

CrossRef DOI of original article:

1 Addressing Security Risk Caused by Climate Change Across 2 Nations: The Role of Non-State Policy Actors

3 Henry Kwabena Kokofu

4 Received: 1 January 1970 Accepted: 1 January 1970 Published: 1 January 1970

5

6 **Abstract**

7 Climate change is projected to produce a lesser amount of expectable rainfall patterns, coupled
8 with extensive droughts intermixed with fleeting but torrential rainfall which has implications
9 on food security risks. The paper examines the role of Non-State Actors (NSAs), specifically,
10 Non-Governmental Organizations (NGOs) in climate change governance and how they address
11 food security risks thereof. The study addresses this objective by placing a special emphasis on
12 the modus operandi of NGOs in helping smallholder farmers navigate through their farming
13 cycle successfully in the Northern belt of Ghana. The study adopts the content analysis and
14 critical stage review of extant literature and other datasets. The study observes that NGOs
15 help smallholder farmers to build their resilience against the ravages of climate change using a
16 more comprehensive approach along the entire value chain of the farming cycle before, during,
17 and after the crop planting exercises. Consequently, we develop and discuss the NSAs-holistic
18 empowerment framework which will contribute to policy, practice, and literature on the topic.
19 The study contends that the impact of most NSAs in climate change is contingent on the
20 resources available and their organizational prowess. The study argues for the need to forge a
21 synergistic relationship and networks between the public and non-state actors to effectively
22 play a more nuanced role in climate change efforts at all levels which will help address food
23 insecurity in areas and regions currently experiencing drought, hunger, and under nutrition.

24

25 **Index terms**— climate change; smallholder farmers; adaptation; mitigation; resilience; NSA

26 **1 I. Introduction**

27 with increased climate change trends, its effects aggravate prevailing socio-economic, and ecological threats in many
28 contexts, which may become a source of insecurity at local and national levels (Pörtner et al, 2022;Malhi et al,
29 2020). The security threats that may be associated with climate change include adverse effects on food, water,
30 and energy supplies, heightened competition over natural resources, loss of jobs, environment-related disasters,
31 and migration and displacement (Owen, 2020).

32 In many contexts, protracted droughts, floods, and increases in sea levels have had exacerbated influences
33 on socio-economic livelihoods, human wellbeing, environment, and related benefits, particularly in rural regions
34 (Pörtner et al, 2022). The focus on climate actions and green economic growth has shifted over some time to giving
35 attention to human-related crises (Lawrence et al, 2020). One particular sector which has been severely affected
36 by climate change is the agricultural sector, especially in the developing world (Malhi et al, 2021;Mahapatra
37 et al, 2021). What is more problematic is that the greater population especially in the rural communities has
38 predominantly been smallholder farmers depending on favourable climate patterns (Atube et al, 2021). With the
39 worsening climate change situation and impacts, climate change continuously affects agricultural productivity in
40 numerous nations across West Africa unfavourably. For example, Ebele and Emadi (2016) report that the growth
41 rates of maize, guinea corn, millet, and rice have decreased due generally to the surge in temperature in Nigeria.
42 On their part, Badjie et al. (2019) report how late arrival and premature termination of rainfall patterns have
43 prompted the variation of yields of cereals and cash crops per season in The Gambia. In Sierra Leone, the climate

1 I. INTRODUCTION

44 change dangers caused include bushfires, droughts, high temperatures, early rains, late rains, serious downpours, 45 thunderstorms, landslides, and floods ??Rhodes et al., 2016).

46 With the trend of climate change coupled with contemporary social and ecological vulnerability, it has been 47 predicted that the Sub-Saharan region will experience the worst impacts (Ntinyari & Gweyi-Onyango, 2021; Ofori 48 et al, 2021).Climate change is projected to producea lesser amount of expectable rainfall patterns, coupled with 49 extensive droughts intermixed with fleeting but torrential rainfall ??World Bank, 2018). Situated along the coast 50 of West Africa, Ghana is a typical case susceptible to climate change vulnerability, especially the rural farming 51 communities of Northern Ghana. Essentially agricultural in outlook, northern Ghana is found in the Sudan zone; 52 a climate zone that is found in the midpoint of semi-arid Sahel and Forest zones ??Magin 2018). With its heavy 53 dependence on natural rainfall for agriculture, subsistence farmers across the Sudan climate zone are expected 54 to face increased food insecurity. This point has been observed by Hjelm and Dasori (2012) that communities 55 in Northern Ghana have witnessed greater heights of food insecurity than the remaining communities found in 56 those regions along the south. Consequently, households in the Northern Regions that undergo food insecurity 57 frequently are saddled with inadequate income, malnutrition, and ill health, among others greatly caused by 58 climate change variability. For example, Nyuor et al. ??2016) report that rising temperatures in the course of 59 the initial and late seasons have led to a decrease in the ensuing revenue that would have been obtained from 60 a hectare of sorghum. The threats to the agricultural sector have implications on food security, socio-economic 61 and human security threats implications since agriculture has been the source of livelihood for many households 62 in rural communities.

63 This makes it more crucial for all stakeholders relevant to global climate change affairs to step up in their 64 actions toward effective policies, interventions, and efforts aimed at stemming the tides. Traditionally, climate 65 change governance and efforts were essentially ceded to state actors who championed these courses of action at 66 the state and global levels. However, it has been observed that international climate change agreements continue 67 to achieve sub-optimal commitments by states (UNEP 2013). Over time, it has become increasingly crucial that 68 non-state actors come on board by way of collaborative governance and policy networks to effectively play a more 69 nuanced role in climate change efforts at all levels (Abbott 2012; Bulkeley et al. 2012;Schroeder & Lovell 2012). 70 The involvement of non-state actors in global climate governance in the last three and half decades has been a 71 unique feature that cannot be overlooked. ??Backstrand, 2013). Consequently, it has been established in the 72 literature and climate governance regimes that climate change adaptation ought to encompass multiple actors 73 from the public and private sectors as well as from across civil society (IPCC 2014). This point has forcefully 74 been argued by Lemos and Agrawal (2006) that climate change involves the typical case of an intricate multi- 75 scalar ecological problem, where mitigation and adaptation require a diversity of actors across the state-society 76 divide. ??äckstrand et al (2017) advance the concept of 'hybrid multilateralism' as a heuristic to demonstrate 77 the strengthened relationship between state and non-state actors in the reviewed arena of global climate change 78 cooperation. They conceptualize non-state actors to include civil society organizations, social movements, as well 79 as economic actors involving, *inter alia*, industry and trade unions and sub-national such as local governments 80 and cities (p 562). The increasing role and recognition of these non-state actors cannot be overestimated. For 81 example, the Copenhagen summit brought forth a climate regime that researchers have described as multifarious, 82 discrete, disjointed, and polycentric (Cole 2015).In other words, the summit saw and recognized numerous actors 83 and stakeholders from varying backgrounds. On his part, Lövbrand et al. (2017) contend that the quantum of 84 participants at the annual Conference of Parties (COPs) has increased over the years, reaching the zenith in Paris 85 with more than 28,000 accredited participants; with at least 8000 of these designated as non-state observers. With 86 the inception of the Paris Agreement, the observer groups present at the annual COPs are called upon to perform 87 a more integrated role in multilateral processes through, monitoring of national action and experimentation with 88 local, regional, and transnational mitigation and adaptation strategies.

