012.

Analysis of the field results revealed that the processes and factors accounting for the widespread adoption of the modern tillage practices include knowledge/information flow, skills, financial resources and individuals' experiences over time. These explanatory variables are in sync with various elements of the diffusion of innovations theory such as the communication channels; relative advantage, triability and the observability attributes of an innovation. Through the focus groups' discussions, it emerged that awareness of these modern tillage practices was created by agricultural extension officers, irrigation officials, experiences from returned migrants and continual experimentations by farmers through indigenous knowledge. Additionally, the capacity of individuals to adopt these strategies is a question of their financial strength (compatibility). For instance, with the late rains necessitating changes in the planting calendar, those who could not change or follow the changing rainfall patterns were poor farmers who were unable to procure new seeds after losing the first seeds to early planting. In a focus group discussion, one respondent detailed the issue of poverty vis-à-vis the adoption of modern tillage practices:

> The rain deceived us last year, so after I sowed all my fields, it stopped and everything dried up. My neighbours simply re-ploughed their fields and sowed again. But I didn't have the money to buy seeds. The seeds lost were from the previous year's harvest. Being poor is not good these days when the rains are misbehaving. (An elderly man in Nyangua, 2012)

Application of fertiliser and other inputs on farms

Declining soil fertility occasioned by over-cultivation, climate change and human factors necessitate the adoption of this strategy. The compound farm system is still very strong in Nyangua, which has limited land for extensive agriculture. Extensive agriculture normally requires inputs beyond household manure. In addition, financial constraints prevented the use of fertilisers in adequate amounts in all the other communities. The non-adoption was due to high prices and poverty (reported in individual interviews).

The application of fertiliser on cropped lands instead of animal manure is among the many autonomous adaptive strategies used in the study villages, although with the implementation of the fertiliser subsidy programme in 2008, fertiliser application could be considered a quasi-planned adaptation strategy. As revealed in Table 8, there is an overwhelming move from traditional organic farming practices to the use of fertiliser and other modern inputs by all communities except Nyangua, which has a low adoption rate. The essentiality of this adaptation strategy is reflected in the following views that were expressed during the interviews.

> The land is no more fertile and greater part of it is mountainous and rocky. So, we need to apply fertilizer. (Chief and linguist of Gbeduri, 2012)
>
> Fertilizer has become a necessity in our farming practices. You may not reap any meaningful harvest without applying fertilizer in your farm because the soils have become infertile, and there is low rainfall. (Chief and elders of Nyoglo, 2012)

Knowledge/information flow, financial resources and the state of leadership are the key determinants of the application of fertiliser and other modern inputs in the study areas. Due to the low soil fertility and the unpredictability of rainfall in these areas, farmers have sought knowledge through the mass media and from officials and other change agents including NGOs, on how to enrich the soil for improved crops yields. Notwithstanding the existence of the fertiliser subsidy programme, many farmers are still unable to access fertiliser in these areas due to lack of affordability, poor communication channels and poor institutional arrangements. A study by Yawson *et al*. (2010) on the subsidy programme in

Table 8. Comparison of the adoption of fertiliser application as an adaptive strategy in the six villages.

	Adopt fertiliser/pesticide application				Why this strategy was not adopted			
Village	Was adopted (%)	Was not adopted (%)	Total (%)	Total (*N*)	Lack of funds (%)	I do not farm (%)	Total (%)	Total (*N*)
Wungu	72.3	27.7	100	83	22	0	100	22
Nyoglo	98.5	1.5	100	65	0	100	100	1
Kanshegu	84.8	15.2	100	79	100	0	–	12
Nyangua	19.8	80.2	100	86	100	0	100	69
Gbeduri	73.8	26.2	100	84	100	0	100	21
Pungu-Bavugnia	80.6	19.4	100	36	87.5	12.5	100	8
Total	299	134	–	433	119	2	–	389

Source: Field Data, 2012.

selected communities in the Central Region of Ghana found that about 72% of respondents could not afford to buy the fertiliser at the subsidised price, while 82% noted the lack of subsidised fertiliser during the planting season. Aside from monetary cost, many respondents in that study attributed the lack of accessibility to the subsidised fertiliser to weak communication channels and corrupt practices of officials. Accordingly, " . . . the respondents identified weak communication of information from extension officers, corrupt tendencies, and bureaucratic bottlenecks as the main factors that constrained access to the subsidised fertiliser" (Yawson *et al*. 2010, p. 196).

Shift from agriculture to non-farm jobs

Evident in the analyses of the data for this paper is the gradual shift of individuals from sole agricultural activities to non-farm jobs or the embracement of diversified livelihood approaches as an adaptive strategy for climate change. These include trading, establishment of cottage industries (examples being groundnuts, shea butter and rice processing), carpentry, masonry, mechanics. As one respondent remarked, "Farming is no longer good, so it makes sense to diversify our livelihoods. The soil is extremely poor" (A 50-year-old farmer, Kanshegu).

