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South African National Climate Change Response Policy Sensitization: An Assessment of Smallholder Farmers in Amathole District Municipality, Eastern Cape Province

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Abstract: The South African National Climate Change Response Policy (NCCRP) was instituted in October 2011. Amongst the policy's priorities is building capacity and resilience in the country's agricultural sector, with the public agricultural extension system being a principal component for climate change sensitization, education, and capacity building. This study, therefore, investigated the level of the policy awareness amongst smallholder farmers in the study area and the sensitization and response implementation. A multistage sampling procedure was used in the selection of the study population, with a cross-sectional household survey conducted using semi-structured questionnaires. Findings revealed that there was an extremely low awareness of the policy, and a dearth of sensitization campaigns and capacity-building training by extension officers in the study area. The practical and policy implications outlined could aid an increase in the resilience of farmers, with support from extension advisers and other relevant stakeholders.

Keywords: response policy; extension; sensitization; capacity buildings

1. Introduction

'The consequences of climate change are already here' [1] (p. 1). According to Bathke et al. [2], studies have shown that the world's population faces significant environmental risks as it confronts the challenges associated with climate change. South Africa, for example, has naturally been a water-stressed region with an average annual rainfall of 450 mm per year, which is extremely below the global average range of 860 mm [3–7]. Thus, increased inconsistencies in the temperature or rainfall patterns is expected to hit the country really hard, setting off increased water challenges in particular, as it is already a restraining factor [7,8]. Evidence from literature [7,9] suggests that temperature levels in the country could increase by 1.2 °C, 2.4 °C, and 4.2 °C in the years 2020, 2050, and 2080, respectively, while rainfall has also been projected to decline by 5.4%, 6.3%, and 9.5% in the same window period. These projections call for serious concerns.

A case in point is the Amathole District Municipality in the Eastern Cape Province, where a major review of Risk and Vulnerability Assessment (RAVA) was done. The Amatole District Municipality—Integrated Development Plan (ADM IDP) [10] identified major hydrometeorological risks for the region as droughts, floods (river, urban, and dam failure), grassland fires, and severe storms (wind, hail, snow, lightning, fog). Based on the report, the District had experienced severe drought in 2008, which lasted until 2010 and there is a greater chance of recurrent periods of droughts in the near future as some parts of the District are already faced with regular periods of below-normal rainfall conditions.

While agriculture may not largely contribute to the overall GDP of the country, it nonetheless plays a substantial role in the nation's economy—job creation and foreign exchange earnings [5,6,11,12]. There is, therefore, a rising concern. The already declining contribution of agriculture to the national economy—from more than 6% in the 1970s to 1.9% in 2013 [12]—is faced with an increased likelihood of further reduction as a result of climate change [13]. South Africa operates a dual agricultural economy involving a finely honed commercial agricultural farming sector and the smallholder division [6,7]. Certain disparities exist between these two distinct groups. For instance, smallholder farmers are largely faced with challenges in securing land [14], limited access to capital [15], insufficient infrastructure, illiteracy/lack of skills, high dependence on natural resources, low awareness and adaptive capacities [16]. The growing trepidation for the smallholder sector thus stems from the understanding that they are already constrained and have become greatly susceptible to climate change led environmental degradation [5,7]. It is equally important to stress that the commercial (large-scale) agricultural sector is also faced with climate change challenges [13]. The motivation, however, behind placing greater emphasis on the smallholder population is because it is already a vulnerable group [14–16] and the emergence of climate change related events has further heightened their vulnerability [13]. This suggests that the already existing discrepancies between both farming sectors puts the smallholder production population in a more disadvantaged position in dealing with environmental changes induced by climate change [15]. For this reason, the response capacity of the South African national government is critical, especially as regards implementing adaptation interventions to curb climate change immediate threats while developing short-medium-long term control measures.

The South African national climate change response policy white paper (NCCRPWP) was approved in 2011 and it sets out the government's vision to institute a responsive intervention system to effectively mitigate the underlying forces of climate change and moderate its deleterious impacts on citizens [17,18]. Amongst its priorities is building capacity and resilience in the country's agricultural sector, and setting up disaster risk reduction and management systems to address vulnerability to extreme climate change threats. The NCCRPWP emphasizes climate change literacy amongst South Africans through effective communication. It seeks to influence behavior in response to climate change and to ensure that farmers' decision-making processes are informed by climate change knowledge. In particular, it stresses the need for climate change information and response strategies for South Africa's most vulnerable farmers. It also proposes a system for managing risks in relation to climate change, advocates for resilience and adaptation, and lays the foundation for education and awareness through outreach campaigns and human capacity development. A process was also initiated to develop an Eastern Cape Climate Change Response Strategy (ECCCRS) in 2010 [19]. Though asserted as one of the provinces with a climate change response plan, the province according to Montmasson-Clair and Zwane [20] is severely challenged with non-budgetary allocation and no dedicated institutional arrangements. These challenges could indeed impede the climate change response policy implementation processes in the province.