89 Conceptually, the category of NSAs may be in the form of virtually anything: organizations, global associations, 90 investors, religious communities, social networks, industry associations, and, at last, people.

91 Many studies either discuss the role of nonstate actors in general terms or generalize based on case studies 92 of one non-state actor category (Fisher & Green 2004). This implies that systematic comparison of perceptions 93 of agency across non-state actors is largely lacking (Bulkeley et al. 2012).Despite the ongoing treatise on the 94 prospect of non-state actors contributing to mitigation and adaptation efforts by global governance scholars (Hale, 95 2016;Kuramochi et al., 2020), the literature has not paid greater attention to the role non-state actors might play 96 in bringing about an appropriate response to climate change. This position has been confirmed by Baker et al. 97 (2020) whilst the growing acceptance of hybridity in climate governance is not in doubt [one that combines public 98 and private authority in governance], the functional participation of the non-state actors in climate governance 99 has seen sufficient research, it appears the actual practices through which climate issues are governed towards 100 positive socio-ecological outcomes remains underresearched. The objective of this paper was to discuss the role of 101 non-state actors in helping smallholder farmers deal with the food and income security threats posed by climate 102 change. Ghana's Climate Change Policy (Ministry of Environment, 2013) recognizes the dangers posed by climate 103 change and points out that the country is especially vulnerable to climate change and variability because of its 104 dependence on areas that are delicate to climate change, like agriculture, forestry, and energy production. In 105 other words, farmers have become saddled with lower yields and total losses due to climate change variability, 106 and the government appears overwhelmed. In what ways do non-state actors in the form of NGOs intervene to

107 help these farmers? The paper discusses the role of non-state actors [with particular emphasis on international
108 NGOs] in addressing the food security threats posed by climate change in the Northern parts of Ghana. In other
109 words, as climate change continues to pose threats to the agricultural activities of farmers which have rendered
110 most of them jobless and others migrated to the urban south, the study discusses efforts by NSAs in ensuring
111 the resultant farmers adapt and mitigate the threats by climate change. The paper is organized into five main
112 sections. The first section is an introduction that provides background to the study as well as elicits the problem
113 statement. The second section provides a brief literature review and theoretical framework which frames and
114 puts the study in context. Section three of the study provides an overview of the methodology employed for the
115 study whilst section four provides analysis and findings which have been presented in themes. The final section
116 provides conclusions and policy implications.

117 **2 II. Theoretical Overview a) Climate Change and Food Secu- 118 rity Risks**

119 A major challenge associated with climate change is food security risks. Among the key issues that are germane
120 to the discussion of food security involve, inter alia: (1) Availability (the extent to which a community or section
121 can make available or be given or achieve adequate food) (2) Access (the extent to which a people or community
122 can obtain the food produced or available), (??) Utilization (the extent to which a people or community can
123 make the most of food's benefits), and (4) Stability (the extent to which a people or community can ensure
124 availability and access to food consistently) ??FAO 2006;Barrett 2010).

125 Across Sub-Saharan Africa, the number and level of undernourished individuals have increased beginning of
126 2014 (FAO, IFAD, UNICEF, WFP, and WHO 2017). Consistent with this pattern, food insecurity is predominant
127 all over the Northern Areas of Ghana (Hjelm & Dasori 2012). Estimating levels of food insecurity is challenging,
128 given contrasts in scale, the meaning of terms, and data collection protocols. Nonetheless, household-level
129 information can give further understanding of whom within a nation is at the highest risk of food insecurity, and
130 can assist with illuminating more vigorous policy (Hussein, 2002;Barrett, 2010).

131 A household study undertaken by Quaye (2008) found subsistence farmers in the Northern part experienced
132 food insecurity from four to six months out of the year, contingent on the crop. Farmers frequently depleted
133 the millet supply in April, and could not replenish their stocks until September harvests. Other significant
134 crops, including sorghum and maize, were lacking from June to October. As climate change advances and forces
135 expanded desertification in the Sudanian savanna zone that traverses Northern Ghana, means subsistence farmers
136 will probably encounter more prominent declines in yields of staple crops (Armah et al. 2011). Wossen and Berger
137 (2015) found that climate change and the fluctuation of food costs were closely connected, bringing about higher
138 food costs for poor families in Ghana. Be that as it may, subsistence farmers who are unable to produce surplus
139 products cannot take part in the market, as they lack the funding and capital to do as such. In such cases,
140 families that basically depend on subsistence farming become more defenseless against food insecurity.

141 **3 b) Concept of Non-State Actors**

142 The concept of non-state actors involves an array of stakeholders or actors who do not hold the sovereign powers
143 of nation-states yet remain crucial in climate governance architecture. This point has been corroborated by
144 ??llan (2020) who contends that the array of NSAs entails cities, multinational establishments, international
145 organizations, and private individuals who assist in varied ways to respond to climate governance.

146 On his part, Bevir (2009) brings the argument closer home by maintaining that the set of non-state actors
147 responds to climate change by serving as promoters of particular policies, setting standards, and making a clarion
148 call for efforts with or short of the cooperation of states (p.87). This suggests that nonstate actors tend to operate
149 as entities on their own or in concert with the state in driving home their activities. According to Hoffman (2011),
150 NSAs mostly advocate and advance their case for actions and efforts towards climate adaptation and mitigation
151 which may include, inter alia, energy efficiency, carbon markets, local adaptation, and revolution of the built
152 environment as well as transportation systems (p. 5).

153 They are a varied group, full of different motivations, capacities of action, and routes took -and have different
154 types of presence at different levels of governance ??Allan, 2020).There are different forms of NSAs in the context
155 of climate change. These are actors who are not negotiating parties within the UNFCCC' given some recognition
156 (Duggan, 2019).