Table 9 shows only two communities where over half of respondents have diversified while another two have a quarter diversifying. Only Kanshegu recorded no one diversifying, which can be attributed to respondents understanding the question as one of complete move from farming. It was evident that one's ability to engage in some of the diversified activities depends on his/her background skills, education, physical strength, financial capital and strength of social networks.

The existence of strong interrelated social networks in a social system is a key driver in aiding diversification as an adaptive strategy and for building communities' adaptive capacity. As Rodima-Taylor *et al.* (2012) notes, "Local networks and associations, and the relationships and patterns of reciprocity and exchanges . . . are paramount to building adaptive capacity" (p. 108). As a social capital, this strong interrelated network has aided women in the Nyoglo village to mobilise revenue to boost their non-farm activities.

> Some of us belong to "susu" groups that contribute small amounts in order to mobilize resources. We have an account at a Rural Bank in Savelugu, and members borrow from it. Our other objective is to attract NGOs and other agencies to support us. (Women focus group, Nyoglo, 2012)

Table 9. Comparison of the adoption of the non-farm jobs strategy in the six villages.

	Finding non-farm jobs				Why this strategy was not adopted					
Village	Was adopted (%)	Was not adopted (%)	Total (%)	Total (*N*)	No skill (%)	No need (%)	Age (%)	Not available (%)	Total (%)	Total (*N*)
Wungu	56	44	100	84	58.3	38.9	2.8	0	100	36
Nyoglo	11.7	88.3	100	77	75.8	3	12.1	9.1	100	33
Kanshegu	0	100	100	78	62.5	37.5	0	0	100	16
Nyangua	22.7	77.3	100	88	16.7	81.8	1.5	0	100	66
Gbeduri	58.3	41.7	100	84	60	37.1	2.9	0	100	35
Pungu-Bavugnia	21.4	78.6	100	42	66.6	16.7	16.7	0	100	12
Total	134	319	–	453	96	90	9	3	–	198

Source: Field Data, 2012.

Table 10. Comparison of the adoption of the migration coping strategy in the six villages.

	Seasonal migration				Why this strategy was not adopted				
Village	Was adopted (%)	Was not adopted (%)	Total (%)	Total (*N*)	No need (%)	Family (%)	Age (%)	Total (%)	Total (*N*)
Wungu	64.3	35.7	100	84	16.7	55.6	27.7	100	18
Nyoglo	3.3	96.7	100	90	79.5	13.6	6.9	100	44
Kanshegu	0	100	100	81	76.5	5.9	17.6	100	17
Nyangua	20.5	79.5	100	88	4.7	90.6	4.7	100	64
Gbeduri	65.5	34.5	100	84	15.8	52.6	31.6	100	19
Pungu-Bavugnia	18.4	81.6	100	49	77.3	13.6	9.1	100	44
Total	139	337	–	476	91	91	24	–	206

Source: Field Data, 2012.

Seasonal emigration

Seasonal migration is another adaptive strategy being employed by respondents to cope with the effects of climate change. According to Laube *et al*. (2012), "Permanent and seasonal migrations are very important coping strategies, as they help to reduce pressure on available resources and create additional income for consumption or investment" (p. 755). The Wungu and Gbeduri communities had the most migrants while Kanshegu and Nyoglo areas, which historically led in this trend, now experience a low migration rate (Table 10). The main reasons for not migrating were family responsibilities, old age and a feeling of no need. Seasonal migration is mainly climate induced, but made more attractive by urban informal job opportunities. While the majority of men still migrate to rural locations as farm hands the majority of women migrate to urban areas as head porters, shop assistants and house helps. During one focus group discussion, the following views were expressed:

> In order to cope with poor crop yields and drought we send some of our children to Accra under the care of known people, to undertake "kayaye" (head potter business) in a bid to earn some money and send home to support the families. (Women focus group discussion, Gbeduri, 2012)

The major drivers of seasonal migration to both rural and urban areas are the flow of information (communication channels) from media sources and interpersonal contacts (social

Table 11. Comparison of the adoption of drought insurance as an adaptive strategy in the six villages.

	Buy insurance				Why this strategy was not adopted				
Village	Was adopted (%)	Was not adopted (%)	Total (%)	Total (*N*)	No access (%)	I have no idea (%)	I have no funds (%)	Total (%)	Total (*N*)
Wungu	4.8	95.2	100	84	18.7	81.3	0	100	80
Nyoglo	0	100	100	90	42.5	56.3	0.7	100	80
Kanshegu	0	100	100	92	44.3	55.7	0	100	70
Nyangua	3.4	96.6	100	88	4.7	95.3	0	100	85
Gbeduri	4.8	95.2	100	84	17.3	82.7	0	100	81
Pungu-Bavugnia	4.1	95.9	100	49	29.9	68.8	1.3	100	77
Total	13	474	–	487	121	350	2	–	473

Source: Field Data, 2012.

networks) with returned migrants in the communities. For those who do not migrate, the main reasons recounted were family responsibilities, old age and a feeling of no need (Table 10).