For the successful execution of its national response policy, the NCCRPWP proposes the involvement of multiple institutional actors and stakeholders or partners, one of which is the region's public agricultural extension system, viewed as a principal component for climate change sensitization, education, and capacity development [17]. The agricultural extension service is particularly significant in promoting rural development, as it serves as an empowerment tool for changing farmers' attitudes and boosting knowledge and capacity through effective agricultural information dissemination, communication, and education [21,22]. The agricultural extension service is charged with the provision of advisory or consultancy services. According to Ignat, Brezuleanu, and Ungureanu [23] (p. 397), extension services are forms of 'oral or written advice that examine practical problems farmers are facing and provide guidelines to address them; or the provision of competent technical advice on a particular subject in order to assist farmers in making decisions'. Terreblanché [24] emphasizes the South African agricultural extension officer's role for an efficient extension system, a role that includes the provision of needs-based services, a focus on behavioral changes and technical support delivery. The South African extension service is expected

to sensitize, educate, and execute training programs in rural communities to enable farmers to understand and adapt to climate change shocks and stresses. It is thus a key institutional actor in disseminating the NCCRP information. The contributions of the extension service are efficacious only if they appropriately harness climate change information and disseminate it effectively; when working optimally, this service is the most significant mechanism for addressing climate change and equipping vulnerable farmers to deal with it [25]. Based on these, the study aims to:

i. Determine the national climate change response policy awareness levels of smallholder farmers in the study area;
ii. Identify the sources of policy awareness and adaptation response trainings; and, assess climate change response policy awareness creation, sensitization and implementation by extension services in the study area.

2. The Conceptual and Theoretical Framework

According to DEA [26], the rate at which climate conditions have been changing is so significant that it is feared to exceed any and all types of ecosystems (marine, coastal, freshwater, and terrestrial), affecting their ability to adapt and function effectively. The agricultural sector is extremely sensitive to climatic variability, posing threats to food security [27]. Empirical studies [28–36] have shown increased impacts of climate change conditions on production activities. The NCCRP is, therefore, crucial in providing adaptation assistance, particularly to vulnerable resource-poor farmers.

In Sub-Saharan Africa, majority of the rural poor largely depend on rain-fed agriculture, which remains the dominant source of staple food production. They almost completely depend on their own productivity to remain food secured [37]. Obi [14], however, points to existing evidences that there has been stagnation in farm productivity levels in Sub-Saharan Africa. South Africa's smallholder farmers for instance, are severely faced (more than ever) with great risks and uncertainty in production [38]. One major causal factor is the changing climate conditions; according to Cooper et al. [39], extended (longer-term) climate changes are currently affecting the livelihoods of most rural agricultural populations. Although climate variabilities and its consequent impacts cannot be completely abated [40], Gbetibouo [29] indicated that the degree to which these impacts are felt depends in large part on the extent of adaptation measures adopted in response to the changing climate conditions. This could significantly reduce smallholder farmer's vulnerabilities. The International Labor Foundation for Sustainable Development (ILFSD) [41] reported that production efficiency could be achieved if proper adaptation measures are utilized to mitigate climate change impacts.

Lynn, MacKendrick, and Donoghue [42] observed that rural communities are already responding to climate change and taking steps to prepare for projected changes. For instance, smallholder farmers in parts of Nigeria and South Africa are shifting planting periods to coincide with the start of rain season, planting on raised ridges, irrigating crops with water from streams, cropping around streams, farming during minor rainfall season, and using dug out wells on farms [29,31]. Juana's et al. [43] review of studies revealed that smallholder farmers in countries like Kenya, Zimbabwe, Cameroon, Ghana, Senegal, Niger, Egypt, Ethiopia, Zambia, Burkina Faso Togo, and Benin are already putting into practice certain climate change response measures. Some of these includes planting of different crop varieties, practicing water and soil conservation, tree planting, irrigating farm lands, and practicing mixed cropping farming system as response measures to the changing climate. However, there is an increased struggle to adapt to climate variations and their effects. In certain regions, for instance, frequency of droughts have increased from once in every ten years to a now more regular basis [44]. For this reason and many more, various initiatives are being set up at the global, regional, and national levels to address the increasing challenges of climate change [45].

Policies are critical for addressing diverse climate change challenges [46,47]. Existing climate change policies encompass both adaptation and mitigation efforts [48]. For instance, some European Countries like Austria, Belgium, Finland, France, Germany, Ireland, Spain, United Kingdom, and

Netherlands have established national mitigation and adaptation policies [49]. Climate change 'adaptation-friendly' policies have been initiated by the European Union (EU) to strengthen the resilient capacities of stakeholders and prepare them for the present and future climate change impacts [50]. According to Herold [51], amongst the key components of the EU's Common Agricultural Policy (CAP) is the provision of a greater support system to small and medium-scaled farm enterprises.

In Latin America, similar climate change response mechanisms are been implemented across its countries. For instance, a cross-sectional study by the World Bank [52] revealed comparable response options in parts of Mexico, central Peru, and Uruguay. According to the World Bank report, the uniformity of response measures across the board is in part due to an initiative to set up a regional agricultural adaptation strategy. In Africa, Pettengell [53] (pp. 10–14), described how Ethiopia and Mozambique have been able to develop policies and strategies and set up institutions to address climate change impacts. In Ethiopia, the Climate Resilient Green Economy (CRGE) initiative was established in 2011 to implement response measures that would improve resilient capacities to climate change. In 2012, Mozambique initiated its National Climate Change Mitigation and Adaptation Strategy (NCCMAS) and became 'one of the first countries in the world to design a national system to track and evaluate the impact of climate change adaptation policy and practice'. According to Kandji, Verchot, and Mackensen [54], member countries of the Southern African Development Community (SADC) Africa, at the regional level formed a task force to track weather situations and issue early warnings to all member countries to help them prepare against extreme weather events like droughts or flooding. Some of these countries includes Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia, and Zimbabwe. At the national level, majority of the Southern African countries have also put in place Early Warning Systems (EWS) to help monitor national climate situations; while at the local level, communities have also adopted a number of coping measures.