6 III. METHOD

157 4 Essentially, the United Nations Framework Convention on 158 Climate Change (UNFCCC) classifies NSAs into these dis- 159 tinct forms: business and industry non-governmental orga- 160 nizations (BINGOs), environmental non-governmental orga- 161 nizations (ENGOS), indigenous peoples' organizations (IPOS), 162 local government and municipal authorities (

163 LGMAs), research and independent non-governmental organizations (RINGOs), trade unions non-governmental
164 organizations (TUNGOs), farmers and agricultural NGOs, women, and gender, and youth (YOUNGO). 2 All
165 these have observer status or serve as observer organizations. Bevir (2009) discusses key ways that non-state
166 actors respond to climate change by serving or acting as promoters of particular policies or courses of action,
167 providing standards, and schemes, and coming out with campaigns for buy-ins and attention to these. This, they
168 may tend to act in concert with the public sector or act alone (p.87). This suggests that non-state actors tend
169 to operate as entities on their own or in concert with the state in driving home their activities. According to
170 Hoffman (2011), NSAs mostly advocate and advance their case for actions and efforts towards climate adaptation
171 and mitigation which may include, *inter alia*, energy efficiency, carbon markets, local adaptation, and revolution
172 of the built environment as well as transportation systems (p. 5).

173 They are a varied group, full of different motivations, capacities of action, and routes taken -and have different
174 types of presence at different levels of governance (Allan, 2020).

175 5 c) Theoretical Framework i. Hybrid Multilateralism, Roles 176 and Modus Operandi of NSAs

177 The concept of 'hybrid multilateralism' has been discussed to denote the new landscape of international climate
178 cooperation which became popular during the period after the Copenhagen Summit which has become well
179 established via the Paris Agreement.

180 The concept was coined by Bäckstrand et al (2017) to mean the various forces and actors including state
181 and non-state actors involved and recognized in climate change governance. It suggests a bottom-up climate
182 policy architecture that combines voluntary pledging by states with an international transparency framework for
183 periodic review and ratcheting-up of ambition, in which non-state actors play important roles as implementers,
184 experts, and watchdogs. Additionally, hybrid multilateralism refers to an increasingly dynamic interplay between
185 multilateral and transnational climate action, where the UNFCCC Secretariat has taken a role as facilitator, or
186 orchestrator, of a multitude of non-state climate initiatives and actions.

187 Non-state actors tend to strappingly support climate change mitigation over people's adaptation. For example,
188 in an empirical study that sampled sixty (60), non-state actors, to assess their activities, it was observed that
189 seventy-five percent (75%) of these NSAs mainly concentrated on mitigation alone, with twenty-two percent
190 (22%) concentrating on both mitigation and adaptation, with 3% paying attention exclusively to adaptation
191 ??Bulkeley et al. (2014).

192 As non-state actors neither do have sovereign powers nor command coercive powers as states, those NSAs who
193 command a few resources and with no regulatory power resort to some subtle ways of influencing climate actions.
194 Their main climate action activities essentially entail lobbying relevant stakeholders, orchestrating some actions,
195 and consensus-building with parties.

196 On the role of the NSA in climate governance, NSA participation can be grouped into two broad categories.
197 First, there are instrumental claims, which hold that CSO participation in public governance provides knowledge
198 to enhance problem-solving capacity, which in turn leads to more effective and efficient policy implementation ??

199 6 III. Method

200 This paper synthesizes from extant theoretical and empirical readings, predominantly sorted from peer-reviewed
201 journal sources and pertinent scholarly books intending to examine the role of non-state actors in addressing the
202 security risk challenges associated with climate change. Whilst NSAs connote a broader concept, the scope of the
203 study was on the role of NGOs in helping smallholder farmers deal with the food security risk which often comes
204 as a result of unpredictable climate patterns caused by climate change. From the extant empirical literature,
205 the study uses the experience of four international NGOs who operate in the Northern Regions of Ghana with a
206 particular emphasis on how they help farmers navigate through the contours of mitigating and adapting to the
207 challenges of climate change. This involves taking cues from the work of Yakubu et al. (2019) which discussed
208 how international NGOs help farmers adapt to climate change adaptation. The literature search covered all
209 terms and concepts related to non-state actors and climate change. The study combined words and

210 The second group of arguments is normative in appeal, based on claims that participation supports democratic
211 values by fostering a more inclusive and deliberative form of public policy decision-making. This in turn can
212 enhance public support for policy and reduce policy conflict. For instance, non-state actors can give voice to

213 under-represented groups, thereby legitimizing and validating policy decisions and improving the democratic
214 quality of a polity ??Bäckstrand & Kuyper 2017).

215 expressions related to climate change security risks and NGOs intervention; NGOs and smallholder farmer
216 adaptation to climate change.

217 The varying combination of words and concepts of NSA in addressing climate change challenges and food
218 security risks were combined variously which made it possible to obtain a pool of more relevant literature on the
219 study. The study resorted to three main search engines which were essentially deployed due to their germaneness
220 to the study and availability to the author: Science Direct, T and Fonline, and Google Scholar. We derived a
221 greater pool of articles from the sources and needed to do an initial skimming and scanning of their synopsis to
222 sort for relevance to the thesis of the paper. After the initial sorting process, all abstracts were independently
223 reviewed by each of the co-authors. Finally, authors convened to jettison duplicated materials and mapped out
224 a narrow down of abstracts that were scheduled for comprehensive and systematic assessment. The distinct
225 arguments and cases discussed in each paper had to be synthesized in different phases to generate the discussions
226 and conclusions.

227 **7 IV. Data Analysis a) Post-Copenhagen Accord and Nature of 228 Global**

229 Climate Governance: Focus on NSAs Although NSAs have been involved in climate action and governance
230 processes, the period after the Copenhagen Accord at the 15 th Session of the Conference of Parties (COP 15) in
231 2009 saw an intensification of NSA actions and varying efforts involving conventional and non-conventional modes
232 of participation in order to drum home issues related to climate justice and climate action. Since the Copenhagen
233 Summit, climate governance and diplomacy have been instrumental in improving access and ensuring inclusivity
234 and representation of NSAs through an array of considered and participatory mechanisms ??Bernstein, 2012).