Drought insurance for maize

The acquisition of drought index insurance for maize ("Sanzali"[2] drought index insurance) was also unearthed in the study as a nascent and a major adaptive strategy in the study villages. The "Sanzali" drought index insurance is similar to the index-based weather risk insurance scheme being operated in India. This drought index insurance scheme was designed by the Ghana Insurers Association and the Ghana Agricultural Insurance Programme in 2011 and implemented on a pilot basis in the three Regions of Northern Ghana to protect farmers and their maize harvest from drought during the 2011 farming season. In this pilot process, the scheme was designed to be most appropriate for the rainfall requirements of maize and had three-stage products: stage 1 – germination cover; stage 2 – crop growth cover; and stage 3 – flowering cover. Depending on the rainfall figures that were recorded by the Ghana Meteorological Agency at any rain gauge closest to adopting communities, an insurer could receive a payout in cash, up to a maximum of GH¢ 70 per acre, if there were more than 16 consecutive days with less than 2.5 mm of rain during stage 1 or stage 2, and if there were fewer than 125 mm of rain during stage 3.

As shown in Table 11 only a few people (13) out of the 487 respondents did purchase this insurance scheme in 2011. There was not even a single adopter from Nyoglo or Kanshegu communities. Adopters of this adaptive strategy in the four other communities are the *innovators* per Rogers (1995) categorisation of adopters. Due to the novelty of this adaptation strategy, many non-adopters (possibly the *laggards*) were sceptical of its success because it had not been tried and tested (*triability*) and also because they did not have the opportunity to observe how it functions. Due to precarious economic conditions, poor farmers will prefer tried and tested (triable) innovations with observable results before adopting. Another factor that drove the low adoption of this adaptive strategy was the inefficient communication strategy used. Due to its pilot nature, mass media was not used except field technicians, hence limiting the coverage of the information flow. In a focus group discussion, many attributed the lack of adoption of this strategy to the lack of understanding of its operations.

Table 12. Qualitative assessment of the characteristics of the factors influencing the adoption of the different adaptive strategies in the six villages.

Adaptive strategy	Villages	Biophysical/natural resources	Traditional leadership	Knowledge/ information flow	Infrastructure	Financial resources	Social network
Intensification of irrigation	Wungu	Low	Weak	High	Low	Low	N/A
	Gbeduri	Low	Weak	High	Low	Low	N/A
	Nyoglo	High	Strong	High	High	High	Strong
	Kanshegu	Low	Weak	High	High	Low	N/A
	Nyangua	High	Strong	High	Low	Low	Strong
	Pungu-Bavugnia	High	Strong	High	High	High	Strong
Application of fertiliser and other inputs on farms	Wungu	N/A	Weak	High	N/A	High	Strong
	Gbeduri	N/A	Weak	High	N/A	High	Strong
	Nyoglo	N/A	Weak	High	N/A	High	Weak
	Kanshegu	N/A	Weak	High	N/A	High	Weak
	Nyangua	N/A	Weak	High	N/A	Low	Weak
	Pungu-Bavugnia	N/A	Weak	High	N/A	High	Strong
Shift from agriculture to non-farm jobs	Wungu	High	N/A	High	High	High	N/A
	Gbeduri	High	N/A	High	High	High	N/A
	Nyoglo	High	N/A	High	Low	High	Strong
	Kanshegu	High	N/A	High	High	High	Strong
	Nyangua	High	N/A	N/A	Low	Low	N/A
	Pungu-Bavugnia	High	N/A	N/A	Low	Low	N/A
Seasonal migration	Wungu	Low	N/A	High	Low	Low	Strong
	Gbeduri	Low	N/A	High	Low	Low	Strong
	Nyoglo	High	N/A	High	High	Low	N/A
	Kanshegu	High	N/A	High	High	High	N/A
	Nyangua	Low	N/A	High	Low	Low	Strong
	Pungu-Bavugnia	Low	N/A	High	Low	Low	Strong
Purchase of drought insurance for maize crop	Wungu	N/A	N/A	Low	N/A	High	Strong
	Gbeduri	N/A	N/A	Low	N/A	High	Strong
	Nyoglo	N/A	N/A	Low	N/A	High	N/A
	Kanshegu	N/A	N/A	Low	N/A	High	N/A
	Nyangua	N/A	N/A	Low	N/A	High	N/A
	Pungu-Bavugnia	N/A	N/A	Low	N/A	High	N/A

Source: Field Data, 2012.
Note: N/A stands for not applicable.