In South Africa, the culmination of research, national and provincial conferences, workshops, wide-ranging stakeholder meetings, and legislative sittings led to the development of its NCCRP, which was approved in October 2011. According to its Department of Environmental Affairs and Tourism (DEAT) [55], the initiation of NCCRP for South Africa was deemed necessary and urgent. The NCCRPWP was, thus, appropriated in 2011 [17,18]. The white paper delineates South Africa's administrative vision for instituting an effective climate change response system and putting in place an efficient transition process from a climate-prone to a climate-resilient nation [18]. The two main objectives of its response policy are: (i) Setting up efficient intervention systems to effectively deal with inevitable impacts brought about by climate change and, thus, build and sustain the socio-economic, environmental resistance, and emergency response capacity; (ii) mitigating climate change by putting in efforts to reduce the level of greenhouse gas (GHG) emissions into the atmosphere.

As agriculture is severely vulnerable to climate variations, the agricultural sector is purportedly leaning more towards adaptation than mitigation [47]. The NCCRP stressed its disaster risk reduction and management adaptation plans to address vulnerability to extreme climate change risks. Amongst its priorities is building the resilient capacity of the agricultural sector to climate change. Emphasis was also placed on educating citizens on climate change issues. The response policy is billed to:

(i) Address the climate change information needs of the most vulnerable population; all residents are to be adequately informed about its impacts, and potential resilient or adaptation actions;
(ii) Utilize efficient and effective communication means to transfer climate change information to target audiences;
(iii) Develop new communication models to reach out to non-educated residents and/or resource-poor population with limited or no access to telephones or other electronic media used in information dissemination; and,
(iv) Design, develop, and implement climate change awareness campaigns in order to allow citizens carry out appropriate adaptation responses both at individual and communal level.

The white paper asserts the extension institution as critical in climate change awareness creation, sensitization, and education. In the opinion of Adekunle [56], agricultural extension continues to be one of the most fundamental means of reaching out to rural farming communities globally. Extension services are expected to play educational, advisory roles and serve as medium for information dissemination to farming communities [57,58]. They provide institutional support, particularly in instigating change amongst the farmers; they are significant in impacting knowledge, skills, attitudes, and building resilient capacities of farming population, especially in the area of climate change adaptation [57]. Agricultural extension plays a major role in providing public information and training platforms critical in supporting farmers to mitigate climate change impacts. Its responsibilities include 'awareness creation and knowledge brokerage on the issues of climate change; building resilience capacities among vulnerable individuals, communities and regions; encouragement of wide participation of all stakeholders in addressing climate change issues; and developing appropriate frameworks for adapting to climate change impacts' [57] (p. 138). Ozor and Cynthia [59] note that organizing awareness or sensitization programs for farmers on climate change, its risks, and management systems is one of the key roles expected to be played by agricultural extension services in farmers' adaptation to climate change. These roles, according to Montmasson-Clair and Zwane [20], have consequently been largely overlooked, particularly in the dissemination of climate change information to smallholder farmers. The level of policy awareness and participation of extension services in disseminating the national adaptation response initiatives are pertinent in climate change discourses.

The availability of and access to relevant and practical climate change information are critical to adaptation [60,61]. Yahaya [62] supports the view that information is a valuable resource that enables people to do things they could not otherwise do and take advantage of opportunities. This is why informed knowledge on climate change and resilient strategies is critical to sustaining small-scaled agricultural farming systems. English and English [63] (pp. 284–285) identified three major dimensions of knowledge. 'Simple knowledge', which constitutes a reservoir of information that an individual already possesses; 'functional knowledge', which describes the application of or practical use of information obtained by an individual; and, 'knowledge of results', which refers to a learning that takes place when a learner is informed that a specific response is appropriate. All three dimensions of knowledge are significant in the context of this study. Smallholder farmers require general, practical, and explicit knowledge on climate change and the remedial actions to its impacts. A dearth of these knowledge elements, particularly amongst rural resource-poor farming communities could affect sustainable production, especially in the face of climate change. There are existing gaps in climate change information dissemination and education [64].

Amongst their numerous production challenges, low level of awareness and adaptive capacities have been found to especially constrain smallholder farmers [16]. The knowledge gap theory provides an explanation as to why disparities in information dissemination may occur. Postulated by Tichenor, Donohue, and Olien [65], the knowledge gap theory indicates that inequality exists among a given population with regards to information accessibility. It emphasizes that not every member of a given population is equally chanced to receive adequate information based on the supposition that there are differences in the socio-economic status of the populace. In essence, as information flows into a social system, parts of the population with higher socio-economic status tend to acquire this information at a faster rate than those at the lower strata, so that the gaps between these groups continue to increase rather than decrease. This theory is therefore crucial to understanding the level of awareness creation, sensitization, and education of the NCCRP in remote communities where majority of its population are of lower economic standing. It could also facilitate the use of definite strategies by the national government in efficiently disseminating climate change information and successfully implementing its NCCRP objectives across board.

According to Clayton et al. [66], psychological studies have revealed that understanding climate change is not credited to what is learnt about it, but to how, and from whom, it is learnt. The significance of providing direct extension information has been established in many literatures. Adekunle [56] buttressed that agricultural extension services remains the most significant outreach

approach to rural farming communities. Montmasson-Clair and Zwane [20] emphasized climate change adaptation, particularly in the agricultural sector, as primarily a grass root issue. The department of agricultural extension, therefore, need to be strengthened in terms of providing up-to-date climate change information, consultation and advisory services, technical trainings, and other adaptation interventions for rural communities. This could, in essence, help reduce the wide margins of climate change knowledge gaps.