235 Ever since UN negotiations on the global climate were initiated in the early 1990s, NGOs, businesses and local
236 governments have been present as activists, experts, and diplomats (Newell 2000, Betsill & Corell 2001, Betsill
237 2015). It should be highlighted that at the global level, transnational climate governance may take different
238 forms, involving, *inter alia*, private carbon reporting, labeling, offsetting and trading schemes, transnational
239 city networks, and local grassroots mobilization for low carbon lifestyles ??Bulkeley et al. 2014). Following
240 Copenhagen, the range of roles available to non-state observers expanded, along with their ability to exercise
241 authority in the international climate regime (Green2014). However, different non-state actor groups play different
242 roles in multilateral climate diplomacy. Treating 'non-state actors' as a homogeneous category can be useful for
243 heuristic purposes, but in practice, heterogeneity prevails (Nasiritousi et al. 2016).

244 From the extant literature on advocacy and roles of NSAs, it has been observed that whilst some NSAs
245 tend to seek insider status, others tend to seek radical, and systemic change (Hadden 2015). This point has been
246 advanced by ??isher (2000) that the intensification of the climate justice movement ignited climate activism which
247 has since witnessed fresher energy and intensification whose actors involve an array of new social groups and
248 networks in global climate politics. The mobilization of non-state actors for climate governance (climate justice)
249 remained crucial on the agenda of the Copenhagen meeting, whose aftermath has been several climate protests,
250 demonstrations, and marches across the countries in the North and South in the run-up to the Paris Conference.
251 From the foregoing, one observes that a very important landmark in the post-Copenhagen climate summit and
252 governance regime has been the progressive coordination between the UNFCCC system and non-state actors in
253 climate governance and efforts ??Betsill et In the year 2012 at the COP 18 held in Doha, states decided to explore
254 a wide range of actions that could help to promote climate action and targets set out. The importance of civil
255 society and private sector contributions was particularly highlighted in relation to developing country activities,
256 such as finance and negative consequences resulting from climate change. In the ensuing year, the COP held in
257 Warsaw, the UNFCCC inaugurated a website that would provide up-to-date data on those collaborative climate
258 actions happening around the globe on multiple scales by governments, international organizations, civil society,
259 and businesses. This suggests a growing recognition of the activities and relevance of NSAs in climate change
260 efforts and interventions. The portal has proven to be very effective and relevant in climate change issues and
261 initiatives (Widerberg 2017)

262 **8 b) Paris Agreement and Non-State Actors in Global**

263 Climate Governance A careful assessment of the Paris Accord of 2015 mostly brings attention to the increasing
264 role of local climate action in the contemporary climate governance sphere (Bang et al. 2016, Falkner 2016). The
265 National Determined Contributions tendered in by nation-states in 2015 signify the primary instrument of the
266 Agreement which also provides the basis from which international adaptation and mitigation efforts towards a
267 less than 2°C mean global warming or emissions. These are voluntary contributions and pledges by states yet it
268 recognized the relevant roles played by non-state actors in ensuring these NDCs are carried out.

269 The Paris Agreement formally acknowledges 'the importance of the engagements of all levels of government,
270 and various actors' (UNFCCC 2015). The accompanying COP decision details the role of 'nonparty stakeholders,
271 especially in enhancing (UNFCCC 2015) and calls for the 'scalingup and introduction of new or strengthened
272 voluntary efforts and initiatives' (UNFCCC ibid). Formally, the Paris Agreement opens up for the engagement

273 of non-state actors in three processes: the 5-year cycles of a global stocktake of NDCs preceded by the
274 'facilitative dialogue' in 2018; the transparency framework reviewing mitigation and adaptation actions; and
275 the implementation and compliance mechanism (van Asselt 2016, p. 7).

276 **9 c) Resources of Non-State Actors**

277 While non-state actors mostly do not possess the conventional forms of political authority and sovereignty, they
278 nonetheless have some influence and alternative sources of power. According to Gulbrandsen and Andresen (2004),
279 the essential skills and resources that non-state actors have may emanate from their intellectual, membership,
280 political, and financial bases (p. 58). This point has been given support by other scholars who contend that
281 knowledge and information remain crucial (see ??etsill & Corell 2008); the economic resources and locus in the
282 bigger society or international community (Falkner 2010); the organizational prowess and capacity, world-wide
283 connections and its capability to mobilize ??Falkner 2010); as well as its legitimacy (Gough & Shackley 2001).
284 This point concerning the capacity of NSAs has essentially been summarized to entail: NGOs play a significant
285 role in agenda setting and help to push some functional policies and laws which will help mitigate climate change
286 impacts. For example, NGOs such as industry associations and research institution do engage in lobbying and
287 agendasetting; what remains outstanding is that they follow through to see the eventual implementation of such
288 policies by the government, and continues to monitor the effectiveness of the process (Gupta, 2010).

289 Despite the fact, climate negotiations at the global level nonetheless operate by color-coding the participants
290 with respect to their institutional affiliation, the 2015 Paris Agreement 1 1 Paris Agreement (adopted 12 December
291 2015, entered into force 4 November 2016) (2016) 55 ILM 740 and later advances have additionally reinforced
292 the role of NSAs in looking over ambitions set out, enforcement by member states, as well as compliance with
293 emission-reduction targets (Asselt, 2016). The literature on environmental governance refers to the growing
294 participation of Nonstate actors within the UNFCCC system as 'hybrid multilateralism' which has been the
295 theoretical framework underpinning this paper. As explained, the concept denotes the 'intensified interplay
296 between state and non-state actors in the new landscape of international climate cooperation' ??Bäckstrand et
297 al, 2017).

298 **10 Table 1: Role of NGOs in Adapting to Climate Change 299 Impact in Northern Ghana**

300 The second case study sought to assess the role and contribution of non-state actors in addressing security threats
301 posed by climate change with a special emphasis on how NGOs address food security threats in Northern Ghana.
302 An analysis of the empirical literature suggests that non-state actors in the form of NGOs have been influential
303 in helping farmers to mitigate and adapt to the nuances of climate change impacts. The various activities of the
304 NGOs have been presented in themes below: Addressing maturity issues A major challenge posed by climate
305 change has been the variable rainfall pattern which in recent times appears unpredictable. In other words, farmers
306 find it difficult to determine when exactly the rains may set in and when they will cease dropping. Sometimes
307 the rains cease at a premature period and crops which are yet to mature may suffer destruction and farmer losses
308 whilst an eventual food crisis may occur. How do we get this challenge resolved? Non-state actors in the form
309 of NGOs operating in Northern Ghana have been responding to this challenge by providing crops with shorter
310 maturity periods to farmers so that even if the rains cease to flow prematurely, the crops would have reached
311 harvest season by that time. These crops have earlygestation times to be adopted to cope with the change in
312 rainfall pattern.