> Patronage of the insurance scheme was low due mainly to the poor understanding of its modus operandi and the poor structuring of benefit streams. (Men focus group discussion, Gbeduri, 2012).

This adaptive strategy to climate change is classified as *autonomous* and not *planned* because it was not developed by the government for the study areas, but by a private organisation. Farmers therefore had the autonomy to adopt or reject it based on their judgements. While some of the early adopters of this adaptive strategy in the study communities attested to its protective features and craved for its up-scaling, the scheme was not implemented beyond the pilot year – 2011. Meanwhile, in October 2012, about 136 farmers in the Northern Region alone received claims under a similar drought-index insurance scheme that was implemented in 2012 by the Feed the Future organisation, the US government's global hunger and food security initiative (Feed the Future 2012). Table 12 encapsulates a summary of the ranking of the factors influencing the adoption of the different adaptive strategies in the six villages.

Conclusions

Through both qualitative and quantitative approaches, the paper examined the nuanced autonomous adaptation strategies of individuals to climate change and variability in slightly different six villages in the rural northern savannah zone of Ghana. Primarily, the paper established evidence of the occurrence of climate change and variability through eliciting respondents' perceptions of changes in temperature and rainfall over the past 30 years. As many have noted, changes in temperature and rainfall are important indicators of climate change in arid and semi-arid regions in Africa (Maddison 2006, Gbetibouo 2009). The effects of the changing climate change in the northern savannah zone of the country contribute to chronic poverty and food insecurity situations in this part of the country (Bawakyillenuo and Kpieta 2013).

On the backdrop of these effects from climate change, the results of the paper showed that panoply of autonomous adaptation strategies have been adopted variedly by individuals in the six villages. Chief among these adaptation strategies are intensification of irrigation; integration of livestock production; changes in tillage practices; fertiliser and other inputs application on farms; shift from agriculture to non-farm jobs; seasonal migration and purchase of drought insurance for maize. As villages within the same geographical zone, one will have expected the adoption of these adaptive strategies to be even. On the contrary, the paper unravelled intricate disparities apropos the adoption of these adaptive strategies in the various villages by virtue of their inherent biophysical/natural resources, institutional arrangements, knowledge/information flow, infrastructure, financial resources and social network. These findings reinforce the argument that adaptive capacity is closely associated with specific contexts or locales with resources and conditions that can enhance or stymie an individual's potential to adapt to climate change (Adger *et al*. 2005, Smit and Wandel 2006, Juhola *et al*. 2012). Besides, they are in line with the diffusion of innovations assertions that the innovation itself, communication channels, time and the nature of the social system are factors that influence the diffusion of an innovation. Particularly, it is knowledge enhancing to unearth the nuanced roles played by traditional leaders as well as the different local knowledge systems in either constraining or facilitating individuals' adaptive capacities within the different villages in the rural northern savannah zone of Ghana.

Several lessons therefore emanate from the findings in this paper. First and foremost, the acquisition of an in-depth understanding of the adoption of autonomous adaptation

strategies to climate change and the adaptive capacity of a particular geographical zone are embedded in the socio-cultural, governance, environmental and economic features, surrounding the individuals. Second and corollary to the first point is that the sustainability of *planned* adaptive strategies, especially the National Adaptation Programme of Action developed for the policies in the NCCP document, must hinge on a thorough understanding of the factors hindering and constraining individuals or communities capacities to adopt certain autonomous adaptation strategies. In other words, it is important for planned adaptation strategies to be demand driven in order to yield the needed impact. It is therefore imperative to integrate the knowledge of local people as well as their expressed needs into the processes of fashioning out sustainable planned adaptation strategies via the creation of participatory channels, enhanced information dissemination and social networks. The dismal adoption of the quasi-autonomous "Sanzali" drought index insurance for maize adaptive strategy uncovered in this paper illustrates the inadequate interaction between national institutions preparing adaptation strategies and local people in the northern savannah zone. The need to reinstitute and up-scale this insurance scheme with appropriate infrastructure in northern savannah zone just like the operations of the index-based weather risk insurance scheme in India cannot be overemphasised. Indeed, this insurance scheme creates an invaluable safety net for farmers in times of drought. Equally important for the success of any planned adaptation strategies is the need to ensure that corrupt and bureaucratic practices of officials are nipped in the bud to increase beneficiaries' confidence in the strategies.

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Notes

1. Under this programme, farmers buy subsidised fertiliser with region-specific and fertiliser-specific coupons distributed by the Ministry of Food and Agriculture through its District Directorates and extension officers (Yawson *et al*. 2010).
2. "Sanzali" is a word from the Dagomba tribe and means "let's come together and help".

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