3. Materials and Methods

3.1. Area and Population of Study

The population of study was drawn from Mbashe Local Municipality within the Amathole District Municipality. Farming households were selected from this municipality to represent the district. Agriculture is ranked the second (2nd) most exploited source of earnings, only after social grants [67]. This indicates that the rural communities are largely dependent on agricultural production for revenue generation. The largest sector contributing to the economy of the municipality is the subsistence agricultural sector, as most households are heavily reliant on subsistence farming for food and income; thus, small scale farming and open grazed livestock production mostly dominate the municipality's economy [68–70]. The municipality could experience 'an approximate increase in median temperate of 1.8–2 Degrees Celsius during the summer months and approximately 1.6–1.8 Degrees Celsius increase during winter; an increase in winter monthly rainfall by 10–15 mm and 25–50 mm in the summer' [71] (p. 43). Projected climate change effects in the area include storm intensity, which would bring about an increased frequency and severity of flooding; frequency of hail events; increased ambient temperature consequently threatening ground and surface water for agricultural use; and, heat waves resulting in intense heat stress to crops and livestock, and fire outbreaks affecting livestock and grazing capacity.

3.2. Unit of Analysis, Sample Size, and Sampling Technique

3.2.1. Unit of Analysis—Farming Households

3.2.2. Sample Size

The census 2011 results showed that the total number of households involved in agricultural activities in the municipality was 36,377 [72]. The number of respondents drawn for this research was, therefore, based on the population of agricultural households in the municipality. Yamane's [73] (p. 258) econometric model was used to calculate the expected sample size for the research.

3.2.3. Sampling Technique

A multistage sampling procedure was used in the selection of the study population. At the first stage, Mbashe Local Municipality was purposively selected. The basis for selection is because it is a low-density, extremely rural settlement [69], and has the second highest population (36, 377) of households involved in agricultural activities among all seven local municipalities within the Amathole District Municipality, Eastern Cape Province. Three units (Dutywa, Elliotdale, and Willowvale) in the municipality were classified as areas facing climate change risks (Table 1).

Table 1. Risks for Mbhashe Local Municipality.

Priority	Risk	Area
HIGH	Severe storms (hailstorms, rainstorms, windstorms, and thunderstorms)	Dutywa, Elliotdale, and Willowvale
HIGH	Floods	Dutywa, Elliotdale, and Willowvale
HIGH	Wild land fires and forest fires	Dutywa, Elliotdale, and Willowvale
MEDIUM	Houses burnt by lightning	Dutywa, Elliotdale, and Willowvale
MEDIUM	Drought	Dutywa

LOW	Road spillage of hazardous goods	Dutywa

Source: Mbhashe Local Municipality—Integrated Development Plan (MLM IDP) [71] (p. 107).

Although Dutywa, Elliotdale, and Willowvale are the three major urban settlements within the municipality [68,70,71,74], the municipality's settlement pattern is largely dispersed with 'pockets of developed urban centres surrounded by scattered low density rural villages' [74] (p. 9). According to development framework, these settlement localities outside the urban edge are termed "rural", and are loosely scattered all over the municipal area. They are characterized by poor basic infrastructural and social amenities with agricultural, forestry, and trading activities as their major formal economic activities. Based on this information, this study's sample population was drawn from the rural settlements surrounding the three units, which has been identified in Table 1 as areas being faced with climate change risks such as severe storms, floods, wild fires, and drought.

The municipality consists of thirty-one Wards. Three Wards were randomly selected from each unit at the second stage, totaling nine Wards; while the third stage involved the simple random selection of two villages from each Ward, totaling 18 villages. A cross-sectional household survey was then carried out in the selected eighteen villages. Three hundred and one (n = 301) smallholder farming households were visited for data collection using the snowball approach.

Selected villages include:

1. Idutywa: Ngxakaxa Sheshegu and Ngxakaxa Phesheya kwe dip (Ward 2); Gwadana Ngaphantsi and Gwadana Phezulu (Ward 3); Keti Cimakala and Keti Lalini (Ward 31).
2. Willovale: Nqadu Phezulu and Nqadu Kumaya (Ward 11); Ematolweni and Ntlabane (Ward 25); Nxanxashe and Kwesika Gosani (Ward 30).
3. Elliotdale: Khasa and Fameli (Ward 13); Mbanyana and Ntlanyane Kulombombo (Ward 16); Ntlonyane Kulophungla and Ezithenjini (Ward 26).

Respondents were grouped according to three primary agro-enterprises—crop, livestock, and poultry production. Respondents who practiced any, either, or all of the agro-enterprises were interviewed, focusing on each agro-enterprise separately with respect to climate change response interventions implemented through agricultural extension services. The aim was to uncover definite findings for each agro-enterprise, which revealed the nature of adaptation intervention schemes provided by extension services for each farming sector.

3.3. Operationalization of Variables

The data gathered from this study was subjected to descriptive analysis. The descriptive statistics utilized are frequency distribution, and percentages. Respondents were asked to provide a 'Yes' or 'No' response to all questions provided in the questionnaire. A score of '1' was given to a 'Yes' response, and '0' to a 'No' response. Data was compiled, collated, analyzed, and interpreted using descriptive statistics (frequencies and percentages).

3.4. Demographic Profile of Respondents (n = 301)

Many of the respondents (69.77%) were above 50 years old. More males (58.80%) were involved in smallholding farming than female, and about 47.84% were married. A higher percentage (61.12%) had below secondary education. Majority (91.03%) had farming experiences of 30 years and below. A considerable percentage (79%) of the smallholder farmers sell parts of their farm produce with a higher percentage (86%), earning below R10,000 from their annual sales. Only about 35.55% of the households had a comparative advantage in terms of increased ability to cope with climate change through reliance on non-farm income sources.