313 Farmer Education, sensitization, and extension services to farmers Knowledge is power and the provision of
314 relevant climate information services to farmers goes a long way to help them understand the key issues, and
315 occurrences, and how to navigate them. Smallholder farmers have held on to traditional or indigenous knowledge
316 and procedures of farming for a longer period; in the wake of climate change impacts, there at times is the need
317 to adapt by altering farm practices and farming methods that can withstand the new conditions of the time.
318 Consequently, the relevant NGOs tend to provide farmers with new and drought-resistant methods of farming
319 that can stand climate change conditions. These have been beneficial to smallholder farmers.

320 Product marketing A major challenge faced by smallholder farmers has been post-harvest losses which have
321 been exacerbated by climate change where the life span of many crops tends to reduce. Access to the ready
322 market, therefore, has become an important aspect in the value chain without which there will be serious food
323 security threats exacerbated by climate change. What the NGOs do is facilitate access to wider markets so that
324 smallholder farmers can easily local consumers for their products. In many cases also motivate farmers to identify
325 potential markets and entities that will demand their products ahead of farming.

326 **11 Value addition and income-generating activities**

327 The NGOs tend to inspire smallholder farmers to add value to their raw farm products by processing raw materials
328 such as cassava into 'gari' and rice into 'parboiled' rice. Processing the crops reduces their vulnerability to side
329 effects of climate change and their susceptibility to becoming unwholesome. The processed products also tend to
330 have higher price value which will augment the social and economic side of farmers.

331 **12 Provision of Insurance Package**

332 Due to the uncertainty that may surround crop planting and their survival due to the unpredictable nature of
333 rainfall, smallholder farmers mostly tend to run at a loss when the unfortunate happens. Many people tend to be
334 discouraged or even if they would, may not put in their all because of this possibility. To address this challenge,
335 NGOs have introduced farmers to and encouraged them to adopt the practice of "crop insurance". It must be
336 noted that this technique has not been very popular or on a wider scale due to the fact that it is coupled with
337 some key complexities such as requiring farmers to painfully record rainfall patterns in their farmlands to get
338 enough proof to substantiate their claim that their crops did not yield better because of poor rains and drought
339 which will be the basis to get the claims from their insurers. More challenging the gadget to help farmers keep
340 records of rainfall that their farmlands receive is not readily available to them.

341 **13 Better water management**

342 In view of the erratic rainfall pattern, it has become imperative for farmers to be educated and encouraged to
343 make bunding or barricades in the farmlands to retain water for some time after rains. The retained water in
344 the farmlands could improve the amount of water in the soil. The adaptation measure was rated high among all
345 the International NGOs that were included in the study.

346 Access to water for farming A crucial role played by NGOs in addressing climate change food security threats
347 has been water issues and making sure crops have access to water for reasonable farming. On some occasions,
348 they educate and train farmers on how to deploy barricades to store water in the farms when during the rainy
349 season which will be put to use when the rains cease prematurely. Another way by which they help in water
350 provisioning has been the

351 **14 Improved varieties**

352 **15 Mitigating the risks of losses**

353 Education, sensitization, extension services

354 **16 Value chain essentials**

355 Better water management

356 **17 Collaboration with stakeholders**

357 Adaptation and mitigating the food security risks of climate change

358 **18 V. Discussion**

359 From the case above, this analysis discovers that non-state actors have been instrumental in contributing to
360 climate change risk reduction and smallholder farmers' adaptation. In other words, NSAs help in building the
361 resilience of stakeholders in order to effectively help deal with climate change impacts. From the data deduced
362 from the extant literature, the following themes have been deduced which have been used to construct figure
363 1 As illustrated in figure 1 above, the study reveals that due to the variability of climate elements such as
364 rainfall and temperature, non-state actors, specifically, NGOs assist farmers with improved varieties of crops
365 that mature earlier before the 'bad times' set in by which time they crops are already matured. Additionally,
366 drought-resistant crops which can withstand the long period of drought have been introduced and encouraged
367 the farmers to use which have been ways of reducing the adverse effects of climate change on food security in
368 these farming communities Even after introducing these drought-resistant and early gestation plants, the study
369 highlights how NGOs go the extra mile to mitigate any unforeseen consequence which might be caused by failure
370 of the rains to set in or unpredictably failure to 'honour its obligations' on the expected times. Consequently,
371 NGOs encourage and assist farmers to insure their farms against any of such losses provided the latter will
372 be able to prove that the crop failure was a result of the rains failing to come at the appropriate time with
373 recorded evidence. Irrespective of the demands of this effort, it nonetheless remains an important intervention
374 that meticulous farmers do incorporate to ensure certainty in their farming activities.

375 More importantly, knowledge is power and the ability to engage in one activity or the other involves one's
376 knowledge and know-how of the entity. Consequently, NGOs sensitize farmers, and educate them on relevant
377 issues regarding climate change and how to cope with same. They provide extension services to monitor and
378 through hands-on activities encourage farmers to adopt best practices that are tried and tested. They assist
379 in the varieties of crops and their advantages, which farming methods are conducive to the times, and other
380 agro-related issues on marketing among others. As part of the sensitization process, farmers are introduced to
381 ways to conserve water and deploy it to use during the dry seasons or when the rains cut summarily. These
382 are ways that do help to reduce some of the vulnerabilities caused by climate change impacts which unattended
383 to could have dire consequences on food security. It was gathered that local farmers do trust the information
384 they receive from these NSA; this observation supports an argument by Haas (1992) that NGOs have functioned
385 as epistemic communities, forming critical bridges that serve as conduits for information flow. Over time, the

386 NGOs have put together firm and credulous associations with local communities, governmental agencies, state,
387 and municipal governments, playing an essential role in the capacity building of an array of key actors (*ibid*).

388 Additionally, the study discovers that NGOs assist in value chain essentials by ensuring that farmers are
389 educated on marketing trends and how to secure ready markets for their farm produce. By also encouraging
390 farmers to add value to their products, it helps in reducing post-harvest losses whilst increasing the returns or
391 income that will emanate from subsequent sales of the processed farm produce. Marketing and value addition
392 are two important activities that help in reducing food security risks associated with climate change whilst they
393 help to reduce the poverty and vulnerability of smallholder farmers to further impoverishment.