4. Results

4.1. Smallholder Farmers' Levels of Awareness of the NCCRP

Table 2 shows the smallholder farmers' levels of awareness of the NCCRP in the study area. Results show that the majority (89%) of farmers did not know about the policy; over 90% claimed there had been no campaigns, workshops, or programs organized in their region for public sensitization of the policy, and neither had they been mobilized or trained by a government department to adopt any adaptation response. Table 3 shows that only about 10% of the study population said that they had been sensitized about the policy by government sources, other information sources such as radio, television, and newspaper, or their cooperative associations. An insignificant percentage of respondents (1.66%) admitted to having received adaptation response training in the form of instructions on using modern climate change adaptation technology (0.66%) and/or the use of improved indigenous coping practices (0.66%); only 1% of whom claimed to have implemented such training into their farming practice.

Table 2. National climate change response policy awareness (n = 301).

SN	NCCRP Awareness	Yes (%)	No (%)
1.	Do you know about the—launched by government?	11	89
2.	Has there been a campaign about government response policy in your area?	9	91
3.	Have there been workshops or programs held in your area on the response policy?	8	92
4.	Have government extension services provided you with any information about the NCCRP?	11	89
5.	Have you received any adaptation response training?	1	99
6.	Have you been mobilized by government to take any climate change response?	2	98
7.	Do you know the primary mandate of the NCCRP?	2	98
8.	Is there any adaptation response you are carrying out as a result of government response policy?	2	98

Table 3. Sources of policy awareness and adaptation response trainings (n = 301).

SN	Sources of National Climate Change Response Policy Awareness	F	%
1.	Government	29	9.63
2.	Others	3	1.00
3.	None	269	89.37
	Total	301	100
	Adaptation Responses Training	**F**	**%**
4.	Yes	5	1.66
5.	No	296	98.34
	Total	301	100
	Number of Training Sessions	**F**	**%**
6.	A single session	5	1.66
7.	Between two and five sessions	0	0.00
8.	More than five sessions	0	0.00
9.	None	296	98.34
	Total	301	100
	Category of Training	**F**	**%**
10.	Use of modern climate change adaptation technology	2	0.66
11.	Improved use of indigenous coping practices	2	0.66
12.	None	296	98.34
	Total	301	100
	Practical Implementation of Training	**F**	**%**
13.	Yes	3	1.00
14.	No	298	99.00
	Total	301	100

4.2. Climate Change Response Awareness Creation, Sensitization, and Implementation by Extension Services in the Study Area

Results presented in Table 4 show that the majority of respondents (88.70%) did not have access to government agricultural extension services on climate change in the study area. The majority (79.07%) felt excluded from government climate change support services, with over 84.72% feeling the urgency for extension services on climate change issues. Table 5 shows that 94.02% participants felt the dearth of private extension services on climate change issues. Table 6 shows that over 90% of the respondents did not have access to climate change intervention services such as the provision of early warning systems, soil, water, and nutrient conservation technologies, irrigation, and water harvesting technologies, dietary improvements for livestock, agricultural insurance schemes, and capacity building training, among other possible services.

Table 4. Access to agricultural extension services (n = 301).

SN	Access to Extension Services	Yes		No	
		F	%	F	%
1.	Do you have access to government-established agricultural extension services on climate change in your area?	34	11.30	267	88.70
2.	Has there been any collaboration between government extension services and private extension services in your area?	4	1.33	297	98.67
3.	Do you feel the urgency for extension services to assist with climate change issues in your area?	255	84.72	46	15.28
4.	Do you feel excluded from government support services as regards to climate change interventions in your area?	238	79.07	63	20.93
5.	Have the extension service providers been able to offer real solutions to climate change challenges in your area?	5	1.66	296	98.34
6.	Do you pay for their services?	1	0.33	300	99.67

Table 5. The availability of private extension services (n = 301).

Availability and Service Provision on Climate Change Issues		F	%
1.	No	283	94.02
2.	Agric. Cooperative Society (ACS)	11	3.65
3.	Farmers Association (FA)	2	0.66
4.	Agric. Cooperative Society and Farmers Association (FA)	4	1.33
5	Others	1	0.33

Table 6. Climate change response measures implemented through extension services.

SN	Some Crop Production Climate Change Response Intervention Technologies Crop Farmers (n = 130)				
		Yes		No	
		F	%	F	%
1.	Early warning systems	0	0.00	130	100.00
2.	Soil conservation technology	4	3.00	126	97.00
3.	Water conservation technology	3	4.00	125	96.00
4.	Nutrient conservation technology	3	2.00	127	98.00
5.	Irrigation technology	1	1.00	129	99.00
6.	Water harvesting technology	3	2.00	127	98.00
7.	Improved (climate resistant) crop breeds	3	2.00	127	98.00
8.	Provision of agricultural insurance schemes	0	0.00	130	100.00
9.	Provision of advisory services on timing of planting	3	2.00	127	98.00
10.	Capacity-building training	1	1.00	129	99.00
Some livestock production climate change response intervention technologies Livestock farmers (n =142)					
		Yes		No	
		F	%	F	%
11.	Improved (climate resistant) livestock breeds	12	8.00	130	92.00
12.	Dietary improvements for livestock	10	7.00	132	93.00

13.	Early warning systems/forecasts	0	0.00	142	100.00
14.	Water conservation technology	5	4.00	137	96.00
15.	Water harvesting technology	5	4.00	137	96.00
16.	Provision of agricultural insurance schemes	0	0.00	142	100.00
17.	Capacity-building training	3	2.00	139	98.00
Some poultry production climate change response intervention technologies Poultry farmers (n =101)					
		Yes		**No**	
		F	**%**	**F**	**%**
18.	Improved breeds of birds	3	3.00	98	97.00
19.	Improved feed supplements	5	5.00	96	95.00
20.	Installation of mechanical ventilation systems	0	0.00	101	100.00
21.	Early warning systems/forecasts	0	0.00	101	100.00
22.	Water conservation technology	2	2.00	99	98.00
23.	Water harvesting technology	2	2.00	99	98.00
24.	Provision of agricultural insurance schemes	0	0.00	101	100.00
25.	Capacity-building training	0	0.00	101	100.00

5. Discussion

Analysis of the smallholder farmers' levels of awareness of the NCCRP in the study area indicated that the majority of the farmers (89%) were not aware of the policy. There was a perceived lack or low level of public sensitization by 91% of the participants and poor educational programs from public extension services by 89% of the respondents.

Public sensitization and education to strengthen the climate change resilient capacities of its citizens is a major priority for South Africa's NCCRP. It is therefore, expected that there should be some form of awareness of the NCCRP to smallholder farmers particularly, about the government's efforts to enhance their adaptation capacities. However, this study shows that there is a profound knowledge gap amongst the farmers in the study area about the instituted response policy. This is of serious concern, as rural smallholder farmers are also an integral part of the country's agricultural system. As such, it is crucial that they are aware of policies being initiated to aid their production practices. According to Eastin, Cicchirillo, and Mabry [75] (p. 416), there has been 'concern for segments of the population facing disparities associated with differential patterns of information dissemination and underlying social inequities that influence how information is used'. The assumption is that there is a significant disproportion in climate change information dissemination between established commercial farmers and rural smallholding farmers. Tichenor, Donohue, and Olien [65] (pp. 159–160) propounded the knowledge gap theory. It states that 'as the infusion of mass media information into a social system increases, segments of the population with higher socioeconomic status tend to acquire this information at a faster rate than the lower status segments, so that the gap in knowledge between these segments tends to increase rather than decrease'. It emphasizes that not every member of a given population is equally chanced to receive adequate information based on socio-economic status differences.

Madzwamuse [13] established that the administration of the NCCRP has been continuously challenged, particularly in the area of education, awareness, and sensitization campaigns that are so desperately needed amongst the South African farming populace. According to Anne-DiFrancesco and Young [76], disseminating climate change information to the masses has proven quite challenging, yet implementing climate change policies may not be achievable without essential public support and involvement. Public trust in the science of climate change is fundamental to the initiation and executing of policies that address it, since 'democracy-formulated policymaking cannot address climate change without public acceptance and trust of climate change science' [77] (p. 231). As opined by Akpan, Anorue, and Ukonu [78], many farmers are contending alone with the changing climate and are short of real-time information as regards their adaptation options. The prioritization of farmers' access to timely weather information, for example, is necessary for their production decision-making [79]. Ajayi [80] (p. 6) argues that the 'availability and accessibility to information on climate change is a key determinant of level of awareness, understanding and

knowledge of climate change'. Sacramento et al. [81], attested that the capacity of farmers to adapt to the changing climate is constrained by factors like restricted access to basic information, low level of education and skills. Balew, Agwata, and Anyango [82] noted that education is fundamental, as literacy provides farmers with better understanding of available climate information and implementation of adaptation measures. According to the authors, ease of access to information on climate and agriculture aids farmers in informed, effective, and comparative decision making, which enables them to select and adopt strategies that they can efficiently utilize to cope with changing climate conditions. In retrospect, lack of such basic information poses a great challenge in adopting strategies, which increases exposure to risks and failures arising from non-adoption of coping and adaptation measures.

Montmasson-Clair and Zwane [20] provide an insightful analysis of the NCCRP's critical challenges. They identified lack of effective guidelines for the country's local governments to adequately translate the national climate change action plan to local-level plans; insufficient monetary allocations in order for local authorities to include climate change adaptation in their schedules, and the incapacity of extension services to promulgate climate change literacy. Some of the deficiencies identified may be attributed to the low level of awareness of the national policy within local government, and poor implementation strategies, where they are attempted. According to Madzwamuse [13], those tasked with the administration of the climate change policy lack sufficient strategies in the area of communication and the use of media, which significantly constrains the efficacy of their sensitization efforts. One underlying factor influencing knowledge gap is the type of media used in information dissemination [65,75]. According to Eveland and Scheufele [83], time, news media use, and publicity are crucial variables to be considered as influencing knowledge gap. This study is in agreement with the notion that the form of media used in disseminating the NCCRP is also critical to determining the level of its awareness amongst rural smallholder farmers. Utilization of contemporary information sources like the radio, television, newspaper, mobile phones, amongst others, with wider coverage capacities could be very effective tools for information dissemination and outreach in core rural areas. This could potentially moderate the existing knowledge gap found in these communities.

This study also found that the majority of respondents complained of poor access to public (88.7%) and private (94.02%) extension services on climate change (Tables 4 and 5). This complaint was buttressed by the urgent need felt by a large proportion of respondents (84.72%) to boost extension services on climate change issues. There is a need to feel the presence of extension services, particularly with regard to climate change information and knowledge provision, the shaping of farmers' attitudes towards climate change, the strengthening of farmers' coping and adaptation skills, and in aiding these farmers to make informed decisions [22]. According to Engle and Lemos [84], institutions are crucial determinants of adaptive aptitude and resilience; thus, institutional mechanisms are critical to awareness creation, education, and capacity building for resilience to climate change shocks and stresses amongst rural farming populations. According to the rational choice theory (RCT) [85], social institutions could also systematically affect an individual's choice of action, as they could either increase or lower the net benefit of any anticipated course of action; providing strong institutional support for smallholder farmers is therefore very crucial in aiding their coping and adaptation to climate change risks. The protection motivation theory (PMT) [86] asserts perceived self-efficacy (people's perception of their capacity to implement adaptation responses or measures) and perceived adaptation efficacy (perceived confidence/trust in the effectiveness of the adaptation responses or measures) as significant cognitive adaptation processes that could also be strongly influenced by institutional factors. This suggests that the extension as a public institution has a critical role to play in boosting the confidence of smallholder farmers as regards their perceived capacity to cope with or adapt to climate change and the efficacy of contemporary adaptation options.