394 The study has brought to the fore that NGOs have been influential in the provision of climate services defined
395 to mean "the generation, provision, and contextualization of information and knowledge derived from climate
396 research for decision-making at all levels of society" (Vaughan & Dessai, 2014, p. The study observes a non-
397 state actor collaboration with state agencies in order to drum home the agenda of climate change resilience
398 and mitigating the security risks associated thereof. In both the Ghanaian case study. The ability of NSAs
399 to effectively coordinate and collaborate with other NSAs or the state remains determines their relevance and
400 impact in communities. From the extant literature, a study by Deason et al (2022) observed that the NSA
401 made an impact by collaborating with the state agencies which helped in strengthening the protection of natural
402 sources against climate hazards. In figure 1 above, this sort of coordination of efforts is denoted by "Collaboration
403 with stakeholders". For NGOs to be very impactful, they need to align their efforts and activities to sync with
404 other interested parties, including the local government, other NGOs, and civil societies. The NGO collaboration
405 with the local government other related state agencies as well as local farmers to achieve a task finds a place in
406 the instrumental claims of NGO participation in public governance which according to Baker and Chapin (2018)
407 involves the former providing relevant knowledge to help solve real societal problems which would lead to effective
408 and efficient outcomes. On the other hand, their activities also find a proper place within the normative sense
409 based on claims that participation supports democratic values by fostering a

410 19 VI. Conclusion and Policy Implications

411 The activities of NSAs have become more pronounced and nuanced in the period after Copenhagen Conference
412 and reinforced by the Paris Conference. The importance of civil society and private sector contributions have
413 particularly been highlighted in relation to developing country activities, such as finance and the negative
414 consequences resulting from climate change. With the Paris Conference where states are obliged to submit
415 Nationally Determined Contributions (NDCs), it can be realized these NDCs can only be fully realized with the
416 state acting in concert with non-state actors.

417 The study concludes that NSAs vary in size, influence, and ability to make a meaningful impacts in terms
418 of reducing the security risks posed by climate change. Based on their resource availability and organizational
419 prowess, they are able to make an impact in the lives of smallholder farmers to help reduce losses incurred by
420 climate change.

421 The study argues that the ability of NGOs to make an impact in the lives of smallholder farmers requires
422 a holistic and more comprehensive approach that addresses the multifarious forces that militate against food
423 security and climate change. In this study, it was observed that the NGO addressed the issues across the varying
424 value chain starting with educating the mindset, helping with the variety of crops to plant, how to plant well and
425 store water, how to insure against a foreseeable loss of crops due to climate change, postharvest issues including
426 value addition and marketing.

427 The study recommends deeper collaboration between state actors as well as local governments and non-state
428 actors with the goal of maximizing the impact they all make in the lives of smallholder farmers in their quest
429 to adapt to climate change. Since these entities have a common goal of ensuring the welfare of local people in
430 building their resilience towards climate change impacts, their efforts will be meaningful if there is a coordination
431 of efforts.

432 20 Statements and Declaration



Figure 1: (

Engagement can also promote governance transparency, thus mitigating the risk of governments catering primarily to influential domestic interest groups (Dombrowski 2010). By pushing for monitoring and stakeholder consultation mechanisms, CSOs can also help foster the creation of formal accountability mechanisms in the system of governance, particularly within public administration (for further discussion, see Bernauer & Gampfer 2013). CSOs participate with the state as actors in international climate change negotiations (Lane & Morrison 2006, United Nations 1992), being recognized as an essential component of good governance (Banks et al. 2015). CSOs also participate as key agents in the implementation, monitoring, and evaluation of climate change policy (Haris et al. 2020).

Figure 2:

Figure 3:

1. Ability to invoke moral claims
2. Knowledge, expertise
3. Access to networks
4. Access to key agents and decision-making processes
5. Access to resources and position in the global economy (see Keck & Sikkink, 1999; Boström & Tamm Hallström, 2010).

d) Role of Non-Governmental Organizations (NGOs) in Climate Change Discourse

The United Nations through its UNFCCC categorizes accredited NSAs into nine clusters which involve those representing: business and industry non-governmental organizations (BINGOs), environmental non-governmental organizations (ENGOS), indigenous peoples' organizations (IPOs), local government and municipal independent non-governmental organizations (RINGOs), trade unions non-governmental organizations (TUNGOs), farmers and agricultural NGOs, women, and gender, and youth (YOUNGO)

auth (LGM And)

Figure 4:

- 1). The utility of climate information for driving farm management practices and decision-making in relation to when and what crops to plant in relation to climate change and variability cannot be over-emphasized (Vaughan et al., 2019; Singh et al., 2017). Mainstreaming CIS into development planning and agricultural systems requires that stakeholders especially smallholder farmers have a full understanding and appreciation of the issues involved in climate change adaptation (UNDP, 2012). Various studies (Ayers et al., 2014; Ellis et al., 2013; Pilato et al., 2018) have highlighted the need to build awareness of climate change issues amongst stakeholders in order to mainstream climate change issues. Lack of awareness or trusted information about uncertainties, risks, opportunities, and trade-offs presents challenges to policymakers (

Figure 5:

433 .1 Funding

434 The authors did not receive support from any organization for the submitted work.

435 .2 Competing interests

436 The authors have no relevant financial or nonfinancial interests to disclose.

437 The authors have no conflicts of interest to declare that are relevant to the content of this article.

438 .3 Consent to Participate

439 Informed consent was obtained from all individual participants included in the study.

440 [Singh et al. ()] , A Singh , S Sharma , B Singh . 2017. (Effect of germination time and temperature on the)
441 [Gupta ()] 'A history of international climate change policy'. J Gupta . *Wiley Interdisciplinary Reviews: Climate*
442 *Change* 2010. 1 (5) p. .

443 [Neumayer ()] 'A missed opportunity: The Stern Review on climate change fails to tackle the issue of non-
444 substitutable loss of natural capital'. E Neumayer . *Global environmental change* 2007. 17 (3-4) p. .

445 [Abbott ()] J Abbott . *Collaborative governance and metropolitan planning in South East Queensland-1990 to*
446 *2010: From a voluntary to a statutory model*, 2012.

447 [Deason et al. ()] 'Actor-network theory and organizational resilience to climate change in community-based
448 tourism'. G Deason , E Seekamp , C Barbieri . *Journal of Outdoor Recreation and Tourism* 2022. p. 100483.

449 [Cole ()] 'Advantages of a polycentric approach to climate change policy'. D H Cole . *Nature Climate Change*
450 2015. 5 (2) p. .