Results in this study shows weak institutional support for climate change related issues. The national climate change strategy for instance, will require the diverse departments in the government to work harmoniously in order to guarantee that adaptation response strategies are

appropriately directed, accepted, and implemented with a national focus [55]. The three tiers of institutions within the South African government are the national, provincial, and local government, all of which are expected to facilitate policy reviews, and work collaboratively in the execution of climate change adaptation interventions [13]. There are however, bourgeoning issues. Ziervogel et al. [87] review of studies revealed that multiple institutional constraints have been pointed out as affecting the effective implementation of climate change response policies in South Africa and these include:

i. Dearth of human resource capacities (both in quantity and quality/expertise);
ii. Increased staff turnover within government institutions;
iii. Lack of proper understanding and expertise in climate-related matters;
iv. Stressing climate change as more of an environmental than development issue;
v. Practicing conservative financial management; and,
vi. Deficient interactions and coordination between the government departments and different tiers of governments, particularly national to local and provincial to local.

So far, the national tier of the government appears to be more active in its implementation of adaptation interventions than its provincial and local counterparts [13]. Adapting to climate change, especially in the agricultural sector, is predominantly a grass root issue; the local institutions (provincial, district, and local municipalities) responsible for handling these grassroots adaptation processes are currently handicapped, as there is a disconnect between the national adaptation response policies and the present situation at the local institutions [20].

In South Africa, the government, through the department of agriculture, is mostly responsible for agricultural extension activities; and at present, the public sector is faced with a number of challenges in 'the transformation of its roles, functions and organization, as well as its relationship with civil society and market actors' [88] (p. 89). These challenges have impinged extension services from effectively achieving their goals. For example, Gandure, Walker, and Botha's [89] study in Gladstone, showed that sensitization and education of rural populations was generally weak, partly as a consequence of feeble institutional support and coordination. Gladstone farmers lacked access to extension services, and they perceived this to have had a negative impact on their production capacities. Juana et al. [43] (p. 132) posited that most farming communities in Sub-Sahara Africa expressed that extension information is very critical to their adoption decisions, as it stimulates and intensifies their utilization of specific adaptation measures like water and soil conservation strategies. 'Accordingly, it is hypothesized that farmers who have significant extension contacts have better chances of being aware of changing climatic conditions as well as adaptation measures in response to the changes in these conditions'. Therefore, extension services are crucial in prompting farmers to make efficient climate change adaptation decisions [82].

One potential rationale for the inadequacies of the advisory institution and its extension service in the study area is that its services are already stretched, this concern was raised in Aliber and Hall's [90] study. According to the authors, extension service shortfalls are a function of more general deficiencies; the core challenge may not be too few extension officers to send into the field, but their inadequate service delivery approaches and use of tools. David and Samuel [88] noted other challenges like frail linkages between farmers, extension agents, and researchers; lack of sufficient commitment and political support—bureaucratic governance; inadequate funding by the government to operate extension schemes; and lack of social expertise and accountability. Van Niekerk et al. [91] study expressed a significant need to revitalize the public extension service in the Eastern Cape Province. According to Leeuwis [92], there is a need for support institutions to modify their support strategies in order to effectively address production challenges of farmers. The author maintained the need to reinvent agricultural extension as a professional practice covering relevant domains like its mission, rationale, mode of operation, management, and organizational structure. David and Samuel [88] corroborate Leeuwis's [92] notion of reinvention of the agricultural extension bodies. New capacity building is critically required at individual and administrative levels to enable the articulation and efficient performance of extension roles, and improve their relevancy. For instance, Diehl et al. [93] expressed that farmers can indeed benefit from 'science-based' adaptation

strategies in order to manage climate variability, climate change, and its related risks. The successful transfer of knowledge however, requires climate training for extension professionals, and such training must be carefully planned and directed towards meeting the specific needs of farmers.

A vast number of researches have proven that collaboration is the most effective path to solving complex problems and achieving remarkable results [94]. Promotion of collaborative efforts between communities, non-governmental organizations [NGOs], farmer groups, and other social networking systems to spread climate change awareness, technology transfer, and capacity building; and, development of disaster recovery mechanisms is also a key strategic priority of the NCCRP. Findings in this study, however, showed that there is presently little or no existing form of collaborative efforts from various stakeholders to address climate change adaptation issues in the study area. According to Ziervogel et al. [87], there is still a weak relationship existing between various stakeholders in South Africa, and these kinds of relationships are quite critical in driving climate change adaptation processes. This study aligns with Joshua et al. [95] assertion that collaborative efforts strongly influence adaptation policies and interventions. As posited by Frydlinger et al. [94], regions that have a relatively higher level of collaboration are inclined to economically thrive much more than regions with lower collaborative leanings. This study also agrees with this school of thought, because it supposes that there is much more power in combining efforts to promote economic growth. Engaging several stakeholders including international, bilateral, multilateral, and other private or civil organizations could further stimulate resource mobilization to enhance climate change response interventions in resource-poor rural communities; thus, reinforcing rural economic development through agriculture.