451 [Chan et al. ()] 'Aligning transnational climate action with international climate governance: The road from
452 Paris'. S Chan , C Brandi , S Bauer . *Comparative & International Environmental Law* 2016. 25 (2) p. .
453 (Review of European)

454 [Hale ()] 'All hands-on deck': The Paris agreement and nonstate climate action'. T Hale . *Global environmental*
455 *politics* 2016. 16 (3) p. .

456 [Banks et al. ()] N Banks , D Hulme , M Edwards . *NGOs, states, and donors revisited: Still too close for*
457 *comfort? World development*, 2015. 66 p. .

458 [Betsill ()] M Betsill . *NGOs. In Research handbook on climate governance*, 2015. Edward Elgar Publishing. p. .

459 [Kuramochi et al. ()] 'Beyond national climate action: the impact of region, city, and business commitments on
460 global greenhouse gas emissions'. T Kuramochi , M Roel Fsema , A Hsu , S Lui , A Weinfurter , S Chan , N
461 Höhne . *Climate Policy* 2020. 20 (3) p. .

462 [Bulkeley et al. ()] *Bringing climate change to the city: towards low carbon urbanism?* *Local environment*, H
463 Bulkeley , V C Broto , G Edwards . 2012. 17 p. .

464 [Betsill et al. ()] 'Building productive links between the UNFCCC and the broader global climate governance
465 landscape'. M Betsill , N K Dubash , M Paterson , H Van Asselt , A Vihma , H Winkler . *Global Environmental*
466 *Politics* 2015. 15 (2) p. .

467 [Lawrence et al. ()] 'Cascading climate change impacts and implications'. J Lawrence , P Blackett , N A Cradock-
468 Henry . *Climate Risk Management* 2020. 29 p. 100234.

469 [Bäckstrand ()] 'Civic science for sustainability: reframing the role of experts, policymakers and citizens in
470 environmental governance'. K Bäckstrand . *Global Environmental Politics* 2003. 3 (4) p. .

471 [Pörtner et al. ()] *Climate change 2022: Impacts, adaptation and vulnerability*, H O Pörtner , D C Roberts , H
472 Adams , C Adler , P Aldunce , E Ali , J Birkmann . 2022. (IPCC Sixth Assessment Report)

473 [Malhi et al. ()] 'Climate change and ecosystems: Threats, opportunities and solutions'. Y Malhi , J Franklin ,
474 N Seddon , M Solan , M G Turner , C B Field , N Knowlton . *Philosophical Transactions of the Royal Society*
475 *B* 2020. 375. 20190104. 375.

476 [Ebele and Emadi ()] 'Climate change and its impact in Nigerian economy'. N E Ebele , N V Emadi . *Journal*
477 *of Scientific Research & Reports* 2016. 10 (6) p. .

478 [Ofori et al. ()] 'Climate change, land, water, and food security: Perspectives From Sub-Saharan Africa'. S A
479 Ofori , S J Cobbina , S Obiri . *Frontiers in Sustainable Food Systems* 2021. 5 p. 680924.

480 [Newell ()] *Climate for change*, P Newell . 2000. p. 240.

481 [Hoffmann ()] *Climate governance at the crossroads: Experimenting with a global response after Kyoto*, M J
482 Hoffmann . 2011. Oxford University Press.

483 [Brasseur and Gallardo ()] 'Climate services: Lessons learned and future prospects'. G P Brasseur , L Gallardo
484 . *Earth's Future* 2016. 4 (3) p. .

485 [Allan ()] 'Dangerous incrementalism of the Paris Agreement'. J I Allan . *Global Environmental Politics* 2019. 19
486 (1) p. .

487 [Ellis et al. ()] *Dating the Anthropocene: Towards an empirical global history of human transformation of the*
488 *terrestrial biosphere Dating the Anthropocene*, E C Ellis , D Q Fuller , J O Kaplan , W G Lutters . 2013. 1.
489 (Elementa: Science of the Anthropocene)

490 [Atube et al. ()] 'Determinants of smallholder farmers' adaptation strategies to the effects of climate change:
491 Evidence from northern Uganda'. F Atube , G M Malinga , M Nyeko , D M Okello , S P Alarakol , I
492 Okello-Uma . *Agriculture & Food Security* 2021. 10 (1) p. .

493 [Duggan ()] J Duggan . *The Role of Sub-state and Nonstate Actors in International Climate Processes: Subnational Governments*, 2019. Chatam House-The Royal Institute of International Affairs

494 [Bernauer and Gampfer ()] 'Effects of civil society involvement on popular legitimacy of global environmental
495 governance'. T Bernauer , R Gampfer . *Global Environmental Change* 2013. 23 (2) p. .

496 [Badjie et al. ()] 'Effects of climate variability on household food availability among rural farmers in Central
497 River Region-South of The Gambia'. M Badjie , S Yaffa , M Sawaneh , A Bah . *Climate Change* 2019. 5 (17)
498 p. .

499 [Dombrowski ()] 'Filling the gap? An analysis of non-governmental organizations responses to participation and
500 representation deficits in global climate governance'. K Dombrowski . *International environmental agreements: politics, law and economics*, 2010. 10 p. .

501 [Armah et al. ()] *Food security and climate change in drought-sensitive savanna zones of Ghana. Mitigation and*
502 *adaptation strategies for global change*, F A Armah , J O Odoi , G T Yengoh , S Obiri , D O Yawson , E K
503 Afrifa . 2011. 16 p. .

504 [Quaye ()] 'Food security situation in northern Ghana, coping strategies and related constraints'. W Quaye .
505 *African journal of agricultural research* 2008. 3 (5) p. .

506 [Ghana National Climate Change Policy Accra. Available online ()] 'Ghana National Climate Change Policy'.
507 <https://pef.org.gh/documents/climate-change/national-climatechange-policy.pdf> Accra. Available online 2013. Ministry of Environment, Science and Technology.

508 [Baker and Chapin ()] 'Going beyond "it depends:" the role of context in shaping participation in natural
509 resource management'. S Baker , F S Chapin . *Ecology and Society* 2018. 23 (1) .

510 [Ntinyari and Gweyi-Onyango ()] 'Greenhouse gases emissions in agricultural systems and climate change effects
511 in Sub-Saharan Africa'. W Ntinyari , J P Gweyi-Onyango . *African Handbook of Climate Change Adaptation*,
512 (Cham) 2021. Springer. p. .

513 [Hadden ()] J Hadden . *Networks in contention*, 2015. Cambridge University Press.