An assessment of climate change response measures implemented through extension services in the study area showed that majority of the respondents did not receive support services on crop, livestock, and/or poultry production climate change response intervention technologies (Table 6). A number of possible intervention schemes like the provision of early warning systems, soil, water, and nutrient conservation technologies, dietary improvements for livestock, irrigation, and water harvesting technologies were reported as not being implemented in the study area. Meanwhile, the NCCRP paper emphasizes the continuous development and enhancement of early warning systems in providing up-to-date information on weather conditions and decision support tools that may be used in assessing farmer's vulnerability and making informed farm management decisions. It also stresses the significance of substantially investing in technological improvements, particularly soil, water, and nutrient conservations techniques, crop, livestock, and overall agricultural production climate resistant enhancement. Some of these conservation practices include tree planting, integrating a number of soil management practices such as practicing zero tillage, use of crop rotation and leguminous plants to boost soil nutrient, altering planting and harvesting times, modifying cropping patterns and using irrigation technologies, efficient use of water, and boosting water retention capacities [96–98]. Distribution of drought resistant cultivars and provision of advisory services on use of contemporary agricultural technologies and farm management systems [99], [100] (p. 13). Promoting development schemes for sustaining livestock and poultry production such as altering livestock production systems, intensifying breeding schemes, implementing grassland rehabilitation and management, adopting good ventilation practices, disease prevention and control, proper treatment techniques of livestock [97,101,102]. In their review of a number of literatures, Diehl et al. [93] (p. 26) garnered that researchers and extension consultants assist farmers who are seeking for ways to adapt to and manage climate change and related agricultural risks by developing adaptation tools and measures, some of which could be 'applied to farm management practices (i.e., planting dates, fertilizer application, and crop varieties), land use practices (i.e., crop rotation and tillage), water management practices (i.e., irrigation), pest management, financial risk management, and climate forecasting and crop modelling'.

Limitation of the Study and Directions for Future Research

This study was not carried out on a comprehensive scale due to budgetary constraints. The study was limited to one local municipality within a district because of insufficient funds and as

such covered a small geographical area of South Africa. This is being considered as a limitation because it does not capture the implementation of the NCCRP scheme in other geographical areas, which may reveal results that differ from what was obtained in this research's area of study.

A recap of our findings shows that there is an extremely low awareness of the NCCRP; poor sensitization, inadequate capacity-building trainings, and almost non-existent mobilization of smallholder farmers to address climate change challenges; and weak institutional (extension service) support for climate change related issues. Based on these findings, our suggestions on areas of further research include:

1. An assessment of the effectiveness of the NCCRP implementation scheme and current strategies/approaches used in sensitizing and educating and training stakeholders.
2. An evaluation of the prevalent challenges of extension services in effectively implementing the NCCRP scheme in the study area.

We also propose a wider assessment of the sensitization and level of awareness of NCCRP and the role of extension services in creating awareness, educating, and implementing the climate change intervention schemes of the NCCRP. Such assessments on a larger scale, covering a wider geographical area of the country, will be significant for carrying out monitoring and evaluation assessments of the implementation of the NCCRP in the country. Comparative studies on the implementation of NCCRP in different regions of the country would also provide a better insight on the effectiveness of the implementation of NCCRP in different regions of the country.

6. Conclusions and Recommendation

There are major concerns that significant changes in the frequency and intensity of climatic variables may bring about severe climate induced disasters, affecting major sectors in the economy, agriculture inclusive. Climate change threatens agriculture with massive implications, especially for resource poor smallholder farmers. This is why the NCCRP is extremely important in addressing the climate change challenges experienced in South Africa, particularly in the agricultural sector. This study, therefore, found it critical to assess the sensitization and level of awareness of the NCCRP amongst smallholder farmers and identify the roles played by the region's public extension services in creating NCCRP awareness, educating and implementing climate change intervention schemes for sustainable agricultural production in the study area. In this study, we show that there is an extremely low awareness of the NCCRP in the area, poor sensitization, inadequate capacity-building trainings, and almost non-existent mobilization of smallholder farmers to address climate change challenges, and weak institutional (extension service) support for climate change related issues.

The South African government, through the Department of Rural Development and Agrarian Reform, is tasked with rendering agricultural extension services to the farming communities. In line with the NCCRP vision, the extension division could play pivotal roles, particularly in stimulating sectoral responses and effecting behavioral change of the public through climate change awareness creation and capacity trainings. It is however, inundated with a number of challenges. These challenges may impinge extension services from effectively carrying out climate change response interventions as envisioned by the NCCRP. These disclosures are especially relevant to this study, as it tends to raise concerns as to how smallholder farming communities within the province are striving to cope with and adapt to current climate shocks.

The study recommends immediate government intervention in the form of appropriate, functional extension services, particularly for carrying out climate change coping and adaptation education, and support. Training for smallholder farmers in the region should be facilitated to increase their capacity. Capacity-building and training in appropriate coping and adaptation practices should be carried out through an increased mobilization of smallholder farmers in the study area. There is also a clear need to empower local authorities in the area of financing and in translating government policy into pragmatic guidelines for appropriate farming practices. In addition, agricultural extension departments functioning at the local level should be financially and technically capacitated to allow for enhanced performance by their field officers. Field officers need

knowledge and skills in how to communicate complex climate change science via training sessions that impart the theory, offer guidance on appropriate farming practice, and develop resilience against climatic shocks and stresses. Private stakeholders should be integrated into these efforts to promote rural climate change literacy and adaptation.

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