514 [Hjelm and Dasori ()] L Hjelm , W Dasori . *Ghana Comprehensive Food Security & Vulnerability Analysis 2010: Focus on Northern Ghana*, Ministry of Food and Agriculture Ghana Statistical Service, 2012. p. .

515 [Hussein ()] K Hussein . *Food Security: Rights, Livelihoods and the world food summit-five years later*, 2002. 36
516 p. .

517 [Malhi et al. ()] 'Impact of climate change on agriculture and its mitigation strategies: A review'. G S Malhi ,
518 M Kaur , P Kaushik . *Sustainability* 2021. 13 (3) p. 1318.

519 [Haas ()] 'Introduction: epistemic communities and international policy coordination'. P M Haas . *International organization* 1992. 46 (1) p. .

520 [Change ()] Ipcc, I P O C Change . 2014. (Climate change)

521 [Cash et al. ()] 'Knowledge systems for sustainable development'. D W Cash , W C Clark , F Alcock , N M
522 Dickson , N Eckley , D H Guston , R B Mitchell . *Proceedings of the national academy of sciences*, (the
523 national academy of sciences) 2003. 100 p. .

524 [Fisher ()] 'Legal pluralism and Human Rights in the idea of Climate Justice'. A D Fisher . *Oslo Law Review*
525 2017. 2 (3) p. .

526 [Lemos and Agrawal ()] M C Lemos , A Agrawal . *Environmental governance. Annual review of environment and resources*, 2006. 31 p. .

527 [Lövbrand et al. ()] 'Making climate governance global: how UN climate summity comes to matter in a complex
528 climate regime'. E Lövbrand , M Hjerpe , B O Linnér . *Environmental Politics* 2017. 26 (4) p. .

529 [Barrett ()] 'Measuring food insecurity'. C B Barrett . *Science* 2010. 327 (5967) p. .

530 [Betsill and Corell ()] 'NGO influence in international environmental negotiations: a framework for analysis'. M
531 M Betsill , E Corell . *Global environmental politics* 2001. 1 (4) p. .

532 [Gulbrandsen and Andresen ()] 'NGO influence in the implementation of the Kyoto Protocol: Compliance,
533 flexibility mechanisms, and sinks'. L H Gulbrandsen , S Andresen . *Global environmental politics* 2004. 4
534 (4) p. .

535 [Gulbrandsen and Andresen ()] 'NGO influence in the implementation of the Kyoto Protocol: Compliance,
536 flexibility mechanisms, and sinks'. L H Gulbrandsen , S Andresen . *Global environmental politics* 2004. 4
537 (4) p. .

541 [Boström and Hallström ()] 'NGO power in global social and environmental standardsetting'. M Boström , K T
542 Hallström . *Global environmental politics* 2010. 10 (4) p. .

543 [Bäckstrand et al. ()] 'Non-state actors in global climate governance: from Copenhagen to Paris and beyond'. K
544 Bäckstrand , J W Kuyper , B O Linnér , E Lövbrand . *Environmental Politics* 2017. 26 (4) p. .

545 [Lane and Morrison ()] 'Public interest or private agenda? A meditation on the role of NGOs in environmental
546 policy and management in Australia'. M B Lane , T H Morrison . *Journal of rural studies* 2006. 22 (2) p. .

547 [Carr et al. ()] *Really effective (for 15% of the men): Lessons in understanding and addressing user needs in
548 climate services from Mali*, E Carr , S Onzere , E R Carr , Onzere . 2018. p. .

549 [Baker et al. ()] 'Susceptible supply limits the role of climate in the early SARS-CoV-2 pandemic'. R E Baker ,
550 W Yang , G A Vecchi , C J E Metcalf , B T Grenfell . *Science* 2020. 369 (6501) p. .

551 [Bevir ()] 'The construction of governance'. M Bevir . *International Journal of Organization Theory & Behavior*
552 2009.

553 [Bäckstrand and Kuyper ()] 'The democratic legitimacy of orchestration: the UNFCCC, non-state actors, and
554 transnational climate governance'. K Bäckstrand , J W Kuyper . *Environmental Politics* 2017. 26 (4) p. .

555 [Falkner ()] 'The Paris Agreement and the new logic of international climate politics'. R Falkner . *International
556 Affairs* 2016. 92 (5) p. .

557 [Bang et al. ()] 'The Paris Agreement: Short-term and long-term effectiveess'. G Bang , J Hovi , T Skodvin .
558 *Politics and Governance* 2016. 4 (3) p. .

559 [Gough and Shackley ()] 'The respectable politics of climate change: the epistemic communities and NGOs'. C
560 Gough , S Shackley . *International affairs* 2001. 77 (2) p. .

561 [Schroeder and Lovell ()] 'The role of nonnation-state actors and side events in the international climate
562 negotiations'. H Schroeder , H Lovell . *Climate Policy* 2012. 12 (1) p. .

563 [Nasiritousi et al. ()] 'The roles of non-state actors in climate change governance: understanding agency through
564 governance profiles'. N Nasiritousi , M Hjerpe , B O Linnér . *International Environmental Agreements: Politics, Law and Economics* 2016. 16 (1) p. .

564 [Green ()] 'The strength of weakness: pseudo-clubs in the climate regime'. J F Green . *Climatic Change* 2017.
565 144 (1) p. .

566 [Bernstein ()] 'The United Nations and the governance of sustainable development goals'. S Bernstein . *Governing
567 through goals: Sustainable Development Goals as governance innovation*, 2017. p. .

567 [Keck and Sikkink ()] 'Transnational advocacy networks in international and regional politics'. M E Keck , K
568 Sikkink . *International social science journal* 1999. 51 (159) p. .

568 [Fisher and Green ()] 'Understanding disenfranchisement: civil society and developing countries' influence and
569 participation in global governance for sustainable development'. D R Fisher , J F Green . *Global Environmental
570 Politics* 2004. 4 (3) p. .

569 [Acheampong et al. ()] 'Vulnerability assessment of Northern Ghana to climate variability'. E N Acheampong ,
570 N Ozor , E S Owusu . *Climatic change* 2014. 126 (1) p. .

570 [Mahapatra et al. ()] 'Vulnerability of agriculture to climate change increases the risk of child malnutrition:
571 Evidence from a large-scale observational study in India'. B Mahapatra , M Walia , C A R Rao , B M K Raju
572 , N Saggurti . *PloS one* 2021. 16 (6) p. 253637.

571 [Owen ()] 'What makes climate change adaptation effective? A systematic review of the literature'. G Owen .
572 *Global Environmental Change* 2020. 62 p. 102071.